

Connectors and APIs

Abstract

This manual describes the Connectors and APIs that can be used with MySQL.

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For help with using MySQL, please visit the [MySQL Forums](#), where you can discuss your issues with other MySQL users.

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Preface and Legal Notices

This manual describes the Connectors and APIs that can be used with MySQL.

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Chapter 1 Introduction

MySQL Connectors provide connectivity to the MySQL server for client programs. APIs provide low-level access to MySQL resources using either the classic MySQL protocol or X Protocol. Both Connectors and the APIs enable you to connect and execute MySQL statements from another language or environment, including ODBC, Java (JDBC), C++, Python, Node.js, PHP, Perl, Ruby, and native C and embedded MySQL instances.

MySQL Connectors

Oracle develops a number of connectors:

- [Connector/C++](#) enables C++ applications to connect to MySQL.
- [Connector/J](#) provides driver support for connecting to MySQL from Java applications using the standard Java Database Connectivity (JDBC) API.
- [Connector/.NET](#) enables developers to create .NET applications that connect to MySQL. Connector/.NET implements a fully functional ADO.NET interface and provides support for use with ADO.NET aware tools. Applications that use Connector/.NET can be written in any supported .NET language.

[MySQL for Visual Studio](#) works with Connector/.NET and Microsoft Visual Studio 2012, 2013, 2015, and 2017. MySQL for Visual Studio provides access to MySQL objects and data from Visual Studio. As a Visual Studio package, it integrates directly into Server Explorer providing the ability to create new connections and work with MySQL database objects.

- [Connector/ODBC](#) provides driver support for connecting to MySQL using the Open Database Connectivity (ODBC) API. Support is available for ODBC connectivity from Windows, Unix, and macOS platforms.
- [Connector/Python](#) provides driver support for connecting to MySQL from Python applications using an API that is compliant with the [Python DB API version 2.0](#). No additional Python modules or MySQL client libraries are required.
- [Connector/Node.js](#) provides an asynchronous API for connecting to MySQL from Node.js applications using X Protocol. Connector/Node.js supports managing database sessions and schemas, working with MySQL Document Store collections and using raw SQL statements.

The MySQL C API

For direct access to using MySQL natively within a C application, the [C API](#) provides low-level access to the MySQL client/server protocol through the [`libmysqlclient`](#) client library. This is the primary method used to connect to an instance of the MySQL server, and is used both by MySQL command-line clients and many of the MySQL Connectors and third-party APIs detailed here.

`libmysqlclient` is included in MySQL distributions distributions.

See also [MySQL C API Implementations](#).

To access MySQL from a C application, or to build an interface to MySQL for a language not supported by the Connectors or APIs in this chapter, the [C API](#) is where to start. A number of programmer's utilities are available to help with the process; see [Program Development Utilities](#).

Third-Party MySQL APIs

The remaining APIs described in this chapter provide an interface to MySQL from specific application languages. These third-party solutions are not developed or supported by Oracle. Basic information on their usage and abilities is provided here for reference purposes only.

All the third-party language APIs are developed using one of two methods, using `libmysqlclient` or by implementing a *native driver*. The two solutions offer different benefits:

- Using `libmysqlclient` offers complete compatibility with MySQL because it uses the same libraries as the MySQL client applications. However, the feature set is limited to the implementation and interfaces exposed through `libmysqlclient` and the performance may be lower as data is copied between the native language, and the MySQL API components.
- *Native drivers* are an implementation of the MySQL network protocol entirely within the host language or environment. Native drivers are fast, as there is less copying of data between components, and they can offer advanced functionality not available through the standard MySQL API. Native drivers are also easier for end users to build and deploy because no copy of the MySQL client libraries is needed to build the native driver components.

[MySQL APIs and Interfaces](#) lists many of the libraries and interfaces available for MySQL.

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MySQL Connector/C++ is the C++ interface for communicating with MySQL servers.

For notes detailing the changes in each release of Connector/C++, see [MySQL Connector/C++ Release Notes](#).

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2.1 Introduction to Connector/C++

MySQL Connector/C++ 8.0 is a MySQL database connector for C++ applications that connect to MySQL servers. Connector/C++ can be used to access MySQL servers that implement a [document store](#), or in a traditional way using SQL statements. The preferred development environment for Connector/C++ 8.0 is to enable development of C++ applications using X DevAPI, or plain C applications using X DevAPI for C, but Connector/C++ 8.0 also enables development of C++ applications that use the legacy JDBC-based API from Connector/C++ 1.1.

Connector/C++ applications that use X DevAPI or X DevAPI for C require a MySQL server that has [X Plugin](#) enabled. Connector/C++ applications that use the legacy JDBC-based API neither require nor support X Plugin.

For more detailed requirements about required MySQL versions for Connector/C++ applications, see [Platform Support and Prerequisites](#).

For notes detailing the changes in each release of Connector/C++, see [MySQL Connector/C++ Release Notes](#).

- [Connector/C++ Benefits](#)
- [X DevAPI and X DevAPI for C](#)
- [Legacy JDBC API and JDBC Compatibility](#)

- [Platform Support and Prerequisites](#)

Connector/C++ Benefits

MySQL Connector/C++ offers the following benefits for C++ users compared to the MySQL C API provided by the MySQL client library:

- Convenience of pure C++.
- Support for these application programming interfaces:
 - X DevAPI
 - X DevAPI for C
 - Legacy JDBC 4.0-based API
- Support for the object-oriented programming paradigm.
- Reduced development time.
- Licensed under the GPL with the FLOSS License Exception.
- Available under a commercial license upon request.

X DevAPI and X DevAPI for C

Connector/C++ implements X DevAPI, which enables connecting to MySQL servers that implement a [document store](#) with [X Plugin](#). X DevAPI also enables applications to execute SQL statements.

Connector/C++ also implements a similar interface called X DevAPI for C for use by applications written in plain C.

For general information about X DevAPI, see [X DevAPI User Guide](#). For reference information specific to the Connector/C++ implementation of X DevAPI and X DevAPI for C, see *MySQL Connector/C++ X DevAPI Reference* in the *X DevAPI* section of [MySQL Documentation](#).

Legacy JDBC API and JDBC Compatibility

Connector/C++ implements the JDBC 4.0 API, if built to include the legacy JDBC connector:

- Connector/C++ binary distributions include the JDBC connector.
- If you build Connector/C++ from source, the JDBC connector is not built by default, but can be included by enabling the `WITH_JDBC CMake` option. See [Section 2.4, “Installing Connector/C++ from Source”](#).

The Connector/C++ JDBC API is compatible with the JDBC 4.0 API. Connector/C++ does not implement the entire JDBC 4.0 API, but does feature these classes: `Connection`, `DatabaseMetaData`, `Driver`, `PreparedStatement`, `ResultSet`, `ResultSetMetaData`, `Savepoint`, `Statement`.

The JDBC 4.0 API defines approximately 450 methods for the classes just mentioned. Connector/C++ implements approximately 80% of these.

Note

The legacy JDBC connector in Connector/C++ 8.0 is based on the connector provided by Connector/C++ 1.1. For more information about using the JDBC API in Connector/C++ 8.0, see [MySQL Connector/C++ 1.1 Developer Guide](#).

Platform Support and Prerequisites

To see which platforms are supported, visit the [Connector/C++ downloads page](#).

On Windows platforms, Commercial and Community Connector/C++ distributions require the Visual C++ Redistributable for Visual Studio. The Redistributable is available at the [Visual Studio Download Center](#); install it before installing Connector/C++. The acceptable Redistributable versions depend on your Connector/C++ version:

- Connector/C++ 8.0.19 and higher: VC++ Redistributable 2017 or higher.
- Connector/C++ 8.0.14 to 8.0.18: VC++ Redistributable 2015 or higher.

The following requirements apply to building and running Connector/C++ applications, and to building Connector/C++ itself if you build it from source:

- To run Connector/C++ applications, the MySQL server requirements depend on the API the application uses:
 - Connector/C++ applications that use X DevAPI or X DevAPI for C require a server from MySQL 8.0 (8.0.11 or higher) or MySQL 5.7 (5.7.12 or higher), with [X Plugin](#) enabled. For MySQL 8.0, X Plugin is enabled by default. For MySQL 5.7, X Plugin must be enabled explicitly. (Some X Protocol features may not work with MySQL 5.7.)
 - Applications that use the JDBC API can use a server from MySQL 5.6 or higher. X Plugin is neither required nor supported.
- To build Connector/C++ applications:
 - The MySQL version does not apply.
 - On Windows, Microsoft Visual Studio is required. The acceptable MSVC versions depend on your Connector/C++ version and the type of linking you use:
 - Connector/C++ 8.0.20 and higher: Same as Connector/C++ 8.0.19, with the addition that binary distributions are also compatible with MSVC 2017 using the static X DevAPI connector library. This means that binary distributions are fully compatible with MSVC 2019, and fully compatible with MSVC 2017 with the exception of the static legacy (JDBC) connector library.
 - Connector/C++ 8.0.19: Connector/C++ binary distributions are compatible with projects built using MSVC 2019 (using either dynamic or static connector libraries) or MSVC 2017 (using dynamic connector libraries).
 - Connector/C++ 8.0.14 to 8.0.18: MSVC 2017 or 2015.
 - Connector/C++ prior to 8.0.14: MSVC 2015.
 - To build Connector/C++ from source:
 - The MySQL C API client library may be required:
 - For Connector/C++ built without the JDBC connector (which is the default), the client library is not needed.
 - To build Connector/C++ with the JDBC connector, configure Connector/C++ with the [WITH_JDBC_CMake](#) option enabled. In this case, the JDBC connector requires a client library from MySQL 8.0 (8.0.11 or higher) or MySQL 5.7 (5.7.9 or higher).
 - On Windows, Microsoft Visual Studio is required. The acceptable MSVC versions depend on your Connector/C++ version:
 - Connector/C++ 8.0.19 and higher: MSVC 2019 or 2017.
 - Connector/C++ 8.0.14 to 8.0.18: MSVC 2017 or 2015.
 - Connector/C++ prior to 8.0.14: MSVC 2015.

2.2 Obtaining Connector/C++

Connector/C++ binary and source distributions are available, in platform-specific packaging formats. To obtain a distribution, visit the [Connector/C++ downloads page](#). It is also possible to clone the Connector/C++ Git source repository.

- Connector/C++ binary distributions are available for Microsoft Windows, and for Unix and Unix-like platforms. See [Section 2.3, “Installing Connector/C++ from a Binary Distribution”](#).
- Connector/C++ source distributions are available as compressed `tar` files or Zip archives and can be used on any supported platform. See [Section 2.4, “Installing Connector/C++ from Source”](#).
- The Connector/C++ source code repository uses Git and is available at GitHub. See [Section 2.4, “Installing Connector/C++ from Source”](#).

2.3 Installing Connector/C++ from a Binary Distribution

To obtain a Connector/C++ binary distribution, visit the [Connector/C++ downloads page](#).

For some platforms, Connector/C++ binary distributions are available in platform-specific packaging formats. Binary distributions are also available in more generic format, in the form of compressed `tar` files or Zip archives.

For descriptions here that refer to documentation files, those files have names such as `CONTRIBUTING.md`, `README.md`, `README.txt`, `README`, `LICENSE.txt`, `LICENSE`, `INFO_BIN`, and `INFO_SRC`. (Prior to Connector/C++ 8.0.14, the information file is `BUILDINFO.txt` rather than `INFO_BIN` and `INFO_SRC`.)

- [Installation on Windows](#)
- [Installation on Linux](#)
- [Installation on macOS](#)
- [Installation on Solaris](#)
- [Installation Using a tar or Zip Package](#)

Installation on Windows

Important

On Windows platforms, Commercial and Community Connector/C++ distributions require the Visual C++ Redistributable for Visual Studio. The Redistributable is available at the [Visual Studio Download Center](#); install it before installing Connector/C++. For information about which VC++ Redistributable versions are acceptable, see [Platform Support and Prerequisites](#).

These methods of installing binary distributions are available on Windows:

- **MySQL Installer.** The simplest and recommended method of installing Connector/C++ on Windows platforms is to download *MySQL Installer* and let it install and configure all the MySQL products on your system. For details, see [MySQL Installer for Windows](#).
- **Windows MSI installer.** As of Connector/C++ 8.0.12, an MSI Installer is available for Windows. To use the MSI Installer (`.msi` file), launch it and follow the prompts in the screens it presents. The MSI Installer can install components for these connectors:
 - The connector for X DevAPI (including X DevAPI for C).
 - The connector for the legacy JDBC API.

For each connector, there are two components:

- The DLL component includes the connector DLLs and libraries to satisfy runtime dependencies. The DLL component is required to run Connector/C++ application binaries that use the connector.
- The Developer component includes header files, static libraries, and import libraries for DLLs. The Developer component is required to build from source Connector/C++ applications that use the connector.

The MSI Installer requires administrative privileges. It begins by presenting a welcome screen that enables you to continue the installation or cancel it. If you continue the installation, the MSI Installer overview screen enables you to select the type of installation to perform:

- The **Complete** installation installs the DLL and Developer components for both connectors.
- The **Typical** installation installs the DLL component for both connectors.
- The **Custom** installation enables you to specify the installation location and select which components to install. The DLL and Developer components for the X DevAPI connector are preselected, but you can override the selection. The Developer component for a connector cannot be selected without also selecting the connector DLL component.

For all installation types, the MSI Installer performs these actions:

- It checks whether the required [Visual C++ Redistributable for Visual Studio](#) is present. If not, the installer asks you to install it and exits with an error. For information about which VC++ Redistributable versions are acceptable, see [Platform Support and Prerequisites](#).
- It installs documentation files.

Important

Prior to Connector/C++ 8.0.13, because the Microsoft Visual C++ 2017 Redistributable installer deletes the Microsoft Visual C++ 2015 Redistributable registry keys that identify its installation, standalone MySQL MSIs may fail to detect the Microsoft Visual C++ 2015 Redistributable if both it and the Microsoft Visual C++ 2017 Redistributable are installed. The solution is to repair the Microsoft Visual C++ 2017 Redistributable via the Windows Control Panel to recreate the registry keys needed for the runtime detection. Unlike the standalone MSIs, MySQL Installer for Windows contains a workaround for the detection problem.

This workaround is unnecessary as of Connector/C++ 8.0.13.

- **Zip archive package without installer.** To install from a Zip archive package ([.zip file](#)), see [Installation Using a tar or Zip Package](#).

Installation on Linux

These methods of installing binary distributions are available on Linux:

- **RPM package.** RPM packages are available for Linux (as of Connector/C++ 8.0.12). The packages are distinguished by their base names (the full names include the Connector/C++ version and suffixes):
 - [mysql-connector-c++](#): This package provides the shared connector library implementing X DevAPI and X DevAPI for C.
 - [mysql-connector-c++-jdbc](#): This package provides the shared legacy connector library implementing the JDBC API.

- `mysql-connector-c++-devel`: This package installs development files required for building applications that use Connector/C++ libraries provided by the other packages, and static connector libraries. This package depends on the shared libraries provided by the other packages. It cannot be installed by itself without the other two packages.
- **Debian package.** Debian packages are available for Linux (as of Connector/C++ 8.0.14). The packages are distinguished by their base names (the full names include the Connector/C++ version and suffixes):
 - `libmysqlcppconn8-1`: This package provides the shared connector library implementing X DevAPI and X DevAPI for C.
 - `libmysqlcppconn7`: This package provides the shared legacy connector library implementing the JDBC API.
 - `libmysqlcppconn-dev`: This package installs development files required for building applications that use Connector/C++ libraries provided by the other packages, and static connector libraries. This package depends on the shared libraries provided by the other packages. It cannot be installed by itself without the other two packages.
- **Compressed tar file.** To install from a compressed `tar` file (`.tar.gz` file), see [Installation Using a tar or Zip Package](#).

Installation on macOS

These methods of installing binary distributions are available on macOS:

- **DMG package.** DMG (disk image) packages for macOS are available as of Connector/C++ 8.0.12. A DMG package provides shared and static connector libraries implementing X DevAPI and X DevAPI for C, and the legacy connector library implementing the JDBC API. The package also includes OpenSSL libraries, public header files, and documentation files.
- **Compressed tar file.** To install from a compressed `tar` file (`.tar.gz` file), see [Installation Using a tar or Zip Package](#).

Installation on Solaris

Important

The installation packages have a dependency on the Oracle Developer Studio 12.6 Runtime Libraries, which must be installed before you run the MySQL installation package. See the download options for Oracle Developer Studio [here](#). The installation package enables you to install the runtime libraries only instead of the full Oracle Developer Studio; see instructions in [Installing Only the Runtime Libraries on Oracle Solaris 11](#).

These methods of installing binary distributions are available on Solaris:

- **Compressed tar file.** To install from a compressed `tar` file (`.tar.gz` file), see [Installation Using a tar or Zip Package](#).

Installation Using a tar or Zip Package

Connector/C++ binary distributions are available for several platforms, packaged in the form of compressed `tar` files or Zip archives, denoted here as `PACKAGE.tar.gz` or `PACKAGE.zip`.

To unpack a compressed `tar` file, use this command in the intended installation directory:

```
tar zxvf PACKAGE.tar.gz
```

To install from a Zip archive package (`.zip` file), use [WinZip](#) or another tool that can read `.zip` files to unpack the file into the location of your choosing.

2.4 Installing Connector/C++ from Source

This chapter describes how to install Connector/C++ using a source distribution or a copy of the Git source repository.

2.4.1 Source Installation System Prerequisites

To install Connector/C++ from source, the following system requirements must be satisfied:

- [Build Tools](#)
- [MySQL Client Library](#)
- [Boost C++ Libraries](#)
- [SSL Support](#)

Build Tools

You must have the cross-platform build tool [CMake](#) (3.0 or higher).

You must have a C++ compiler that supports C++11.

MySQL Client Library

To build Connector/C++ from source, the MySQL C API client library may be required:

- Building the JDBC connector requires a client library from MySQL 8.0 (8.0.11 or higher) or MySQL 5.7 (5.7.9 or higher). This occurs when Connector/C++ is configured with the [WITH_JDBC_CMake](#) option enabled to include the JDBC connector.
- For Connector/C++ built without the JDBC connector, the client library is not needed.

Typically, the MySQL client library is installed when MySQL is installed. However, check your operating system documentation for other installation options.

To specify where to find the client library, set the [MYSQL_DIR CMake](#) option appropriately at configuration time as necessary (see [Section 2.4.4, “Connector/C++ Source-Configuration Options”](#)).

Boost C++ Libraries

To compile Connector/C++ the Boost C++ libraries are needed only if you build the legacy JDBC API or if the version of the C++ standard library on your system does not implement the UTF8 converter ([codecvt_utf8](#)).

If the Boost C++ libraries are needed, Boost 1.59.0 or newer must be installed. To obtain Boost and its installation instructions, visit [the official Boost site](#).

After Boost is installed, use the [WITH_BOOST CMake](#) option to indicate where the Boost files are located (see [Section 2.4.4, “Connector/C++ Source-Configuration Options”](#)):

```
cmake [other_options] -DWITH_BOOST=/usr/local/boost_1_59_0
```

Adjust the path as necessary to match your installation.

SSL Support

Use the [WITH_SSL CMake](#) option to specify which SSL library to use when compiling Connector/C++. OpenSSL 1.0.x or higher is required. As of Connector/C++ 8.0.18, it is possible to compile against OpenSSL 1.1.

For more information about `WITH_SSL` and SSL libraries, see [Section 2.4.4, “Connector/C++ Source-Configuration Options”](#).

2.4.2 Obtaining and Unpacking a Connector/C++ Source Distribution

To obtain a Connector/C++ source distribution, visit the [Connector/C++ downloads page](#). Alternatively, clone the Connector/C++ Git source repository.

A Connector/C++ source distribution is packaged as a compressed `tar` file or Zip archive, denoted here as `PACKAGE.tar.gz` or `PACKAGE.zip`. A source distribution in `tar` file or Zip archive format can be used on any supported platform.

The distribution when unpacked includes an `INFO_SRC` file that provides information about the product version and the source repository from which the distribution was produced. The distribution also includes other documentation files such as those listed in [Section 2.3, “Installing Connector/C++ from a Binary Distribution”](#).

To unpack a compressed `tar` file, use this command in the intended installation directory:

```
tar zxvf PACKAGE.tar.gz
```

After unpacking the distribution, build it using the appropriate instructions for your platform later in this chapter.

To install from a Zip archive package (`.zip` file), use [WinZip](#) or another tool that can read `.zip` files to unpack the file into the location of your choosing. After unpacking the distribution, build it using the appropriate instructions for your platform later in this chapter.

To clone the Connector/C++ code from the source code repository located on GitHub at <https://github.com/mysql/mysql-connector-cpp>, use this command:

```
git clone https://github.com/mysql/mysql-connector-cpp.git
```

That command should create a `mysql-connector-cpp` directory containing a copy of the entire Connector/C++ source tree.

The `git clone` command sets the sources to the `master` branch, which is the branch that contains the latest sources. Released code is in the `8.0` branch (the `8.0` branch contains the same sources as the `master` branch). If necessary, use `git checkout` in the source directory to select the desired branch. For example, to build Connector/C++ 8.0:

```
cd mysql-connector-cpp
git checkout 8.0
```

After cloning the repository, build it using the appropriate instructions for your platform later in this chapter.

After the initial checkout operation to get the source tree, run `git pull` periodically to update your source to the latest version.

2.4.3 Installing Connector/C++ from Source

To install Connector/C++ from source, verify that your system satisfies the requirements outlined in [Section 2.4.1, “Source Installation System Prerequisites”](#).

- [Configuring Connector/C++](#)
- [Building Connector/C++](#)
- [Installing Connector/C++](#)
- [Verifying Connector/C++ Functionality](#)

Configuring Connector/C++

Use `CMake` to configure and build Connector/C++. Only out-of-source-builds are supported, so create a directory to use for the build and change location into it. Then configure the build using this command, where `concpp_source` is the directory containing the Connector/C++ source code:

```
cmake concpp_source
```

It may be necessary to specify other options on the configuration command. Some examples:

- By default, these installation locations are used:

- `/usr/local/mysql/connector-c++-8.0` (Unix and Unix-like systems)
- `User_home/MySQL/"MySQL Connector C++ 8.0"` (Windows)

To specify the installation location explicitly, use the `CMAKE_INSTALL_PREFIX` option:

```
-DCMAKE_INSTALL_PREFIX=path_name
```

- On Windows, you can use the `-G` and `-A` options to select a particular generator:

- `-G "Visual Studio 16" -A x64` (64-bit builds)
- `-G "Visual Studio 16" -A Win32` (32-bit builds)

Consult the `CMake` manual or check `cmake --help` to find out which generators are supported by your `CMake` version. (However, it may be that your version of `CMake` supports more generators than can actually be used to build Connector/C++.)

- If the Boost C++ libraries are needed, use the `WITH_BOOST` option to specify their location:

```
-DWITH_BOOST=path_name
```

- By default, the build creates dynamic (shared) libraries. To build static libraries, enable the `BUILD_STATIC` option:

```
-DBUILD_STATIC=ON
```

- By default, the legacy JDBC connector is not built. If you plan to build this connector, an additional `git` command is needed to perform submodule initialization (do this in the top-level source directory):

```
git submodule update --init
```

To include the JDBC connector in the build, enable the `WITH_JDBC` option:

```
-DWITH_JDBC=ON
```

Note

If you configure and build the test programs later, use the same `CMake` options to configure them as the ones you use to configure Connector/C++ (`-G`, `WITH_BOOST`, `BUILD_STATIC`, and so forth). Exceptions: Path name arguments will differ, and you need not specify `CMAKE_INSTALL_PREFIX`.

For information about `CMake` configuration options, see [Section 2.4.4, “Connector/C++ Source-Configuration Options”](#).

Building Connector/C++

After configuring the Connector/C++ distribution, build it using this command:

```
cmake --build . --config build_type
```

The `--config` option is optional. It specifies the build configuration to use, such as `Release` or `Debug`. If you omit `--config`, the default is `Debug`.

Important

If you specify the `--config` option on the preceding command, specify the same `--config` option for later steps, such as the steps that install Connector/C++ or that build test programs.

If the build is successful, it creates the connector libraries in the build directory. (For Windows, look for the libraries in a subdirectory with the same name as the `build_type` value specified for the `--config` option.)

- If you build dynamic libraries, they have these names:

- `libmysqlcppconn8.so.1` (Unix)
- `libmysqlcppconn8.1.dylib` (macOS)
- `mysqlcppconn8-1-vs14.dll` (Windows)
- If you build static libraries, they have these names:
 - `libmysqlcppconn8-static.a` (Unix, macOS)
 - `mysqlcppconn8-static.lib` (Windows)

If you enabled the `WITH_JDBC` option to include the legacy JDBC connector in the build, the following additional library files are created.

- If you build legacy dynamic libraries, they have these names:
 - `libmysqlcppconn.so.7` (Unix)
 - `libmysqlcppconn.7.dylib` (macOS)
 - `mysqlcppconn-7-vs14.dll` (Windows)
- If you build legacy static libraries, they have these names:
 - `libmysqlcppconn-static.a` (Unix, macOS)
 - `mysqlcppconn-static.lib` (Windows)

Installing Connector/C++

To install Connector/C++, use this command:

```
cmake --build . --target install --config build_type
```

Verifying Connector/C++ Functionality

To verify connector functionality, build and run one or more of the test programs included in the `testapp` directory of the source distribution. Create a directory to use and change location into it. Then issue the following commands:

```
cmake [other_options] -DWITH_CONCPP=concpp_install concpp_source/testapp
cmake --build . --config=build_type
```

`WITH_CONCPP` is an option used only to configure the test application. `other_options` consists of the options that you used to configure Connector/C++ itself (`-G`, `WITH_BOOST`, `BUILD_STATIC`, and so forth). `concpp_source` is the directory containing the Connector/C++ source code, and `concpp_install` is the directory where Connector/C++ is installed:

The preceding commands should create the `devapi_test` and `xapi_test` programs in the `run` directory of the build location. If you enable `WITH_JDBC` when configuring the test programs, the build also creates the `jdbc_test` program.

Before running test programs, ensure that a MySQL server instance is running with X Plugin enabled. The easiest way to arrange this is to use the `mysql-test-run.pl` script from the MySQL distribution. For MySQL 8.0, X Plugin is enabled by default, so invoke this command in the `mysql-test` directory of that distribution:

```
perl mysql-test-run.pl --start-and-exit
```

For MySQL 5.7, X Plugin must be enabled explicitly, so add an option to do that:

```
perl mysql-test-run.pl --start-and-exit --mysqld---plugin-load=mysqlx
```

The command should start a test server instance with X Plugin enabled and listening on port 13009 instead of its standard port (33060).

Now you can run one of the test programs. They accept a connection-string argument, so if the server was started as just described, you can run them like this:

```
run/devapi_test mysqlx://root@127.0.0.1:13009
run/xapi_test mysqlx://root@127.0.0.1:13009
```

The connection string assumes availability of a `root` user account without any password and the programs assume that there is a `test` schema available (assumptions that hold for a server started using `mysql-test-run.pl`).

To test `jdbc_test`, you need a MySQL server, but X Plugin is not required. Also, the connection options must be in the form specified by the JDBC API. Pass the user name as the second argument. For example:

```
run/jdbc_test tcp://127.0.0.1:13009 root
```

2.4.4 Connector/C++ Source-Configuration Options

Connector/C++ recognizes the `CMake` options described in this section.

Table 2.1 Connector/C++ Source-Configuration Option Reference

Formats	Description	Default	Introduced
<code>BUILD_STATIC</code>	Whether to build a static library	<code>OFF</code>	
<code>BUNDLE_DEPENDENCIES</code>	Whether to bundle external dependency libraries with the connector	<code>OFF</code>	
<code>CMAKE_BUILD_TYPE</code>	Type of build to produce	<code>Debug</code>	
<code>CMAKE_INSTALL_DOCDIR</code>	Documentation installation directory		8.0.14
<code>CMAKE_INSTALL_INCLUDEDIR</code>	Header file installation directory		8.0.14
<code>CMAKE_INSTALL_LIBDIR</code>	Library installation directory		8.0.14
<code>CMAKE_INSTALL_PREFIX</code>	Installation base directory	<code>/usr/local</code>	
<code>MAINTAINER_MODE</code>	For internal use only	<code>OFF</code>	8.0.12
<code>MYSQLCLIENT_STATIC_BINDINGS</code>	Whether to link to the shared MySQL client library	<code>ON</code>	8.0.16
<code>MYSQLCLIENT_STATIC_LINKING</code>	Whether to statically link to the MySQL client library	<code>ON</code>	8.0.16

Formats	Description	Default	Introduced
<code>MYSQL_CONFIG_EXECUTABLE</code>	Path to the mysql_config program	<code> \${MYSQL_DIR}/bin/mysql_config</code>	
<code>MYSQL_DIR</code>	MySQL Server installation directory		
<code>STATIC_MSVCRT</code>	Use the static runtime library		
<code>WITH_BOOST</code>	The Boost source directory		
<code>WITH_DOC</code>	Whether to generate Doxygen documentation	<code>OFF</code>	
<code>WITH_JDBC</code>	Whether to build legacy JDBC library	<code>OFF</code>	8.0.7
<code>WITH_SSL</code>	Type of SSL support	<code>system</code>	8.0.7

- `-DBUILD_STATIC=bool`

By default, dynamic (shared) libraries are built. If this option is enabled, static libraries are built instead.

- `-DBUNDLE_DEPENDENCIES=bool`

This is an internal option used for creating Connector/C++ distribution packages.

- `-DCMAKE_BUILD_TYPE=type`

The type of build to produce:

- `Debug`: Disable optimizations and generate debugging information. This is the default.
- `Release`: Enable optimizations.
- `RelWithDebInfo`: Enable optimizations and generate debugging information.
- `-DCMAKE_INSTALL_DOCDIR=dir_name`

The documentation installation directory, relative to `CMAKE_INSTALL_PREFIX`. If not specified, the default is to install in `CMAKE_INSTALL_PREFIX`.

This option requires that `WITH_DOC` be enabled.

This option was added in Connector/C++ 8.0.14.

- `-DCMAKE_INSTALL_INCLUDEDIR=dir_name`

The header file installation directory, relative to `CMAKE_INSTALL_PREFIX`. If not specified, the default is `include`.

This option was added in Connector/C++ 8.0.14.

- `-DCMAKE_INSTALL_LIBDIR=dir_name`

The library installation directory, relative to `CMAKE_INSTALL_PREFIX`. If not specified, the default is `lib64` or `lib`.

This option was added in Connector/C++ 8.0.14.

- `-DCMAKE_INSTALL_PREFIX=dir_name`

The installation base directory (where to install Connector/C++).

- `-DMAINTAINER_MODE=bool`

This is an internal option used for creating Connector/C++ distribution packages. It was added in Connector/C++ 8.0.12.

- `-DMYSQLCLIENT_STATIC_BINDING=bool`

Whether to link to the shared MySQL client library. This option is used only if `MYSQLCLIENT_STATIC_LINKING` is disabled to enable dynamic linking of the MySQL client library. In that case, if `MYSQLCLIENT_STATIC_BINDING` is enabled (the default), Connector/C++ is linked to the shared MySQL client library. Otherwise, the shared MySQL client library is loaded and mapped at runtime.

This option applies only if you are building the legacy JDBC connector (that is, only if `WITH_JDBC` is enabled). It was added in Connector/C++ 8.0.16.

- `-DMYSQLCLIENT_STATIC_LINKING=bool`

Whether to link statically to the MySQL client library. The default is `ON` (use static linking to the client library). Disabling this option enables dynamic linking to the client library.

This option applies only if you are building the legacy JDBC connector (that is, only if `WITH_JDBC` is enabled). It was added in Connector/C++ 8.0.16.

- `-DMYSQL_CONFIG_EXECUTABLE=file_name`

The path to the `mysql_config` program.

On non-Windows systems, `CMake` checks to see whether `MYSQL_CONFIG_EXECUTABLE` is set. If not, `CMake` tries to locate `mysql_config` in the default locations.

This option applies only if you are building the legacy JDBC connector (that is, only if `WITH_JDBC` is enabled).

- `-DMYSQL_DIR=dir_name`

The directory where MySQL is installed.

This option applies only if you are building the legacy JDBC connector (that is, only if `WITH_JDBC` is enabled).

- `-DSTATIC_MSVCRT=bool`

(Windows only) Use the static runtime library (the `/MT*` compiler option). This option might be necessary if code that uses Connector/C++ also uses the static runtime library.

- `-DWITH_BOOST=dir_name`

The directory where the Boost sources are installed.

- `-DWITH_DOC=bool`

Whether to enable generating the Doxygen documentation. As of Connector/C++ 8.0.16, enabling this option also causes the Doxygen documentation to be built by the `all` target.

- `-DWITH_JDBC=bool`

Whether to build the legacy JDBC connector. This option is disabled by default. If it is enabled, Connector/C++ 8.0 applications can use the legacy JDBC API, just like Connector/C++ 1.1 applications.

- `-DWITH_SSL={ssl_type|path_name}`

This option specifies which SSL library to use when compiling Connector/C++. The option value indicates the type of SSL support to include or the path name to the SSL installation to use:

- `ssl_type` can be one of the following values:
 - `system`: Use the system OpenSSL library.

When running an application that is linked to the connector dynamic library, the OpenSSL libraries on which the connector depends should be correctly found if they are placed in the file system next to the connector library. The application should also work when the OpenSSL libraries are installed at the standard system-wide locations. This assumes that the version of OpenSSL is as expected by Connector/C++.

Compressed `tar` files or Zip archive distributions for Windows, Linux, and macOS should contain the required OpenSSL libraries in the same location as the connector library.

Except for Windows, it should be possible to run an application linked to the connector dynamic library when the connector library and the OpenSSL libraries are placed in a nonstandard location, provided that these locations were stored as runtime paths when building the application (`gcc -rpath` option).

For Windows, an application that is linked to the connector shared library can be run only if the connector library and the OpenSSL libraries are stored either:

- In the Windows system folder
- In the same folder as the application
- In a folder listed in the `PATH` environment variable

If the application is linked to the connector static library, it remains true that the required OpenSSL libraries must be found in one of the preceding locations.

- `path_name` is the path name to the SSL installation to use. It should be the path to the installed OpenSSL library, and must point to a directory containing a `lib` subdirectory with OpenSSL libraries that are already built.

Specifying a path name for the OpenSSL installation can be preferable to using the `ssl_type` value of `system` because it can prevent `CMake` from detecting and using an older or incorrect OpenSSL version installed on the system.

2.5 Building Connector/C++ Applications

This chapter provides guidance on building Connector/C++ applications:

- General considerations for building Connector/C++ applications successfully. See [Section 2.5.1, “Building Connector/C++ Applications: General Considerations”](#).
- Information about building Connector/C++ applications that applies to specific platforms such as Windows, macOS, and Solaris. See [Section 2.5.2, “Building Connector/C++ Applications: Platform-Specific Considerations”](#).

For discussion of the programming interfaces available to Connector/C++ applications, see [Section 2.1, “Introduction to Connector/C++”](#).

2.5.1 Building Connector/C++ Applications: General Considerations

This section discusses general considerations to keep in mind when building Connector/C++ applications. For information that applies to particular platforms, see the section that applies to your platform in [Section 2.5.2, “Building Connector/C++ Applications: Platform-Specific Considerations”](#).

Commands shown here are as given from the command line (for example, as invoked from a `Makefile`). The commands apply to any platform that supports `make` and command-line build tools such as `g++`, `cc`, or `clang`, but may need adjustment for your build environment.

- [Build Tools and Configuration Settings](#)
- [C++11 Support](#)
- [Connector/C++ Header Files](#)
- [Boost Header Files](#)
- [Link Libraries](#)
- [Runtime Libraries](#)
- [Using the Connector/C++ Dynamic Library](#)
- [Using the Connector/C++ Static Library](#)

Build Tools and Configuration Settings

It is important that the tools you use to build your Connector/C++ applications are compatible with the tools used to build Connector/C++ itself. Ideally, build your applications with the same tools that were used to build the Connector/C++ binaries.

To avoid issues, ensure that these factors are the same for your applications and Connector/C++ itself:

- Compiler version.
- Runtime library.
- Runtime linker configuration settings.

To avoid potential crashes, the build configuration of Connector/C++ should match the build configuration of the application using it. For example, do not use a release build of Connector/C++ with a debug build of the client application.

To use a different compiler version, release configuration, or runtime library, first build Connector/C++ from source using your desired settings (see [Section 2.4, “Installing Connector/C++ from Source”](#)), then build your applications using those same settings.

Connector/C++ binary distributions include an `INFO_BIN` file that describes the environment and configuration options used to build the distribution. If you installed Connector/C++ from a binary distribution and experience build-related issues on a platform, it may help to check the settings that were used to build the distribution on that platform. Binary distributions also include an `INFO_SRC` file that provides information about the product version and the source repository from which the distribution was produced. (Prior to Connector/C++ 8.0.14, look for `BUILDINFO.txt` rather than `INFO_BIN` and `INFO_SRC`.)

C++11 Support

X DevAPI uses C++11 language features. To compile Connector/C++ applications that use X DevAPI, enable C++11 support in the compiler using the `-std=c++11` option. This option is not needed for applications that use X DevAPI for C (which is a plain C API) or the legacy JDBC API (which is based on plain C++), unless the application code uses C++11.

Connector/C++ Header Files

The API an application uses determines which Connector/C++ header files it should include. The following include directives work under the assumption that the include path contains `$MYSQL_CPPCONN_DIR/include`, where `$MYSQL_CPPCONN_DIR` is the Connector/C++ installation location. Pass an `-I $MYSQL_CPPCONN_DIR/include` option on the compiler invocation command to ensure this.

- For applications that use X DevAPI:

```
#include <mysqlx/xdevapi.h>
```

- For applications that use X DevAPI for C:

```
#include <mysqlx/xapi.h>
```

- For applications that use the legacy JDBC API, the header files are version dependent:

- As of Connector/C++ 8.0.16, a single `#include` directive suffices:

```
#include <jdbc/mysql_driver.h>
```

- Prior to Connector/C++ 8.0.16, use this set of `#include` directives:

```
#include <jdbc/mysql_driver.h>
#include <jdbc/mysql_connection.h>
#include <jdbc/cppconn/*.h>
```

The notation `<jdbc/cppconn/*.h>` means that you should include all header files from the `j dbc/c ppconn` directory that are needed by your application. The particular files needed depend on the application.

- Legacy code that uses Connector/C++ 1.1 has `#include` directives of this form:

```
#include <mysql_driver.h>
#include <mysql_connection.h>
#include <cppconn/*.h>
```

To build such code with Connector/C++ 8.0 without modifying it, add `$MYSQL_CPPCONN_DIR/include/jdbc` to the include path.

To compile code that you intend to link statically against Connector/C++, define a macro that adjusts API declarations in the header files for usage with the static library. For details, see [Using the Connector/C++ Static Library](#).

Boost Header Files

The Boost header files are needed under these circumstances:

- To compile Connector/C++ applications that use the legacy JDBC API.
- Prior to Connector/C++ 8.0.16, on Unix and Unix-like platforms for applications that use X DevAPI or X DevAPI for C, if you build using `gcc` and the version of the C++ standard library on your system does not implement the UTF8 converter (`codecvt_utf8`).

If the Boost header files are needed, Boost 1.59.0 or newer must be installed, and the location of the headers must be added to the include path. To obtain Boost and its installation instructions, visit [the official Boost site](#).

Link Libraries

Building Connector/C++ using OpenSSL makes the connector library dependent on OpenSSL dynamic libraries. In that case:

- When linking an application to Connector/C++ dynamically, this dependency is relevant only at runtime.
- When linking an application to Connector/C++ statically, link to the OpenSSL libraries as well. On Linux, this means adding `-lssl -lcrypto` explicitly to the compile/link command. On Windows, this is handled automatically.

On Windows, link to the dynamic version of the C++ Runtime Library.

Runtime Libraries

X DevAPI for C applications need `libstdc++` at runtime. Depending on your platform or build tools, a different library may apply. For example, the library is `libc++` on macOS; see [Section 2.5.2.2, “macOS Notes”](#).

If an application is built using dynamic link libraries, those libraries must be present not just on the build host, but on target hosts where the application runs. The dynamic linker must be properly configured to find those libraries and their runtime dependencies, as well as to find Connector/C++ libraries and their runtime dependencies.

Connector/C++ libraries built by Oracle depend on the OpenSSL libraries. The latter must be installed on the system in order to run code that links against Connector/C++ libraries. Another option is to put the OpenSSL libraries in the same location as Connector/C++, in which case, the dynamic linker should find them next to the connector library. See also [Section 2.5.2.1, “Windows Notes”](#), and [Section 2.5.2.2, “macOS Notes”](#).

Using the Connector/C++ Dynamic Library

The Connector/C++ dynamic library name depends on the platform. These libraries implement X DevAPI and X DevAPI for C, where `A` in the library name represents the ABI version:

- `libmysqlcppconn8.so.A` (Unix)
- `libmysqlcppconn8.A.dylib` (macOS)
- `mysqlcppconn8-A-vsNN.dll`, with import library `vsNN/mysqlcppconn8.lib` (Windows)

For the legacy JDBC API, the dynamic libraries are named as follows, where `B` in the library name represents the ABI version:

- `libmysqlcppconn.so.B` (Unix)
- `libmysqlcppconn.B.dylib` (macOS)
- `mysqlcppconn-B-vsNN.dll`, with import library `vsNN/mysqlcppconn-static.lib` (Windows)

On Windows, the `vsNN` value in library names depends on the MSVC toolchain version used to build the libraries. (Connector/C++ libraries provided by Oracle use `vs14`, and they are compatible with MSVC 2019 and 2017.) This convention enables using libraries built with different versions of MSVC on the same system. See also [Section 2.5.2.1, “Windows Notes”](#).

To build code that uses X DevAPI or X DevAPI for C, add `-lmysqlcppconn8` to the linker options. To build code that uses the legacy JDBC API, add `-lmysqlcppconn`.

You must also indicate whether to use the 64-bit or 32-bit libraries by specifying the appropriate library directory. Use an `-L` linker option to specify `$MYSQL_CONCPP_DIR/lib64` (64-bit libraries) or `$MYSQL_CONCPP_DIR/lib` (32-bit libraries), where `$MYSQL_CPPCONN_DIR` is the Connector/C++ installation location. On FreeBSD, `/lib64` is not used. The library name always ends with `/lib`.

To build a Connector/C++ application that uses X DevAPI, has sources in `app.cc`, and links dynamically to the connector library, the `Makefile` might look like this:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -I $(MYSQL_CONCPP_DIR)/include -L $(MYSQL_CONCPP_DIR)/lib64
LDLIBS = -lmysqlcppconn8
CXXFLAGS = -std=c++11
app : app.cc
```

With that [Makefile](#), the command `make app` generates the following compiler invocation:

```
g++ -std=c++11 -I .../include -L .../lib64 app.cc -lmysqlcppconn8 -o app
```

To build a plain C application that uses X DevAPI for C, has sources in [app.c](#), and links dynamically to the connector library, the [Makefile](#) might look like this:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -I $(MYSQL_CONCPP_DIR)/include -L $(MYSQL_CONCPP_DIR)/lib64
LDLIBS = -lmysqlcppconn8
app : app.c
```

With that [Makefile](#), the command `make app` generates the following compiler invocation:

```
cc -I .../include -L .../lib64 app.c -lmysqlcppconn8 -o app
```

Note

The resulting code, even though it is compiled as plain C, depends on the C++ runtime (typically `libstdc++`, though this may differ depending on platform or build tools; see [Runtime Libraries](#)).

To build a plain C++ application that uses the legacy JDBC API, has sources in [app.c](#), and links dynamically to the connector library, the [Makefile](#) might look like this:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -I $(MYSQL_CONCPP_DIR)/include -L $(MYSQL_CONCPP_DIR)/lib64
LDLIBS = -lmysqlcppcon
app : app.c
```

The library option in this case is `-lmysqlcppcon`, rather than `-lmysqlcppcon8` as for an X DevAPI or X DevAPI for C application.

With that [Makefile](#), the command `make app` generates the following compiler invocation:

```
cc -I .../include -L .../lib64 app.c -lmysqlcppcon -o app
```

Note

When running an application that uses the Connector/C++ dynamic library, the library and its runtime dependencies must be found by the dynamic linker. See [Runtime Libraries](#).

Using the Connector/C++ Static Library

It is possible to link your application with the Connector/C++ static library. This way there is no runtime dependency on the connector, and the resulting binary can run on systems where Connector/C++ is not installed.

Note

Even when linking statically, the resulting code still depends on all runtime dependencies of the Connector/C++ library. For example, if Connector/C++ is built using OpenSSL, the code has a runtime dependency on the OpenSSL libraries. See [Runtime Libraries](#).

The Connector/C++ static library name depends on the platform. These libraries implement X DevAPI and X DevAPI for C:

- `libmysqlcppconn8-static.a` (Unix, macOS)
- `vsNN/mysqlcppconn8-static.lib` (Windows)

For the legacy JDBC API, the static libraries are named as follows:

- `libmysqlcppconn-static.a` (Unix, macOS)
- `vsNN/mysqlcppconn-static.lib` (Windows)

On Windows, the `vsNN` value in library names depends on the MSVC toolchain version used to build the libraries. (Connector/C++ libraries provided by Oracle use `vs14`, and they are compatible with MSVC 2019 and 2017.) This convention enables using libraries built with different versions of MSVC on the same system. See also [Section 2.5.2.1, “Windows Notes”](#).

To compile code that you intend to link statically against Connector/C++, define a macro that adjusts API declarations in the header files for usage with the static library. One way to define the macro is by passing a `-D` option on the compiler invocation command:

- For applications that use X DevAPI, X DevAPI for C, or (as of Connector/C++ 8.0.16) the legacy JDBC API, define the `STATIC_CONCPP` macro. All that matters is that you define it; the value does not matter. For example: `-DSTATIC_CONCPP`
- Prior to Connector/C++ 8.0.16, for applications that use the legacy JDBC API, define the `CPPCONN_PUBLIC_FUNC` macro as an empty string. To ensure this, define the macro as `CPPCONN_PUBLIC_FUNC=`, not as `CPPCONN_PUBLIC_FUNC`. For example: `-DCPPCONN_PUBLIC_FUNC=`

To build a Connector/C++ application that uses X DevAPI, has sources in `app.cc`, and links statically to the connector library, the `Makefile` might look like this:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -DSTATIC_CONCPP -I $(MYSQL_CONCPP_DIR)/include
LDLIBS = $(MYSQL_CONCPP_DIR)/lib64/libmysqlcppconn8-static.a -lssl -lcrypto -lpthread
CXXFLAGS = -std=c++11
app : app.cc
```

With that `Makefile`, the command `make app` generates the following compiler invocation:

```
g++ -std=c++11 -DSTATIC_CONCPP -I .../include app.cc
      .../lib64/libmysqlcppconn8-static.a -lssl -lcrypto -lpthread -o app
```

Note

To avoid having the linker report unresolved symbols, the compile line must include the OpenSSL libraries and the `pthread` library on which Connector/C++ code depends.

OpenSSL libraries are not needed if Connector/C++ is built without them, but Connector/C++ distributions built by Oracle do depend on OpenSSL.

The exact list of libraries required by Connector/C++ library depends on the platform. For example, on Solaris, the `socket`, `rt`, and `ns1` libraries might be needed.

To build a plain C application that uses X DevAPI for C, has sources in `app.c`, and links statically to the connector library, the `Makefile` might look like this:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -DSTATIC_CONCPP -I $(MYSQL_CONCPP_DIR)/include
LDLIBS = $(MYSQL_CONCPP_DIR)/lib64/libmysqlcppconn8-static.a -lssl -lcrypto -lpthread
app : app.c
```

With that `Makefile`, the command `make app` generates the following compiler invocation:

```
cc -DSTATIC_CONCPP -I .../include app.c
    .../lib64/libmysqlcppconn8-static.a -lssl -lcrypto -lpthread -o app
```

To build a plain C application that uses the legacy JDBC API, has sources in `app.c`, and links statically to the connector library, the [Makefile](#) might look like this:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -DCPPCONN_PUBLIC_FUNC= -I $(MYSQL_CONCPP_DIR)/include
LDLIBS = $(MYSQL_CONCPP_DIR)/lib64/libmysqlcppconn-static.a -lssl -lcrypto -lpthread
app : app.c
```

The library option in this case names `libmysqlcppcon-static.a`, rather than `libmysqlcppcon8-static.a` as for an X DevAPI or X DevAPI for C application.

With that [Makefile](#), the command `make app` generates the following compiler invocation:

```
cc -std=c++11 --DCPPCONN_PUBLIC_FUNC= -I .../include app.c
    .../lib64/libmysqlcppconn-static.a -lssl -lcrypto -lpthread -o app
```

When building plain C code, it is important to take care of connector's dependency on the C++ runtime, which is introduced by the connector library even though the code that uses it is plain C:

- One approach is to ensure that a C++ linker is used to build the final code. This approach is taken by the [Makefile](#) shown here:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -DSTATIC_CONCPP -I $(MYSQL_CONCPP_DIR)/include
LDLIBS = $(MYSQL_CONCPP_DIR)/lib64/libmysqlcppconn8-static.a -lssl -lcrypto -lpthread
LINK.o = $(LINK.cc) # use C++ linker
app : app.o
```

With that [Makefile](#), the build process has two steps: first compile the application source in `app.c` using a plain C compiler to produce `app.o`, then link the final executable (`app`) using the C++ linker, which takes care of the dependency on the C++ runtime. The commands look something like this:

```
cc -DSTATIC_CONCPP -I .../include -c -o app.o app.c
g++ -DSTATIC_CONCPP -I .../include app.o
    .../libmysqlcppconn8-static.a -lssl -lcrypto -lpthread -o app
```

- Another approach is to use a plain C compiler and linker, but add the `libstdc++` C++ runtime library as an explicit option to the linker. This approach is taken by the [Makefile](#) shown here:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -DSTATIC_CONCPP -I $(MYSQL_CONCPP_DIR)/include
LDLIBS = $(MYSQL_CONCPP_DIR)/lib64/libmysqlcppconn8-static.a -lssl -lcrypto -lpthread -lstdc++
app : app.c
```

With that [Makefile](#), the compiler is invoked as follows:

```
cc -DSTATIC_CONCPP -I .../include app.c
    .../libmysqlcppconn8-static.a -lssl -lcrypto -lpthread -lstdc++ -o app
```

Note

Even if the application that uses Connector/C++ is written in plain C, the final executable depends on the C++ runtime which must be installed on the target computer on which the application is to run.

2.5.2 Building Connector/C++ Applications: Platform-Specific Considerations

This section discusses platform-specific considerations to keep in mind when building Connector/C++ applications. For general considerations that apply on a platform-independent basis, see [Section 2.5.1, “Building Connector/C++ Applications: General Considerations”](#).

2.5.2.1 Windows Notes

This section describes Windows-specific aspects of building Connector/C++ applications. For general application-building information, see [Section 2.5.1, “Building Connector/C++ Applications: General Considerations”](#).

Developers using Microsoft Windows must satisfy these conditions to build Connector/C++ applications:

- An acceptable version of Microsoft Visual Studio is required.
- Your applications should use the same linker configuration as Connector/C++. For example, use one of `/MD`, `/MDd`, `/MT`, or `/MTd`.
- Target hosts running client applications must have an acceptable version of the [Visual C++ Redistributable for Visual Studio](#) installed.

For information about which Visual Studio and VC++ Restributable versions are acceptable, see [Platform Support and Prerequisites](#).

On Windows, applications can be built in different modes (also called build configurations), which determine the type of the runtime library that is used by the final executable:

- An application can be built in 32-bit or 64-bit mode.
- An application can be built in debug or release mode.
- You can choose between the static runtime (`/MT`) or dynamic runtime (`/MD`). Different versions of the MSVC compiler also use different versions of the runtime.

Binary distributions of Connector/C++ 8.0 are available as 64-bit and 32-bit packages, which store libraries in directories named `lib64` and `lib`, respectively. Package names and certain library file and directory names also include `vsNN`. The `vsNN` value in these names depends on the MSVC toolchain version used to build the libraries. This convention enables using libraries built with different versions of MSVC on the same system.

Note

The `vsNN` value represents the major version of the MSVC toolchain used to build the libraries. Currently it is `vs14`, which is the toolchain used by MSVC 2015 through 2019.

It is important to ensure that the compiler version and the build mode of an application match the corresponding parameters used to build the connector library, to ensure that the connector and the application use the same runtime library.

Binary distributions of Connector/C++ 8.0 ship libraries built in release mode using the dynamic runtime (`/MD`). The libraries are compatible with MSVC 2019 and 2017, and code that uses these libraries can be built with either MSVC 2019 or 2017 in `/MD` mode. To build code in a different mode, first build Connector/C++ from source in that mode (see [Section 2.4.3, “Installing Connector/C++ from Source”](#)), then build your applications using the same mode.

Note

When linking dynamically, it is possible to build your code in debug mode even if the connector libraries are built in release mode. However, in that case, it is not possible to step inside connector code during a debug session. To be able to do that, or to build in debug mode while linking statically to the connector, you must first build Connector/C++ in debug mode

- [Linking Connector/C++ to Applications](#)

- [Building Connector/C++ Applications with Microsoft Visual Studio](#)

Linking Connector/C++ to Applications

Connector/C++ is available as a dynamic or static library to use with your application.

A dynamic connector library name has a `.dll` extension and is used with an import library that has a `.lib` extension in the `vsNN` subdirectory. Thus, a connector dynamic library named `mysqlcppconn8-2-vs14.dll` is used with an import library named `vs14/mysqlcppconn8.lib`. The `2` in the dynamic library name is the major ABI version number. (This helps when using compatibility libraries with an old ABI together with new libraries having a different ABI.) The libraries installed on your system may have a different ABI version in their file names. The corresponding static library is named `vs14/mysqlcppconn8-static.lib`.

A legacy JDBC connector dynamic library named `mysqlcppconn-7-vs14.dll` is used with an import library named `vs14/mysqlcppconn.lib`. The corresponding static library is named `vs14/mysqlcppconn-static.lib`.

The following tables indicate which dynamic and import library files to use for dynamic linking, and which static library files to use for static linking. `LIB` denotes the Connector/C++ installation library path name. The name of the last path component is `lib64` (for 64-bit packages) or `lib` (for 32-bit packages).

Table 2.2 Connector/C++ Dynamic and Import Libraries

Connector Type	Dynamic Library File Name	Import Library File Name
X DevAPI, X DevAPI for C	<code>LIB/mysqlcppconn8-2-vs14.dll</code>	<code>LIB/vs14/mysqlcppconn8.lib</code>
JDBC	<code>LIB/mysqlcppconn-7-vs14.dll</code>	<code>LIB/vs14/mysqlcppconn.lib</code>

Table 2.3 Connector/C++ Static Libraries

Connector Type	Static Library File Name
X DevAPI, X DevAPI for C	<code>LIB/vs14/mysqlcppconn8-static.lib</code>
JDBC	<code>LIB/vs14/mysqlcppconn-static.lib</code>

When building code that uses Connector/C++ libraries, use these guidelines for setting build options in the project configuration:

- As an additional include directory, specify `$MYSQL_CPPCONN_DIR/include`.
- As an additional library directory, specify `$MYSQL_CONCPP_DIR/lib64` (for 64-bit libraries) or `$MYSQL_CONCPP_DIR/lib` (for 32-bit libraries).
- To use a dynamic library file (`.dll` extension), link your application with a `.lib` import library: add `vs14/mysqlcppconn8.lib` to the linker options, or `vs14/mysqlcppconn.lib` for legacy code. At runtime, the application must have access to the `.dll` library.
- To use a static library file (`.lib` extension), link your application with the library: add `vs14/mysqlcppconn8-static.lib`, or `vs14/mysqlcppconn-static.lib` for legacy code.

If linking statically, the linker must find the link libraries (with `.lib` extension) for the required OpenSSL libraries. If the connector was installed from a binary package provided by Oracle, they are present in the `vs14` subdirectory under the main library directory (`$MYSQL_CONCPP_DIR/lib64` or `$MYSQL_CONCPP_DIR/lib`), and the corresponding OpenSSL `.dll` libraries are present in the main library directory, next to the connector `.dll` libraries.

Note

A Windows application that uses the connector dynamic library must be able to locate it at runtime, as well as its dependencies such as OpenSSL. The common way of arranging this is to put the required DLLs in the same location as the executable.

Building Connector/C++ Applications with Microsoft Visual Studio

The initial steps for building an application are the same whether you use the dynamic or static library. Some additional steps vary, depending on whether you use the dynamic or static library.

- [Initial Application-Building Steps](#)
- [Building with the Dynamic Library](#)
- [Building with the Static Library](#)

Initial Application-Building Steps

These steps are the same whether you use the dynamic or static library:

1. Start a new Visual C++ project in Visual Studio.
2. In the drop-down list for build configuration on the toolbar, change the configuration from the default option of **Debug** to **Release**.

Connector/C++ and Application Build Configuration Must Match

Because the application build configuration must match that of the Connector/C++ it uses, **Release** is required when using an Oracle-built Connector/C++, which is built in the release configuration. When linking dynamically, it is possible to build your code in debug mode even if the connector libraries are built in release mode. However, in that case, it is not possible to step inside connector code during a debug session. To be able to do that, or to build in debug mode while linking statically to the connector, you must build Connector/C++ from source yourself using the **Debug** configuration.

3. From the main menu select **Project, Properties**. This can also be accessed using the hot key **ALT + F7**.
4. Under **Configuration Properties**, open the tree view.
5. Select **C/C++, General** in the tree view.
6. In the **Additional Include Directories** text field:
 - Add the `include/` directory of Connector/C++. This directory should be located within the Connector/C++ installation directory.
 - If Boost is required to build the application, also add the Boost library root directory. See [Section 2.5.1, “Building Connector/C++ Applications: General Considerations”](#).
7. In the tree view, open **Linker, General, Additional Library Directories**.
8. In the **Additional Library Directories** text field, add the Connector/C++ library directory. This directory should be located within the Connector/C++ installation directory. The directory name ends with `lib64` (for 64-bit builds) or `lib` (for 32-bit builds).

The remaining steps depend on whether you are building an application to use the Connector/C++ dynamic or static library.

Building with the Dynamic Library

To build an application to use the Connector/C++ dynamic library, follow these steps:

1. Open **Linker, Input** in the **Property Pages** dialog.
2. Add the appropriate import library name into the **Additional Dependencies** text field. For example, use `vs14/mysqlcppconn8.lib`, or `vs14/mysqlcppconn.lib` for legacy applications; see [Linking Connector/C++ to Applications](#).
3. Choose the C++ Runtime Library to link to. In the **Property Pages** dialog, open **C++, Code Generation** in the tree view, and then select the appropriate option for **Runtime Library**.

Link to the dynamic version of the C++ Runtime Library by selecting the `/MD` compiler option. Also, target hosts running the client application must have the [Visual C++ Redistributable for Visual Studio](#) installed. For information about which VC++ Restributable versions are acceptable, see [Platform Support and Prerequisites](#).

Do *not* use the `/MTd` or `/MDd` option if you are using an Oracle-built Connector/C++. For an explanation, see this discussion: [Connector/C++ and Application Build Configuration Must Match](#).

4. Copy the appropriate dynamic library to the same directory as the application executable (see [Linking Connector/C++ to Applications](#)). Alternatively, extend the `PATH` environment variable using `SET PATH=%PATH%;C:\path\to\cpp`, or copy the dynamic library to the Windows installation directory, typically `C:\windows`.

The dynamic library must be in the same directory as the application executable, or somewhere on the system's path, so that the application can access the Connector/C++ dynamic library at runtime.

Building with the Static Library

To build an application to use the Connector/C++ static library, follow these steps:

1. Open **Linker, Input** in the **Property Pages** dialog.
2. Add the appropriate static library name into the **Additional Dependencies** text field. For example, use `vs14/mysqlcppconn8-static.lib`, or `vs14/mysqlcppconn-static.lib` for legacy applications; see [Linking Connector/C++ to Applications](#).
3. To compile code that is linked statically with the connector library, define a macro that adjusts API declarations in the header files for usage with the static library. By default, the macro is defined to declare functions to be compatible with an application that calls a DLL.

In the **Project, Properties** tree view, under **C++, Preprocessor**, enter the appropriate macro into the **Preprocessor Definitions** text field:

- For applications that use X DevAPI, X DevAPI for C, or (as of Connector/C++ 8.0.16) the legacy JDBC API, define the `STATIC_CONCPP` macro. All that matters is that you define it; the value does not matter. For example: `-DSTATIC_CONCPP`
 - Prior to Connector/C++ 8.0.16, for applications that use the legacy JDBC API, define the `CPPCONN_PUBLIC_FUNC` macro as an empty string. To ensure this, define the macro as `CPPCONN_PUBLIC_FUNC=`, not as `CPPCONN_PUBLIC_FUNC`.
4. Choose the C++ Runtime Library to link to. In the **Property Pages** dialog, open **C++, Code Generation** in the tree view, and then select the appropriate option for **Runtime Library**.

Link to the dynamic version of the C++ Runtime Library by selecting the `/MD` compiler option. Also, target hosts running the client application must have the [Visual C++ Redistributable for Visual Studio](#) installed. For information about which VC++ Restributable versions are acceptable, see [Platform Support and Prerequisites](#).

Do not use the `/MTd` or `/MDd` option if you are using an Oracle-built Connector/C++. For an explanation, see this discussion: [Connector/C++ and Application Build Configuration Must Match](#).

2.5.2.2 macOS Notes

This section describes macOS-specific aspects of building Connector/C++ applications. For general application-building information, see [Section 2.5.1, “Building Connector/C++ Applications: General Considerations”](#).

The binary distribution of Connector/C++ for macOS is compiled using the macOS native `clang` compiler. For that reason, an application that uses Connector/C++ should be built with the same `clang` compiler.

The `clang` compiler can use two different implementations of the C++ runtime library: either the native `libc++` or the GNU `libstdc++` library. It is important that an application uses the same runtime implementation as Connector/C++ that is, the native `libc++`. To ensure that, the `-stdlib=libc++` option should be passed to the compiler and the linker invocations.

To build a Connector/C++ application that uses X DevAPI, has sources in `app.cc`, and links dynamically to the connector library, the `Makefile` for building on macOS might look like this:

```
MYSQL_CONCPP_DIR = Connector/C++ installation location
CPPFLAGS = -I $(MYSQL_CONCPP_DIR)/include -L $(MYSQL_CONCPP_DIR)/lib64
LDLIBS = -lmysqlcppconn8
CXX = clang++ -stdlib=libc++
CXXFLAGS = -std=c++11
app : app.cc
```

Binary packages for macOS include OpenSSL libraries that are required by code linked with the connector. These libraries are installed in the same location as the connector libraries and should be found there by the dynamic linker.

2.5.2.3 Solaris Notes

This section describes Solaris-specific aspects of building Connector/C++ applications. For general application-building information, see [Section 2.5.1, “Building Connector/C++ Applications: General Considerations”](#).

As of Connector/C++ 8.0.13, it is possible to build Connector/C++ applications on Solaris. This requires the SunPro 5.15 or higher compiler (from Developer Studio 12.6). Earlier versions and building with GCC are not supported.

To use a Connector/C++ package provided by Oracle, application code must be built with SunPro 5.15 or higher under the following options: `-m64 -std=c++11`. The C++ runtime libraries and atomics library used should be the defaults (`-library=stdcpp, -xatomicss=studio`).

Important

The connector library and any code that uses it depends on the GCC runtime libraries shipped with Oracle Developer Studio 12.6, which must be installed before you run the application. See the [download options](#) for Oracle Developer Studio. The installation package enables you to install the runtime libraries only instead of the full Oracle Developer Studio; see instructions in [Installing Only the Runtime Libraries on Oracle Solaris 11](#).

Target hosts running client applications must have the runtime libraries from Developer Studio 12.6 installed.

2.6 Connector/C++ Known Issues

To report bugs, use the MySQL Bug System. See [How to Report Bugs or Problems](#).

For notes detailing the changes in each release of Connector/C++, see [MySQL Connector/C++ Release Notes](#).

- Generally speaking, C++ library binaries are less portable than C library binaries. Issues can be caused by name mangling, different Standard Template Library (STL) versions, and using different compilers and linkers for linking against the libraries than were used for building the library itself.

Even a small change in the compiler version can cause problems. If you obtain error messages that you suspect are related to binary incompatibilities, build Connector/C++ from source, using the same compiler and linker that you use to build and link your application.

Due to variations between Linux distributions, compiler versions, linker versions, and STL versions, it is not possible to provide binaries for every possible configuration. However, Connector/C++ binary distributions include an [INFO_BIN](#) file that describes the environment and configuration options used to build the binary versions of the connector libraries. Binary distributions also include an [INFO_SRC](#) file that provides information about the product version and the source repository from which the distribution was produced. (Prior to Connector/C++ 8.0.14, look for [BUILDINFO.txt](#) rather than [INFO_BIN](#) and [INFO_SRC](#).)

- To avoid potential crashes, the build configuration of Connector/C++ should match the build configuration of the application using it. For example, do not use a release build of Connector/C++ with a debug build of the client application.

2.7 Connector/C++ Support

For general discussion of Connector/C++, please use the [C/C++ community forum](#).

To report bugs, use the MySQL Bug System. See [How to Report Bugs or Problems](#).

For notes detailing the changes in each release of Connector/C++, see [MySQL Connector/C++ Release Notes](#).

For Licensing questions, and to purchase MySQL Products and Services, please see <http://www.mysql.com/buy-mysql/>.

Chapter 3 MySQL Connector/J Developer Guide

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MySQL Connector/J is a JDBC driver for communicating with MySQL servers.

For notes detailing the changes in each release of Connector/J, see [MySQL Connector/J Release Notes](#).

For legal information, see the [Legal Notices](#).

For help with using MySQL, please visit the [MySQL Forums](#), where you can discuss your issues with other MySQL users.

Licensing information. This product may include third-party software, used under license. If you are using a *Commercial* release of MySQL Connector/J 8.0, see [this document](#) for licensing information, including licensing information relating to third-party software that may be included in this Commercial release. If you are using a *Community* release of MySQL Connector/J 8.0, see [this document](#) for licensing information, including licensing information relating to third-party software that may be included in this Community release.

3.1 Overview of MySQL Connector/J

MySQL provides connectivity for client applications developed in the Java programming language with MySQL Connector/J. Connector/J implements the [Java Database Connectivity \(JDBC\) API](#), as well as a number of value-adding extensions of it. It also supports the new X DevAPI.

MySQL Connector/J is a JDBC Type 4 driver, implementing the [JDBC 4.2](#) specification. The Type 4 designation means that the driver is a pure Java implementation of the MySQL protocol and does not rely on the MySQL client libraries. See [Section 3.2, “Connector/J Versions, and the MySQL and Java Versions They Require”](#) for compatibility information.

For large-scale programs that use common design patterns of data access, consider using one of the popular persistence frameworks such as [Hibernate](#), [Spring's JDBC templates](#) or [MyBatis SQL Maps](#) to reduce the amount of JDBC code for you to debug, tune, secure, and maintain.

Key Topics

- For installation instructions for Connector/J, see [Section 3.3, “Connector/J Installation”](#).
- For help with connection strings, connection options, and setting up your connection through JDBC, see [Section 3.5, “Connector/J Reference”](#).
- For information on connection pooling, see [Section 3.7, “Connection Pooling with Connector/J”](#).
- For information on multi-host connections, see [Section 3.8, “Multi-Host Connections”](#).

3.2 Connector/J Versions, and the MySQL and Java Versions They Require

There are currently two MySQL Connector/J versions available:

- Connector/J 8.0 (formerly Connector/J 6.0; see [Changes in MySQL Connector/J 8.0.7](#) for an explanation of the version number change) is a Type 4 pure Java JDBC 4.2 driver for the Java 8 platform. It provides compatibility with all the functionality of MySQL 5.6, 5.7, and 8.0. Connector/J 8.0 provides ease of development features, including auto-registration with the Driver Manager, standardized validity checks, categorized SQLExceptions, support for large update counts, support for local and offset date-time variants from the `java.time` package, support for JDBC-4.x XML processing, support for per connection client information, and support for the `NCHAR`, `NVARCHAR` and `NLOB` data types.
- Connector/J 5.1 is also a Type 4 pure Java JDBC driver that conforms to the JDBC 4.2 specification. It provides compatibility with all the functionality of MySQL 5.6, 5.7, and 8.0. Connector/J 5.1 is covered by [its own manual](#).

The following table summarizes the Connector/J versions available, along with the compatibility information for different versions of JDBC, MySQL Server, and Java, as well as the support status for each of the Connector/J versions:

Table 3.1 Summary of Connector/J Versions

Connector/J version	JDBC version	MySQL Server version	JRE Required	JDK Required for Compilation	Status
8.0	4.2 ¹	5.6, 5.7, 8.0	JRE 8 or higher	JDK 8.0 or higher ³	General availability. Recommended version.
5.1	3.0, 4.0, 4.1, 4.2	5.6 ² , 5.7 ² , 8.0 ²	JRE 5 or higher ²	JDK 5.0 AND JDK 8.0 or higher ³	General availability

Notes

- ¹ Connector/J 8.0 implements JDBC 4.2. While Connector/J 8.0 works with libraries of higher JDBC versions, it returns a `SQLFeatureNotSupportedException` for any calls of methods supported only by JDBC 4.3 and higher.,
- ² JRE 8 or higher is required for Connector/J 5.1 to connect to MySQL 5.6, 5.7, and 8.0 with SSL/TLS when using some cipher suites.
- ³ A customized JSSE provider might be required to use some later TLS versions and cipher suites when connecting to MySQL servers. For example, because Oracle's Java 8 is shipped with a JSSE implementation that only supports TLSv1.2 and lower, you need a customized JSSE implementation to use TLSv1.3 on Oracle's Java 8 platform.

3.3 Connector/J Installation

You can install the Connector/J package using either a binary or source distribution. While the binary distribution provides the easiest method for installation, the source distribution lets you customize your installation. Both types of distributions are available from the [Connector/J Download page](#). The source code for Connector/J is also available on GitHub at <https://github.com/mysql/mysql-connector-j>.

Connector/J is also available as a Maven artifact in the Central Repository. See [Section 3.3.2, “Installing Connector/J Using Maven”](#) for details.

If you are upgrading from a previous version, read the upgrade information in [Section 3.3.4, “Upgrading from an Older Version”](#) before continuing.

Important

You may also need to install the following third-party libraries on your system for Connector/J 8.0 to work:

- Protocol Buffers (required for using X DevAPI)
- Simple Logging Facade API (required for using the logging capabilities provided by the default implementation of `org.slf4j.Logger.Slf4JLogger` by Connector/J)

These and other third-party libraries are required for [building Connector/J from source](#) (see the section for more information on the required libraries).

3.3.1 Installing Connector/J from a Binary Distribution

Obtaining and Using the Binary Distribution Packages

Different types of binary distribution packages for Connector/J are available from the [Connector/J Download page](#). The following explains how to use each type of the packages to install Connector/J.

Using Platform-independent Archives: `.tar.gz` or `.zip` archives are available for installing Connector/J on any platform. Using the appropriate graphical or command-line utility (for example, `tar` for the `.tar.gz` archive and `WinZip` for the `.zip` archive), extract the JAR archive from the `.tar.gz` or `.zip` archive to a suitable location.

Note

Because there are potentially long file names in the distribution, the Connector/J archives use the GNU Tar archive format. Use GNU Tar or a compatible application to unpack the `.tar.gz` variant of the distribution.

Using Packages for Software Package Management Systems on Linux Platforms: RPM and Debian packages are available for installing Connector/J on a number of Linux distributions like Oracle Linux, Debian, Ubuntu, SUSE, and so on. Install these packages using your system's software package management system.

Configuring the CLASSPATH

Once `mysql-connector-java-version.jar` has been extracted from the binary distribution package to the right place, finish installing the driver by placing the JAR archive in your Java classpath, either by adding its full file path to your `CLASSPATH` environment variable, or by directly specifying the file path with the command line switch `-cp` when starting the JVM.

For example, on Linux platforms, add the Connector/J driver to your `CLASSPATH` using one of the following forms, depending on your command shell:

```
# Bourne-compatible shell (sh, ksh, bash, zsh):  
shell> export CLASSPATH=/path/mysql-connector-java-ver.jar:$CLASSPATH  
# C shell (csh, tcsh):  
shell> setenv CLASSPATH /path/mysql-connector-java-ver.jar:$CLASSPATH
```

You can also set the `CLASSPATH` environment variable in a profile file, either locally for a user within the user's `.profile`, `.login`, or other login file, or globally by editing the global `/etc/profile` file.

For Windows platforms, you set the environment variable through the System Control Panel.

Remember to also add the locations of the [third-party libraries required for using Connector/J](#) to `CLASSPATH`.

Configuring Connector/J for Application Servers

To use MySQL Connector/J with an application server such as GlassFish, Tomcat, or JBoss, read your vendor's documentation for information on how to configure third-party class libraries, as most application servers ignore the `CLASSPATH` environment variable. For configuration examples for some J2EE application servers, see [Section 3.7, “Connection Pooling with Connector/J”](#), [Section 3.8.3, “Configuring Load Balancing with Connector/J”](#), and [Section 3.8.5, “Advanced Load-balancing and Failover Configuration”](#). However, the authoritative source for JDBC connection pool configuration information is the documentation for your own application server.

If you are developing servlets or JSPs and your application server is J2EE-compliant, you can put the driver's `.jar` file in the `WEB-INF/lib` subdirectory of your web application, as this is a standard location for third-party class libraries in J2EE web applications. You can also use the `MysqlDataSource` or `MysqlConnectionPoolDataSource` classes in the `com.mysql.cj.jdbc` package, if your J2EE application server supports or requires them. The `javax.sql.XADataSource` interface is implemented using the `com.mysql.cj.jdbc.MysqlXADataSource` class, which supports XA distributed transactions. The various `MysqlDataSource` classes support the following parameters (through standard set mutators):

- `user`
- `password`
- `serverName`
- `databaseName`
- `port`

3.3.2 Installing Connector/J Using Maven

You can also use Maven dependencies manager to install and configure the Connector/J library in your project. Connector/J is published in The [Maven Central Repository](#) with "`GroupId: mysql`" and "`ArtifactId: mysql-connector-java`", and can be linked to your project by adding the following dependency in your `pom.xml` file:

```
<dependency>
    <groupId>mysql</groupId>
    <artifactId>mysql-connector-java</artifactId>
    <version>x.y.z</version>
</dependency>
```

Note that if you use Maven to manage your project dependencies, you do not need to explicitly refer to the library `protobuf-java` as it is resolved by dependency transitivity. However, if you do not want to use the X DevAPI features, you may also want to add a dependency exclusion to avoid linking the unneeded sub-library. For example:

```
<dependency>
    <groupId>mysql</groupId>
    <artifactId>mysql-connector-java</artifactId>
    <version>x.y.z</version>
    <exclusions>
        <exclusion>
            <groupId>com.google.protobuf</groupId>
            <artifactId>protobuf-java</artifactId>
        </exclusion>
    </exclusions>
</dependency>
```

3.3.3 Installing from Source

Caution

Read this section only if you want to build a customized version of Connector/J from source, or if you are interested in helping us test our new code. To just get MySQL Connector/J up and running on your system, install Connector/J using a standard binary release distribution; see [Section 3.3.1, “Installing Connector/J from a Binary Distribution”](#) for instructions.

To install MySQL Connector/J from source, make sure that you have the following software on your system:

- A Git client, if you want to check out the sources from our GitHub repository (available from <http://git-scm.com/downloads>).
- Apache Ant version 1.8.2 or newer (available from <http://ant.apache.org>).
- JDK 1.8.x (available from <https://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html>).
- The following third-party libraries:
 - JUnit 4.12 (`junit-4.12.jar`, available from <https://github.com/junit-team/junit/wiki/Download-and-Install>).

- Javassist 3.19 or newer (`javassist.jar`, available from <http://jboss-javassist.github.io/javassist/>).
- Protocol Buffers Java API 3.6.1 (`protobuf-java-3.6.1.jar`, available from, for example, the Maven Central Repository at <https://repo1.maven.org/maven2/com/google/protobuf/protobuf-java/3.6.1/>).
- C3P0 0.9.1 or newer (both `c3p0-0.9.1.x.jar` and `c3p0-0.9.1.x.src.zip`, available from <https://sourceforge.net/projects/c3p0/>).
- JBoss common JDBC wrapper 3.2.3 or newer (`jboss-common-jdbc-wrapper-3.2.3.jar`, available from, for example, the Maven Central Repository at <http://central.maven.org/maven2/jboss/jboss-common-jdbc-wrapper/>).
- Simple Logging Facade API 1.6.1 or newer (`slf4j-api-1.6.1.jar`, available from <https://www.slf4j.org/download.html>).

To build MySQL Connector/J from source, follow these steps:

1. Make sure that you have JDK 1.8.x installed.
2. Obtain the sources for Connector/J by one of the following means:
 - Download the platform independent distribution archive (in `.tar.gz` or `.zip` format) for Connector/J, which contains the sources, from the [Connector/J Download page](#). Extract contents of the archive into a folder named, for example, `mysql-connector-j`.
 - Download a source RPM package for Connector/J from [Connector/J Download page](#) and install it.
 - Check out the code from the source code repository for MySQL Connector/J located on GitHub at <https://github.com/mysql/mysql-connector-j>. The latest release of the Connector/J 8.0 series is on the `release/8.0` branch; use the following command to check it out:

```
shell> git clone --branch release/8.0 https://github.com/mysql/mysql-connector-j.git
```

Under the current directory, the command creates a `mysql-connector-j` subdirectory, which contains the code you want.

3. Place all the required third-party libraries in a separate directory—for example, `/home/username/ant-extralibs`.
4. Change your current working directory to the `mysql-connector-j` directory created in step 2 above.
5. In the directory, create a file named `build.properties` to indicate to Ant the locations of the root directories for your JDK 1.8.x installation, as well as the location of the extra libraries. The file should contain the following property settings, with the “`path_to_*`” parts replaced by the appropriate file paths:

```
com.mysql.cj.build.jdk=path_to_jdk_1.8
com.mysql.cj.extra.libs=path_to_folder_for_extra_libraries
```

Alternatively, you can set the values of those properties through the Ant `-D` options.

Note

Going from Connector/J 5.1 to 8.0, a number of Ant properties for building Connector/J have been renamed or removed; see [Changes for Build Properties](#) for details.

6. Issue the following command to compile the driver and create a `.jar` file for Connector/J:

```
shell> ant dist
```

This creates a `build` directory in the current directory, where all the build output goes. A directory is created under the `build` directory, whose name includes the version number of the release you are building. That directory contains the sources, the compiled `.class` files, and a `.jar` file for deployment.

For information on all the build targets, including those that create a fully packaged distribution, issue the following command:

```
shell> ant -projecthelp
```

7. Install the newly created `.jar` file for the JDBC driver as you would install a binary `.jar` file you download from MySQL by following the instructions given in [Configuring the CLASSPATH](#) or [Configuring Connector/J for Application Servers](#).

3.3.4 Upgrading from an Older Version

This section has information for users who are upgrading from one version of Connector/J to another, or to a new version of the MySQL server that supports a more recent level of JDBC. A newer version of Connector/J might include changes to support new features, improve existing functionality, or comply with new standards.

3.3.4.1 Upgrading to MySQL Connector/J 8.0

Upgrading an application developed for Connector/J 5.1 to use Connector/J 8.0 might require certain changes to your code or the environment in which it runs. Here are some changes for Connector/J going from 5.1 to 8.0, for which adjustments might be required:

Running on the Java 8 Platform

Connector/J 8.0 is created specifically to run on the Java 8 platform. While Java 8 is known to be strongly compatible with earlier Java versions, incompatibilities do exist, and code designed to work on Java 7 might need to be adjusted before being run on Java 8. Developers should refer to the [incompatibility information](#) provided by Oracle.

Changes in Connection Properties

A complete list of Connector/J 8.0 connection properties are available in [connector-j-reference-set-config](#). The following are connection properties that have been changed (removed, added, have their names changed, or have their default values changed) going from Connector/J 5.1 to 8.0.

Properties that have been removed (do not use them during connection):

- `useDynamicCharsetInfo`
- `useBlobToStoreUTF8OutsideBMP`, `utf8OutsideBmpExcludedColumnNamePattern`, and `utf8OutsideBmpIncludedColumnNamePattern`: MySQL 5.6 and later supports the utf8mb4 character set, which is the character set that should be used by Connector/J applications for supporting characters beyond the Basic Multilingual Plane (BMP) of Unicode Version 3.
- `useJvmCharsetConverters`: JVM character set conversion is now used in all cases
- The following date and time properties:
 - `dynamicCalendars`
 - `noTzConversionForTimeType`
 - `noTzConversionForDateType`

- `cacheDefaultTimezone`
- `useFastIntParsing`
- `useFastDateParsing`
- `useJDBCCompliantTimezoneShift`
- `useLegacyDatetimeCode`
- `useSSPSCompatibleTimezoneShift`
- `useTimezone`
- `useGmtMillisForDatetimes`
- `dumpMetadataOnColumnNotFound`
- `relaxAutoCommit`
- `strictFloatingPoint`
- `runningCTS13`
- `retainStatementAfterResultSetClose`
- `nullNamePatternMatchesAll` (removed since release 8.0.9)

Properties that have been added:

- `mysqlx.useAsyncProtocol`

Property that has its name changed:

- `com.mysql.jdbc.faultInjection.serverCharsetIndex` changed to `com.mysql.cj.testsuite.faultInjection.serverCharsetIndex`
- `loadBalanceEnableJMX` to `ha.enableJMX`
- `replicationEnableJMX` to `ha.enableJMX`

Properties that have their default values changed:

- `nullCatalogMeansCurrent` is now `false` by default

Changes in the Connector/J API

This section describes some of the more important changes to the Connector/J API going from version 5.1 to 8.0. You might need to adjust your API calls accordingly:

- The name of the class that implements `java.sql.Driver` in MySQL Connector/J has changed from `com.mysql.jdbc.Driver` to `com.mysql.cj.jdbc.Driver`. The old class name has been deprecated.
- The names of these commonly-used classes and interfaces have also been changed:
 - `ExceptionInterceptor`: from `com.mysql.jdbc.ExceptionInterceptor` to `com.mysql.cj.exceptions.ExceptionInterceptor`
 - `StatementInterceptor`: from `com.mysql.jdbc.StatementInterceptorV2` to `com.mysql.cj.interceptors.QueryInterceptor`
 - `ConnectionLifecycleInterceptor`: from `com.mysql.jdbc.ConnectionLifecycleInterceptor` to `com.mysql.cj.jdbc.interceptors.ConnectionLifecycleInterceptor`

- **AuthenticationPlugin**: from `com.mysql.jdbc.AuthenticationPlugin` to `com.mysql.cj.protocol.AuthenticationPlugin`
- **BalanceStrategy**: from `com.mysql.jdbc.BalanceStrategy` to `com.mysql.cj.jdbc.ha.BalanceStrategy`
- **MysqlDataSource**: from `com.mysql.jdbc.jdbc2.optional.MysqlDataSource` to `com.mysql.cj.jdbc.MysqlDataSource`
- **MysqlDataSourceFactory**: from `com.mysql.jdbc.jdbc2.optional.MysqlDataSourceFactory` to `com.mysql.cj.jdbc.MysqlDataSourceFactory`
- **MysqlConnectionPoolDataSource**: from `com.mysql.jdbc.jdbc2.optional.MysqlConnectionPoolDataSource` to `com.mysql.cj.jdbc.MysqlConnectionPoolDataSource`
- **MysqlXADataSource**: from `com.mysql.jdbc.jdbc2.optional.MysqlXADataSource` to `com.mysql.cj.jdbc.MysqlXADataSource`
- **MysqlXid**: from `com.mysql.jdbc.jdbc2.optional.MysqlXid` to `com.mysql.cj.jdbc.MysqlXid`

Changes for Build Properties

A number of Ant properties for [building Connector/J from source](#) have been renamed; see [Table 3.2, “Changes with the Build Properties from Connector/J 5.1 to 8.0”](#)

Table 3.2 Changes with the Build Properties from Connector/J 5.1 to 8.0

Old name	New name
<code>com.mysql.jdbc.extra.libs</code>	<code>com.mysql.cj.extra.libs</code>
<code>com.mysql.jdbc.jdk</code>	<code>com.mysql.cj.build.jdk</code>
<code>debug.enable</code>	<code>com.mysql.cj.build.addDebugInfo</code>
<code>com.mysql.jdbc.noCleanBetweenCompiles</code>	<code>com.mysql.cj.build.noCleanBetweenCompiles</code>
<code>com.mysql.jdbc.commercialBuild</code>	<code>com.mysql.cj.build.commercial</code>
<code>com.mysql.jdbc.filterLicense</code>	<code>com.mysql.cj.build.filterLicense</code>
<code>com.mysql.jdbc.noCryptoBuild</code>	<code>com.mysql.cj.build.noCrypto</code>
<code>com.mysql.jdbc.noSources</code>	<code>com.mysql.cj.build.noSources</code>
<code>com.mysql.jdbc.noMavenSources</code>	<code>com.mysql.cj.build.noMavenSources</code>
<code>major_version</code>	<code>com.mysql.cj.build.driver.version.major</code>
<code>minor_version</code>	<code>com.mysql.cj.build.driver.version.minor</code>
<code>subminor_version</code>	<code>com.mysql.cj.build.driver.version.subminor</code>
<code>version_status</code>	<code>com.mysql.cj.build.driver.version.status</code>
<code>extra.version</code>	<code>com.mysql.cj.build.driver.version.extra</code>
<code>snapshot.version</code>	<code>com.mysql.cj.build.driver.version.snapshot</code>
<code>version</code>	<code>com.mysql.cj.build.driver.version</code>
<code>full.version</code>	<code>com.mysql.cj.build.driver.version.full</code>
<code>prodDisplayName</code>	<code>com.mysql.cj.build.driver.displayName</code>
<code>prodName</code>	<code>com.mysql.cj.build.driver.name</code>
<code>fullProdName</code>	<code>com.mysql.cj.build.driver.fullName</code>

Old name	New name
buildDir	com.mysql.cj.build.dir
buildDriverDir	com.mysql.cj.build.dir.driver
mavenUploadDir	com.mysql.cj.build.dir.maven
distDir	com.mysql.cj.dist.dir
toPackage	com.mysql.cj.dist.dir.prepare
packageDest	com.mysql.cj.dist.dir.package
com.mysql.jdbc.docs.sourceDir	com.mysql.cj.dist.dir.prebuilt.docs

Change for Test Properties

A number of Ant properties for [testing Connector/J](#) have been renamed or removed; see [Table 3.3, "Changes with the Test Properties from Connector/J 5.1 to 8.0"](#)

Table 3.3 Changes with the Test Properties from Connector/J 5.1 to 8.0

Old name	New name
buildTestDir	com.mysql.cj.testsuite.build.dir
junit.results	com.mysql.cj.testsuite.junit.results
com.mysql.jdbc.testsuite.jvm	com.mysql.cj.testsuite.jvm
test	com.mysql.cj.testsuite.test.class
methods	com.mysql.cj.testsuite.test.methods
com.mysql.jdbc.testsuite.url	com.mysql.cj.testsuite.url
com.mysql.jdbc.testsuite.admin-url	com.mysql.cj.testsuite.url.admin
com.mysql.jdbc.testsuite.ClusterUrl	com.mysql.cj.testsuite.url.cluster
com.mysql.jdbc.testsuite.url.sha256def	com.mysql.cj.testsuite.url.openssl
com.mysql.jdbc.testsuite.cantGrant	com.mysql.cj.testsuite.cantGrant
com.mysql.jdbc.testsuite.no-multi-hosts-tests	com.mysql.cj.testsuite.disable.multihost.tests
com.mysql.jdbc.test.ds.host	com.mysql.cj.testsuite.ds.host
com.mysql.jdbc.test.ds.port	com.mysql.cj.testsuite.ds.port
com.mysql.jdbc.test.ds.db	com.mysql.cj.testsuite.ds.db
com.mysql.jdbc.test.ds.user	com.mysql.cj.testsuite.ds.user
com.mysql.jdbc.test.ds.password	com.mysql.cj.testsuite.ds.password
com.mysql.jdbc.test.tablename	com.mysql.cj.testsuite.loadstoreperf.tablename
com.mysql.jdbc.testsuite.loadstoreperf	com.mysql.cj.testsuite.loadstoreperf.useBigResultSets
com.mysql.jdbc.testsuite.MiniAdminTest	com.mysql.cj.testsuite.miniAdminTest.runShutdown
com.mysql.jdbc.testsuite.noDebugOutput	com.mysql.cj.testsuite.noDebugOutput
com.mysql.jdbc.testsuite.retainArtifacts	com.mysql.cj.testsuite.retainArtifacts
com.mysql.jdbc.testsuite.runLongTests	com.mysql.cj.testsuite.runLongTests
com.mysql.jdbc.test.ServerController.basedir	com.mysql.cj.testsuite.serverController.basedir
com.mysql.jdbc.ReplicationConnection.isShared	com.mysql.cj.testsuite.replicationConnection.isShared
com.mysql.jdbc.test.isLocalHostnameRep	Removed
com.mysql.jdbc.testsuite.driver	Removed
com.mysql.jdbc.testsuite.url.default	Removed. No longer needed, as multi-JVM tests have been removed from the test suite.

Changes for Exceptions

Some exceptions have been removed from Connector/J going from version 5.1 to 8.0. Applications that used to catch the removed exceptions should now catch the corresponding exceptions listed in [Table 3.4](#) below.

Note

Some of these Connector/J 5.1 exceptions are duplicated in the com.mysql.jdbc.exception.jdbc4 package; that is indicated by “[jdbc4.]” in their names in [Table 3.4](#).

Table 3.4 Changes for Exceptions from Connector/J 5.1 to 8.0

Removed Exception in Connector/J 5.1
com.mysql.jdbc.exceptions.jdbc4.CommunicationsException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLDataException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLIntegrityConstraintViolationException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLInvalidAuthorizationSpecException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLNonTransientConnectionException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLNonTransientException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLQueryInterruptedException
com.mysql.jdbc.exceptions.MySQLStatementCancelledException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLSyntaxErrorException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLTimeoutException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLTransactionRollbackException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLTransientConnectionException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLTransientException
com.mysql.jdbc.exceptions.[jdbc4.]MySQLIntegrityConstraintViolationException

Other Changes

Here are other changes with Connector/J 8.0:

- Removed [ReplicationDriver](#). Instead of using a separate driver, you can now obtain a connection for a replication setup just by using the `jdbc:mysql:replication://` scheme.
- See [Section 3.3, “Connector/J Installation”](#) for [third-party libraries required for Connector/J 8.0 to work](#).
- Connector/J 8.0 always performs time offset adjustments on date-time values, and the adjustments require one of the following to be true:
 - The MySQL server is configured with a canonical time zone that is recognizable by Java (for example, Europe/Paris, Etc/GMT-5, UTC, etc.)
 - The server's time zone is overridden by setting the Connector/J connection property `serverTimezone` (for example, `serverTimezone=Europe/Paris`).

3.3.5 Testing Connector/J

The Connector/J source code repository or packages that are shipped with source code include an extensive test suite, containing test cases that can be executed independently. The test cases are divided into the following categories:

- *Unit tests*: They are methods located in packages aligning with the classes that they test.

- *Functional tests*: Classes from the package `testsuite.simple`. Include test code for the main features of Connector/J.
- *Performance tests*: Classes from the package `testsuite.perf`. Include test code to make measurements for the performance of Connector/J.
- *Regression tests*: Classes from the package `testsuite.regression`. Includes code for testing bug and regression fixes.
- *X DevAPI and X Protocol tests*: Classes from the package `testsuite.x` for testing X DevAPI and X Protocol functionality.

The bundled Ant build file contains targets like `test`, which can facilitate the process of running the Connector/J tests; see the target descriptions in the build file for details. Besides the requirements for building Connector/J from the source code described in [Section 3.3.3, “Installing from Source”](#), a number of the tests also require the File System Service Provider 1.2 for the Java Naming and Directory Interface (JNDI), available at <http://www.oracle.com/technetwork/java/javasebusiness/downloads/java-archive-downloads-java-plat-419418.html>)—place the jar files downloaded from there into the `lib` directory or in the directory pointed to by the property `com.mysql.cj.extra.libs`.

To run the test using Ant, in addition to the properties required for [Section 3.3.3, “Installing from Source”](#), you must set the following properties in the `build.properties` file or through the Ant `-D` options:

- `com.mysql.cj.testsuite.jvm`: the JVM to be used for the tests. If the property is not set, the JVM supplied with `com.mysql.cj.build.jdk` will be used.
- `com.mysql.cj.testsuite.url`: it specifies the JDBC URL for connection to a MySQL test server; see [Section 3.5.2, “Connection URL Syntax”](#).
- `com.mysql.cj.testsuite.url.openssl`: it specifies the JDBC URL for connection to a MySQL test server compiled with OpenSSL; see [Section 3.5.2, “Connection URL Syntax”](#).
- `com.mysql.cj.testsuite.mysqlx.url`: it specifies the X DevAPI URL for connection to a MySQL test server; see [Section 3.5.2, “Connection URL Syntax”](#).
- `com.mysql.cj.testsuite.mysqlx.url.openssl`: it specifies the X DevAPI URL for connection to a MySQL test server compiled with OpenSSL; see [Section 3.5.2, “Connection URL Syntax”](#).

After setting these parameters, run the tests with Ant in the following ways:

- Building the `test` target with `ant test` runs all test cases by default on a single server instance. If you want to run a particular test case, put the test's fully qualified class names in the `com.mysql.cj.testsuite.test.class` variable; for example:

```
shell > ant -Dcom.mysql.cj.testsuite.test.class=testsuite.simple.StringUtilsTest test
```

You can also run individual tests in a test case by specifying the names of the corresponding methods in the `com.mysql.cj.testsuite.test.methods` variable, separating multiple methods by commas; for example:

```
shell > ant -Dcom.mysql.cj.testsuite.test.class=testsuite.simple.StringUtilsTest \
-Dcom.mysql.cj.testsuite.test.methods=testIndexOfIgnoreCase,testGetBytes test
```

While the test results are partially reported by the console, complete reports in HTML and XML formats are provided. View the HTML report by opening `buildtest/junit/report/index.html`. XML version of the reports are located in the folder `buildtest/junit`.

Note

Going from Connector/J 5.1 to 8.0, a number of Ant properties for testing Connector/J have been renamed or removed; see [Change for Test Properties](#) for details.

3.4 Connector/J Examples

Examples of using Connector/J are located throughout this document. This section provides a summary and links to these examples.

- Example 3.1, “Connector/J: Obtaining a connection from the `DriverManager`”
- Example 3.2, “Connector/J: Using `java.sql.Statement` to execute a `SELECT` query”
- Example 3.3, “Connector/J: Calling Stored Procedures”
- Example 3.4, “Connector/J: Using `Connection.prepareStatement()`”
- Example 3.5, “Connector/J: Registering output parameters”
- Example 3.6, “Connector/J: Setting `CallableStatement` input parameters”
- Example 3.7, “Connector/J: Retrieving results and output parameter values”
- Example 3.8, “Connector/J: Retrieving `AUTO_INCREMENT` column values using `Statement.getGeneratedKeys()`”
- Example 3.9, “Connector/J: Retrieving `AUTO_INCREMENT` column values using `SELECT LAST_INSERT_ID()`”
- Example 3.10, “Connector/J: Retrieving `AUTO_INCREMENT` column values in `UpdatableResultSets`”
- Example 3.11, “Connector/J: Using a connection pool with a J2EE application server”
- Example 3.12, “Connector/J: Example of transaction with retry logic”

3.5 Connector/J Reference

This section of the manual contains reference material for MySQL Connector/J.

3.5.1 Driver/Datasource Class Name

The name of the class that implements `java.sql.Driver` in MySQL Connector/J is `com.mysql.cj.jdbc.Driver`.

3.5.2 Connection URL Syntax

This section explains the syntax of the URLs for connecting to MySQL.

This is the generic format of the connection URL:

```
protocol://[hosts][/database][?properties]
```

The URL consists of the following parts:

Important

Any reserved characters for URLs (for example, `/`, `:`, `@`, `(`, `)`, `[`, `]`, `&`, `#`, `=`, `?`, and space) that appear in any part of the connection URL must be percent encoded.

protocol

There are the possible protocols for a connection:

- `jdbc:mysql`: is for ordinary and basic JDBC failover connections.
- `jdbc:mysql:loadbalance`: is for load-balancing JDBC connections. See [Section 3.8.3, “Configuring Load Balancing with Connector/J”](#) for details.

- `jdbc:mysql:replication`: is for JDBC replication connections. See [Section 3.8.4, “Configuring Master/Slave Replication with Connector/J”](#) for details.
- `mysqlx`: is for X DevAPI connections.
- `jdbc:mysql+srv`: is for ordinary and basic failover JDBC connections that make use of DNS SRV records.
- `jdbc:mysql+srv:loadbalance`: is for load-balancing JDBC connections that make use of DNS SRV records.
- `jdbc:mysql+srv:replication`: is for replication JDBC connections that make use of DNS SRV records.
- `mysqlx+srv`: is for X DevAPI connections that make use of DNS SRV records.

hosts

Depending on the situation, the `hosts` part may consist simply of a host name, or it can be a complex structure consisting of various elements like multiple host names, port numbers, host-specific properties, and user credentials.

- Single host:

- Single-host connections without adding host-specific properties:

- The `hosts` part is written in the format of `host:port`. This is an example of a simple single-host connection URL:

```
jdbc:mysql://host1:33060/sakila
```

- `host` can be an IPv4 or an IPv6 host name string, and in the latter case it must be put inside square brackets, for example “[1000:2000::abcd]”. When `host` is not specified, the default value of `localhost` is used.
 - `port` is a standard port number, i.e., an integer between 1 and 65535. The default port number for an ordinary MySQL connection is 3306, and it is 33060 for a connection using the X Protocol. If `port` is not specified, the corresponding default is used.

- Single-host connections adding host-specific properties:

- In this case, the host is defined as a succession of `key=value` pairs. Keys are used to identify the host, the port, as well as any host-specific properties. There are two alternate formats for specifying keys:

- The “address-equals” form:

```
address=(host=host_or_ip)(port=port)(key1=value1)(key2=value2)...(keyN=valueN)
```

Here is a sample URL using the “address-equals” form :

```
jdbc:mysql://address=(host=myhost)(port=1111)(key1=value1)/db
```

- The “key-value” form:

```
(host=host,port=port,key1=value1,key2=value2,...,keyN=valueN)
```

Here is a sample URL using the “key-value” form :

```
jdbc:mysql://(host=myhost,port=1111,key1=value1)/db
```

- The host and the port are identified by the keys `host` and `port`. The descriptions of the format and default values of `host` and `port` in [Single host without host-specific properties \[42\]](#) above also apply here.

- Other keys that can be added include `user`, `password`, `protocol`, and so on. They override the global values set in the [properties part of the URL](#). Limit the overrides to user, password, network timeouts, and statement and metadata cache sizes; the effects of other per-host overrides are not defined.
- Different protocols may require different keys. For example, the `mysqlx`: scheme uses two special keys, `address` and `priority`. `address` is a `host:port` pair and `priority` an integer. For example:

```
mysqlx://(address=host:1111,priority=1,key1=value1)/db
```

- `key` is case-sensitive. Two keys differing in case only are considered conflicting, and there are no guarantees on which one will be used.
- Multiple hosts

There are two formats for specifying multiple hosts:

- List hosts in a comma-separated list:

```
host1,host2,...,hostN
```

Each host can be specified in any of the three ways described in [Single host \[42\]](#) above. Here are some examples:

```
jdbc:mysql://myhost1:1111,myhost2:2222/db  
jdbc:mysql://address=(host=myhost1)(port=1111)(key1=value1),address=(host=myhost2)(port=2222)(key2=value2)/db  
jdbc:mysql://(host=myhost1,port=1111,key1=value1),(host=myhost2,port=2222,key2=value2)/db  
jdbc:mysql://myhost1:1111,(host=myhost2,port=2222,key2=value2)/db  
mysqlx://(address=host1:1111,priority=1,key1=value1),(address=host2:2222,priority=2,key2=value2)/db
```

- List hosts in a comma-separated list, and then encloses the list by square brackets:

```
[host1,host2,...,hostN]
```

This is called the host sublist form, which allows sharing of the [user credentials](#) by all hosts in the list as if they are a single host. Each host in the list can be specified in any of the three ways described in [Single host \[42\]](#) above. Here are some examples:

```
jdbc:mysql://sandy:secret@[myhost1:1111,myhost2:2222]/db  
jdbc:mysql://sandy:secret@[address=(host=myhost1)(port=1111)(key1=value1),address=(host=myhost2)(port=2222)(key2=value2)]/db  
jdbc:mysql://sandy:secret@[myhost1:1111,address=(host=myhost2)(port=2222)(key2=value2)]/db
```

While it is not possible to write host sublists recursively, a host list may contain host sublists as its member hosts.

- User credentials

User credentials can be set outside of the connection URL—for example, as arguments when getting a connection from the `java.sql.DriverManager` (see [Section 3.5.3, “Configuration Properties”](#) for details). When set with the connection URL, there are several ways to specify them:

- Prefix the a single host, a host sublist (see [Multiple hosts \[43\]](#)), or any host in a list of hosts with the user credentials with an `@`:

```
user:password@host_or_host_sublist
```

For example:

```
mysqlx://sandy:secret@[ (address=host1:1111,priority=1,key1=value1),(address=host2:2222,priority=2,k
```

- Use the keys `user` and `password` to specify credentials for each host:

```
(user=sandy)(password=mypass)
```

For example:

```
jdbc:mysql://[(host=myhost1,port=1111,user=sandy,password=secret),(host=myhost2,port=2222,user=finn,password=secret)]  
jdbc:mysql://address=(host=myhost1)(port=1111)(user=sandy)(password=secret),address=(host=myhost2)(port=2222)
```

In both forms, when multiple user credentials are specified, the one to the left takes precedence—that is, going from left to right in the connection string, the first one found that is applicable to a host is the one that is used.

Inside a host sublist, no host can have user credentials in the @ format, but individual host can have user credentials specified in the key format.

database

The default database or catalog to open. If the database is not specified, the connection is made with no default database. In this case, either call the `setCatalog()` method on the `Connection` instance, or specify table names using the database name (that is, `SELECT dbname.tablename.colname FROM dbname.tablename...`) in your SQL statements. Opening a connection without specifying the database to use is, in general, only useful when building tools that work with multiple databases, such as GUI database managers.

Note

Always use the `Connection.setCatalog()` method to specify the desired database in JDBC applications, rather than the `USE database` statement.

properties

A succession of global properties applying to all hosts, preceded by ? and written as `key=value` pairs separated by the symbol “&.” Here are some examples:

```
jdbc:mysql://(host=myhost1,port=1111),(host=myhost2,port=2222)/db?key1=value1&key2=value2&key3=value3
```

The following are true for the key-value pairs:

- `key` and `value` are just strings. Proper type conversion and validation are performed internally in Connector/J.
- `key` is case-sensitive. Two keys differing in case only are considered conflicting, and it is uncertain which one will be used.
- Any host-specific values specified with key-value pairs as explained in [Single host with host-specific properties \[42\]](#) and [Multiple hosts \[43\]](#) above override the global values set here.

See [Section 3.5.3, “Configuration Properties”](#) for details about the configuration properties.

3.5.3 Configuration Properties

Configuration properties define how Connector/J will make a connection to a MySQL server. Unless otherwise noted, properties can be set for a `DataSource` object or for a `Connection` object.

Configuration properties can be set in one of the following ways:

- Using the `set*()` methods on MySQL implementations of `java.sql.DataSource` (which is the preferred method when using implementations of `java.sql.DataSource`):
 - `com.mysql.cj.jdbc.MysqlDataSource`
 - `com.mysql.cj.jdbc.MysqlConnectionPoolDataSource`
- As a key-value pair in the `java.util.Properties` instance passed to `DriverManager.getConnection()` or `Driver.connect()`

- As a JDBC URL parameter in the URL given to `java.sql.DriverManager.getConnection()`, `java.sql.Driver.connect()` or the MySQL implementations of the `javax.sql.DataSource.setURL()` method. If you specify a configuration property in the URL without providing a value for it, nothing will be set; for example, adding `useServerPrepStmts` alone to the URL does not make Connector/J use server-side prepared statements; you need to add `useServerPrepStmts=true`.

Note

If the mechanism you use to configure a JDBC URL is XML-based, use the XML character literal `&` to separate configuration parameters, as the ampersand is a reserved character for XML.

The properties are listed in the following tables.

Authentication.

Properties and Descriptions	
user	The user to connect as
	Since version: all versions
password	The password to use when connecting
	Since version: all versions

Connection.

Properties and Descriptions	
connectionAttributes	A comma-delimited list of user-defined key:value pairs (in addition to standard MySQL-defined key:value pairs) to be passed to MySQL Server for display as connection attributes in the PERFORMANCE_SCHEMA.SESSION_CONNECT_ATTRS table. Example usage: <code>connectionAttributes=key1:value1,key2:value2</code> This functionality is available for use with MySQL Server version 5.6 or later only. Earlier versions of MySQL Server do not support connection attributes, causing this configuration option to be ignored. Setting <code>connectionAttributes=none</code> will cause connection attribute processing to be bypassed, for situations where Connection creation/initialization speed is critical.
	Since version: 5.1.25
connectionLifecycleInterceptors	A comma-delimited list of classes that implement <code>"com.mysql.cj.jdbc.interceptors.ConnectionLifecycleInterceptor"</code> that should be notified of connection lifecycle events (creation, destruction, commit, rollback, setting the current database and changing the autocommit mode) and potentially alter the execution of these commands. <code>ConnectionLifecycleInterceptors</code> are "stackable", more than one interceptor may be specified via the configuration property as a comma-delimited list, with the interceptors executed in order from left to right.
	Since version: 5.1.4
useConfigs	Load the comma-delimited list of configuration properties before parsing the URL or applying user-specified properties. These configurations are explained in the 'Configurations' of the documentation.

Properties and Descriptions
Since version: 3.1.5
authenticationPlugins
Comma-delimited list of classes that implement com.mysql.cj.protocol.AuthenticationPlugin and which will be used for authentication unless disabled by "disabledAuthenticationPlugins" property.
Since version: 5.1.19
clientInfoProvider
The name of a class that implements the com.mysql.cj.jdbc.ClientInfoProvider interface in order to support JDBC-4.0's Connection.getClientInfo() methods
Default: com.mysql.cj.jdbc.CommentClientInfoProvider
Since version: 5.1.0
createDatabaseIfNotExist
Creates the database given in the URL if it doesn't yet exist. Assumes the configured user has permissions to create databases.
Default: false
Since version: 3.1.9
databaseTerm
MySQL uses the term "schema" as a synonym of the term "database," while Connector/J historically takes the JDBC term "catalog" as synonymous to "database". This property sets for Connector/J which of the JDBC terms "catalog" and "schema" is used in an application to refer to a database. The property takes one of the two values CATALOG or SCHEMA and uses it to determine (1) which Connection methods can be used to set/get the current database (e.g. setCatalog() or setSchema()?), (2) which arguments can be used within the various DatabaseMetaData methods to filter results (e.g. the catalog or schemaPattern argument of getColumns()?), and (3) which fields in the ResultSet returned by DatabaseMetaData methods contain the database identification information (i.e., the TABLE_CAT or TABLE_SCHEMA field in the ResultSet returned by getTables()?).
If databaseTerm=CATALOG, schemaPattern for searches are ignored and calls of schema methods (like setSchema() or get Schema()) become no-ops, and vice versa.
Default: CATALOG
Since version: 8.0.17
defaultAuthenticationPlugin
Name of a class implementing com.mysql.cj.protocol.AuthenticationPlugin which will be used as the default authentication plugin (see below). It is an error to use a class which is not listed in "authenticationPlugins" nor is it one of the built-in plugins. It is an error to set as default a plugin which was disabled with "disabledAuthenticationPlugins" property. It is an error to set this value to null or the empty string (i.e. there must be at least a valid default authentication plugin specified for the connection, meeting all constraints listed above).
Default: com.mysql.cj.protocol.a.authentication.MySQLNativePasswordPlugin
Since version: 5.1.19
detectCustomCollations

Properties and Descriptions
Should the driver detect custom charsets/collations installed on server (true/false, defaults to 'false'). If this option set to 'true' driver gets actual charsets/collations from server each time connection establishes. This could slow down connection initialization significantly.
Default: false
Since version: 5.1.29
disabledAuthenticationPlugins
Comma-delimited list of classes implementing com.mysql.cj.protocol.AuthenticationPlugin or mechanisms, i.e. "mysql_native_password". The authentication plugins or mechanisms listed will not be used for authentication which will fail if it requires one of them. It is an error to disable the default authentication plugin (either the one named by "defaultAuthenticationPlugin" property or the hard-coded one if "defaultAuthenticationPlugin" property is not set).
Since version: 5.1.19
disconnectOnExpiredPasswords
If "disconnectOnExpiredPasswords" is set to "false" and password is expired then server enters "sandbox" mode and sends ERR(08001, ER_MUST_CHANGE_PASSWORD) for all commands that are not needed to set a new password until a new password is set.
Default: true
Since version: 5.1.23
interactiveClient
Set the CLIENT_INTERACTIVE flag, which tells MySQL to timeout connections based on INTERACTIVE_TIMEOUT instead of WAIT_TIMEOUT
Default: false
Since version: 3.1.0
passwordCharacterEncoding
What character encoding is used for passwords? Leaving this set to the default value (null), uses the value set in "characterEncoding" if there is one, otherwise uses UTF-8 as default encoding. If the password contains non-ASCII characters, the password encoding must match what server encoding was set to when the password was created. For passwords in other character encodings, the encoding will have to be specified with this property (or with "characterEncoding"), as it's not possible for the driver to auto-detect this.
Since version: 5.1.7
propertiesTransform
An implementation of com.mysql.cj.conf.ConnectionPropertiesTransform that the driver will use to modify URL properties passed to the driver before attempting a connection
Since version: 3.1.4
rollbackOnPooledClose
Should the driver issue a rollback() when the logical connection in a pool is closed?
Default: true
Since version: 3.0.15

Properties and Descriptions**useAffectedRows**

Don't set the CLIENT_FOUND_ROWS flag when connecting to the server (not JDBC-compliant, will break most applications that rely on "found" rows vs. "affected rows" for DML statements), but does cause "correct" update counts from "INSERT ... ON DUPLICATE KEY UPDATE" statements to be returned by the server.

Default: false

Since version: 5.1.7

Session.**Properties and Descriptions****sessionVariables**

A comma or semicolon separated list of name=value pairs to be sent as SET [SESSION] ... to the server when the driver connects.

Since version: 3.1.8

characterEncoding

What character encoding should the driver use when dealing with strings? (defaults is to 'autodetect')

Since version: 1.1g

characterSetResults

Character set to tell the server to return results as.

Since version: 3.0.13

connectionCollation

If set, tells the server to use this collation in SET NAMES charset COLLATE connectionCollation. Also overrides the characterEncoding with those corresponding to the character set of this collation.

Since version: 3.0.13

Networking.**Properties and Descriptions****socksProxyHost**

Name or IP address of SOCKS host to connect through.

Since version: 5.1.34

socksProxyPort

Port of SOCKS server.

Default: 1080

Since version: 5.1.34

socketFactory

The name of the class that the driver should use for creating socket connections to the server. This class must implement the interface 'com.mysql.cj.protocol.SocketFactory' and have public no-args constructor.

Properties and Descriptions
Default: com.mysql.cj.protocol.StandardSocketFactory
Since version: 3.0.3
connectTimeout
Timeout for socket connect (in milliseconds), with 0 being no timeout. Only works on JDK-1.4 or newer. Defaults to '0'.
Default: 0
Since version: 3.0.1
socketTimeout
Timeout (in milliseconds) on network socket operations (0, the default means no timeout).
Default: 0
Since version: 3.0.1
dnsSrv
Should the driver use the given host name to lookup for DNS SRV records and use the resulting list of hosts in a multi-host failover connection? Note that a single host name and no port must be provided when this option is enabled.
Default: false
Since version: 8.0.19
localSocketAddress
Hostname or IP address given to explicitly configure the interface that the driver will bind the client side of the TCP/IP connection to when connecting.
Since version: 5.0.5
maxAllowedPacket
Maximum allowed packet size to send to server. If not set, the value of system variable 'max_allowed_packet' will be used to initialize this upon connecting. This value will not take effect if set larger than the value of 'max_allowed_packet'. Also, due to an internal dependency with the property "blobSendChunkSize", this setting has a minimum value of "8203" if "useServerPrepStmts" is set to "true".
Default: 65535
Since version: 5.1.8
tcpKeepAlive
If connecting using TCP/IP, should the driver set SO_KEEPALIVE?
Default: true
Since version: 5.0.7
tcpNoDelay
If connecting using TCP/IP, should the driver set SO_TCP_NODELAY (disabling the Nagle Algorithm)?
Default: true

Properties and Descriptions
Since version: 5.0.7
tcpRcvBuf
If connecting using TCP/IP, should the driver set SO_RCV_BUF to the given value? The default value of '0', means use the platform default value for this property)
Default: 0
Since version: 5.0.7
tcpSndBuf
If connecting using TCP/IP, should the driver set SO SND BUF to the given value? The default value of '0', means use the platform default value for this property)
Default: 0
Since version: 5.0.7
tcpTrafficClass
If connecting using TCP/IP, should the driver set traffic class or type-of-service fields ?See the documentation for java.net.Socket.setTrafficClass() for more information.
Default: 0
Since version: 5.0.7
useCompression
Use zlib compression when communicating with the server (true/false)? Defaults to 'false'.
Default: false
Since version: 3.0.17
useUnbufferedInput
Don't use BufferedInputStream for reading data from the server
Default: true
Since version: 3.0.11

Security.

Properties and Descriptions
allowMultiQueries
Allow the use of ';' to delimit multiple queries during one statement (true/false). Default is 'false', and it does not affect the addBatch() and executeBatch() methods, which rely on rewriteBatchStatements instead.
Default: false
Since version: 3.1.1
useSSL
For 8.0.12 and earlier: Use SSL when communicating with the server (true/false), default is 'true' when connecting to MySQL 5.5.45+, 5.6.26+ or 5.7.6+, otherwise default is 'false'.
For 8.0.13 and later: Default is 'true'. DEPRECATED. See sslMode property description for details.

Properties and Descriptions
Default: true
Since version: 3.0.2
requireSSL
For 8.0.12 and earlier: Require server support of SSL connection if useSSL=true? (defaults to 'false').
For 8.0.13 and later: DEPRECATED. See sslMode property description for details.
Default: false
Since version: 3.1.0
verifyServerCertificate
For 8.0.12 and earlier: If "useSSL" is set to "true", should the driver verify the server's certificate? When using this feature, the keystore parameters should be specified by the "clientCertificateKeyStore*" properties, rather than system properties. Default is 'false' when connecting to MySQL 5.5.45+, 5.6.26+ or 5.7.6+ and "useSSL" was not explicitly set to "true". Otherwise default is 'true'.
For 8.0.13 and later: Default is 'false'. DEPRECATED. See sslMode property description for details.
Default: false
Since version: 5.1.6
clientCertificateKeyStoreUrl
URL to the client certificate KeyStore (if not specified, use defaults)
Since version: 5.1.0
clientCertificateKeyStoreType
KeyStore type for client certificates (NULL or empty means use the default, which is "JKS". Standard keystore types supported by the JVM are "JKS" and "PKCS12", your environment may have more available depending on what security products are installed and available to the JVM.
Default: JKS
Since version: 5.1.0
clientCertificateKeyStorePassword
Password for the client certificates KeyStore
Since version: 5.1.0
trustCertificateKeyStoreUrl
URL to the trusted root certificate KeyStore (if not specified, use defaults)
Since version: 5.1.0
trustCertificateKeyStoreType
KeyStore type for trusted root certificates (NULL or empty means use the default, which is "JKS". Standard keystore types supported by the JVM are "JKS" and "PKCS12", your environment may have more available depending on what security products are installed and available to the JVM.
Default: JKS

Properties and Descriptions
Since version: 5.1.0
trustCertificateKeyStorePassword
Password for the trusted root certificates KeyStore
Since version: 5.1.0
enabledSSLCipherSuites
If "useSSL" is set to "true", overrides the cipher suites enabled for use on the underlying SSL sockets. This may be required when using external JSSE providers or to specify cipher suites compatible with both MySQL server and used JVM.
Since version: 5.1.35
enabledTLSProtocols
If "useSSL" is set to "true", overrides the TLS protocols enabled for use on the underlying SSL sockets. This may be used to restrict connections to specific TLS versions.
Since version: 8.0.8
allowLoadLocalInfile
Should the driver allow use of 'LOAD DATA LOCAL INFILE...'? Default: false
Since version: 3.0.3
allowUrlInLocalInfile
Should the driver allow URLs in 'LOAD DATA LOCAL INFILE' statements? Default: false
Since version: 3.1.4
allowPublicKeyRetrieval
Allows special handshake roundtrip to get server RSA public key directly from server. Default: false
Since version: 5.1.31
paranoid
Take measures to prevent exposure sensitive information in error messages and clear data structures holding sensitive data when possible? (defaults to 'false') Default: false
Since version: 3.0.1
serverRSAPublicKeyFile
File path to the server RSA public key file for sha256_password authentication. If not specified, the public key will be retrieved from the server. Since version: 5.1.31
sslMode

Properties and Descriptions
<p>By default, network connections are SSL encrypted; this property permits secure connections to be turned off, or a different levels of security to be chosen. The following values are allowed: "DISABLED" - Establish unencrypted connections; "PREFERRED" - (default) Establish encrypted connections if the server enabled them, otherwise fall back to unencrypted connections; "REQUIRED" - Establish secure connections if the server enabled them, fail otherwise; "VERIFY_CA" - Like "REQUIRED" but additionally verify the server TLS certificate against the configured Certificate Authority (CA) certificates; "VERIFY_IDENTITY" - Like "VERIFY_CA", but additionally verify that the server certificate matches the host to which the connection is attempted.</p> <p>This property replaced the deprecated legacy properties "useSSL", "requireSSL", and "verifyServerCertificate", which are still accepted but translated into a value for "sslMode" if "sslMode" is not explicitly set: "useSSL=false" is translated to "sslMode=DISABLED"; {"useSSL=true", "requireSSL=false", "verifyServerCertificate=false"} is translated to "sslMode=PREFERRED"; {"useSSL=true", "requireSSL=true", "verifyServerCertificate=false"} is translated to "sslMode=REQUIRED"; {"useSSL=true" AND "verifyServerCertificate=true"} is translated to "sslMode=VERIFY_CA". There is no equivalent legacy settings for "sslMode=VERIFY_IDENTITY". Note that, for ALL server versions, the default setting of "sslMode" is "PREFERRED", and it is equivalent to the legacy settings of "useSSL=true", "requireSSL=false", and "verifyServerCertificate=false", which are different from their default settings for Connector/J 8.0.12 and earlier in some situations. Applications that continue to use the legacy properties and rely on their old default settings should be reviewed.</p> <p>The legacy properties are ignored if "sslMode" is set explicitly. If none of "sslMode" or "useSSL" is set explicitly, the default setting of "sslMode=PREFERRED" applies.</p> <p>Default: PREFERRED</p> <p>Since version: 8.0.13</p>

Statements.

Properties and Descriptions
<p>continueBatchOnError</p> <p>Should the driver continue processing batch commands if one statement fails. The JDBC spec allows either way (defaults to 'true').</p> <p>Default: true</p> <p>Since version: 3.0.3</p>
<p>dontTrackOpenResources</p> <p>The JDBC specification requires the driver to automatically track and close resources, however if your application doesn't do a good job of explicitly calling close() on statements or result sets, this can cause memory leakage. Setting this property to true relaxes this constraint, and can be more memory efficient for some applications. Also the automatic closing of the Statement and current ResultSet in Statement.closeOnCompletion() and Statement.getMoreResults ([Statement.CLOSE_CURRENT_RESULT Statement.CLOSE_ALL_RESULTS]), respectively, ceases to happen. This property automatically sets holdResultsOpenOverStatementClose=true.</p> <p>Default: false</p> <p>Since version: 3.1.7</p>
<p>queryInterceptors</p> <p>A comma-delimited list of classes that implement "com.mysql.cj.interceptors.QueryInterceptor" that should be placed "in between" query execution to influence the results. QueryInterceptors are</p>

Properties and Descriptions
"chainable", the results returned by the "current" interceptor will be passed on to the next in the chain, from left-to-right order, as specified in this property.
Since version: 8.0.7
queryTimeoutKillsConnection
If the timeout given in Statement.setQueryTimeout() expires, should the driver forcibly abort the Connection instead of attempting to abort the query?
Default: false
Since version: 5.1.9

Prepared Statements.

Properties and Descriptions
allowNaNAndInf
Should the driver allow NaN or +/- INF values in PreparedStatement.setDouble()?
Default: false
Since version: 3.1.5
autoClosePStmtStreams
Should the driver automatically call .close() on streams/readers passed as arguments via set*() methods?
Default: false
Since version: 3.1.12
compensateOnDuplicateKeyUpdateCounts
Should the driver compensate for the update counts of "ON DUPLICATE KEY" INSERT statements (2 = 1, 0 = 1) when using prepared statements?
Default: false
Since version: 5.1.7
emulateUnsupportedPstmts
Should the driver detect prepared statements that are not supported by the server, and replace them with client-side emulated versions?
Default: true
Since version: 3.1.7
generateSimpleParameterMetadata
Should the driver generate simplified parameter metadata for PreparedStatements when no metadata is available either because the server couldn't support preparing the statement, or server-side prepared statements are disabled?
Default: false
Since version: 5.0.5
processEscapeCodesForPrepStmts

Properties and Descriptions
Should the driver process escape codes in queries that are prepared? Default escape processing behavior in non-prepared statements must be defined with the property 'enableEscapeProcessing'. Default: true
Since version: 3.1.12
useServerPrepStmts
Use server-side prepared statements if the server supports them? Default: false
Since version: 3.1.0
useStreamLengthsInPrepStmts
Honor stream length parameter in PreparedStatement/ResultSet.setXXXStream() method calls (true/false, defaults to 'true')? Default: true
Since version: 3.0.2

Result Sets.

Properties and Descriptions
clobberStreamingResults
This will cause a 'streaming' ResultSet to be automatically closed, and any outstanding data still streaming from the server to be discarded if another query is executed before all the data has been read from the server. Default: false
Since version: 3.0.9
emptyStringsConvertToZero
Should the driver allow conversions from empty string fields to numeric values of '0'? Default: true
Since version: 3.1.8
holdResultsOpenOverStatementClose
Should the driver close result sets on Statement.close() as required by the JDBC specification? Default: false
Since version: 3.1.7
jdbcCompliantTruncation
Should the driver throw java.sql.DataTruncation exceptions when data is truncated as is required by the JDBC specification when connected to a server that supports warnings (MySQL 4.1.0 and newer)? This property has no effect if the server sql-mode includes STRICT_TRANS_TABLES. Default: true
Since version: 3.1.2
maxRows

Properties and Descriptions
The maximum number of rows to return (0, the default means return all rows).
Default: -1
Since version: all versions
netTimeoutForStreamingResults
What value should the driver automatically set the server setting 'net_write_timeout' to when the streaming result sets feature is in use? (value has unit of seconds, the value '0' means the driver will not try and adjust this value)
Default: 600
Since version: 5.1.0
padCharsWithSpace
If a result set column has the CHAR type and the value does not fill the amount of characters specified in the DDL for the column, should the driver pad the remaining characters with space (for ANSI compliance)?
Default: false
Since version: 5.0.6
populateInsertRowWithDefaultValues
When using ResultSets that are CONCUR_UPDATABLE, should the driver pre-populate the "insert" row with default values from the DDL for the table used in the query so those values are immediately available for ResultSet accessors? This functionality requires a call to the database for metadata each time a result set of this type is created. If disabled (the default), the default values will be populated by the an internal call to refreshRow() which pulls back default values and/or values changed by triggers.
Default: false
Since version: 5.0.5
strictUpdates
Should the driver do strict checking (all primary keys selected) of updatable result sets (true, false, defaults to 'true')?
Default: true
Since version: 3.0.4
tinyInt1isBit
Should the driver treat the datatype TINYINT(1) as the BIT type (because the server silently converts BIT -> TINYINT(1) when creating tables)?
Default: true
Since version: 3.0.16
transformedBitIsBoolean
If the driver converts TINYINT(1) to a different type, should it use BOOLEAN instead of BIT for future compatibility with MySQL-5.0, as MySQL-5.0 has a BIT type?
Default: false

Properties and Descriptions

Since version: 3.1.9

Metadata.**Properties and Descriptions****getProceduresReturnsFunctions**

Pre-JDBC4 DatabaseMetaData API has only the getProcedures() and getProcedureColumns() methods, so they return metadata info for both stored procedures and functions. JDBC4 was extended with the getFunctions() and getFunctionColumns() methods and the expected behaviours of previous methods are not well defined. For JDBC4 and higher, default 'true' value of the option means that calls of DatabaseMetaData.getProcedures() and DatabaseMetaData.getProcedureColumns() return metadata for both procedures and functions as before, keeping backward compatibility. Setting this property to 'false' decouples Connector/J from its pre-JDBC4 behaviours for DatabaseMetaData.getProcedures() and DatabaseMetaData.getProcedureColumns(), forcing them to return metadata for procedures only.

Default: true

Since version: 5.1.26

noAccessToProcedureBodies

When determining procedure parameter types for CallableStatements, and the connected user can't access procedure bodies through "SHOW CREATE PROCEDURE" or select on mysql.proc should the driver instead create basic metadata (all parameters reported as INOUT VARCHARs) instead of throwing an exception?

Default: false

Since version: 5.0.3

nullDatabaseMeansCurrent

When DatabaseMetadata methods ask for a 'catalog' or 'schema' parameter, does the value null mean use the current database? See also property 'databaseTerm'.

Default: false

Since version: 3.1.8

useHostsInPrivileges

Add '@hostname' to users in DatabaseMetaData.getColumn/TablePrivileges() (true/false), defaults to 'true'.

Default: true

Since version: 3.0.2

useInformationSchema

Should the driver use the INFORMATION_SCHEMA to derive information used by DatabaseMetaData? Default is 'true' when connecting to MySQL 8.0.3+, otherwise default is 'false'.

Default: false

Since version: 5.0.0

BLOB/CLOB processing.

Properties and Descriptions
autoDeserialize
Should the driver automatically detect and de-serialize objects stored in BLOB fields?
Default: false
Since version: 3.1.5
blobSendChunkSize
Chunk size to use when sending BLOB/CLOBS via ServerPreparedStatements. Note that this value cannot exceed the value of "maxAllowedPacket" and, if that is the case, then this value will be corrected automatically.
Default: 1048576
Since version: 3.1.9
blobsAreStrings
Should the driver always treat BLOBs as Strings - specifically to work around dubious metadata returned by the server for GROUP BY clauses?
Default: false
Since version: 5.0.8
clobCharacterEncoding
The character encoding to use for sending and retrieving TEXT, MEDIUMTEXT and LONGTEXT values instead of the configured connection characterEncoding
Since version: 5.0.0
emulateLocators
Should the driver emulate java.sql.Blobs with locators? With this feature enabled, the driver will delay loading the actual Blob data until the one of the retrieval methods (getInputStream(), getBytes(), and so forth) on the blob data stream has been accessed. For this to work, you must use a column alias with the value of the column to the actual name of the Blob. The feature also has the following restrictions: The SELECT that created the result set must reference only one table, the table must have a primary key; the SELECT must alias the original blob column name, specified as a string, to an alternate name; the SELECT must cover all columns that make up the primary key.
Default: false
Since version: 3.1.0
functionsNeverReturnBlobs
Should the driver always treat data from functions returning BLOBS as Strings - specifically to work around dubious metadata returned by the server for GROUP BY clauses?
Default: false
Since version: 5.0.8
locatorFetchBufferSize
If 'emulateLocators' is configured to 'true', what size buffer should be used when fetching BLOB data for getBinaryInputStream?
Default: 1048576

Properties and Descriptions	
Since version: 3.2.1	
Datetime types processing.	
Properties and Descriptions	
noDatetimeStringSync	
Don't ensure that ResultSet.getDatetimeType().toString().equals(ResultSet.getString())	
Default: false	
Since version: 3.1.7	
sendFractionalSeconds	
Send fractional part from TIMESTAMP seconds. If set to false, the nanoseconds value of TIMESTAMP values will be truncated before sending any data to the server. This option applies only to prepared statements, callable statements or updatable result sets.	
Default: true	
Since version: 5.1.37	
serverTimezone	
Override detection/mapping of time zone. Used when time zone from server doesn't map to Java time zone	
Since version: 3.0.2	
treatUtilDateAsTimestamp	
Should the driver treat java.util.Date as a TIMESTAMP for the purposes of PreparedStatement.setObject()?	
Default: true	
Since version: 5.0.5	
yearIsDateType	
Should the JDBC driver treat the MySQL type "YEAR" as a java.sql.Date, or as a SHORT?	
Default: true	
Since version: 3.1.9	
zeroDateTimeBehavior	
What should happen when the driver encounters DATETIME values that are composed entirely of zeros (used by MySQL to represent invalid dates)? Valid values are "EXCEPTION", "ROUND" and "CONVERT_TO_NULL".	
Default: EXCEPTION	
Since version: 3.1.4	

High Availability and Clustering.

Properties and Descriptions	
autoReconnect	

Properties and Descriptions
Should the driver try to re-establish stale and/or dead connections? If enabled the driver will throw an exception for a queries issued on a stale or dead connection, which belong to the current transaction, but will attempt reconnect before the next query issued on the connection in a new transaction. The use of this feature is not recommended, because it has side effects related to session state and data consistency when applications don't handle SQLExceptions properly, and is only designed to be used when you are unable to configure your application to handle SQLExceptions resulting from dead and stale connections properly. Alternatively, as a last option, investigate setting the MySQL server variable "wait_timeout" to a high value, rather than the default of 8 hours.
Default: false
Since version: 1.1
autoReconnectForPools
Use a reconnection strategy appropriate for connection pools (defaults to 'false')
Default: false
Since version: 3.1.3
failOverReadOnly
When failing over in autoReconnect mode, should the connection be set to 'read-only'?
Default: true
Since version: 3.0.12
maxReconnects
Maximum number of reconnects to attempt if autoReconnect is true, default is '3'.
Default: 3
Since version: 1.1
reconnectAtTxEnd
If autoReconnect is set to true, should the driver attempt reconnections at the end of every transaction?
Default: false
Since version: 3.0.10
retriesAllDown
When using loadbalancing or failover, the number of times the driver should cycle through available hosts, attempting to connect. Between cycles, the driver will pause for 250ms if no servers are available.
Default: 120
Since version: 5.1.6
initialTimeout
If autoReconnect is enabled, the initial time to wait between re-connect attempts (in seconds, defaults to '2').
Default: 2

Properties and Descriptions	
Since version: 1.1	
queriesBeforeRetryMaster	
Number of queries to issue before falling back to the primary host when failed over (when using multi-host failover). Whichever condition is met first, 'queriesBeforeRetryMaster' or 'secondsBeforeRetryMaster' will cause an attempt to be made to reconnect to the primary host. Setting both properties to 0 disables the automatic fall back to the primary host at transaction boundaries. Defaults to 50.	
Default: 50	
Since version: 3.0.2	
secondsBeforeRetryMaster	
How long should the driver wait, when failed over, before attempting to reconnect to the primary host? Whichever condition is met first, 'queriesBeforeRetryMaster' or 'secondsBeforeRetryMaster' will cause an attempt to be made to reconnect to the master. Setting both properties to 0 disables the automatic fall back to the primary host at transaction boundaries. Time in seconds, defaults to 30	
Default: 30	
Since version: 3.0.2	
allowMasterDownConnections	
By default, a replication-aware connection will fail to connect when configured master hosts are all unavailable at initial connection. Setting this property to 'true' allows to establish the initial connection, by failing over to the slave servers, in read-only state. It won't prevent subsequent failures when switching back to the master hosts i.e. by setting the replication connection to read/write state.	
Default: false	
Since version: 5.1.27	
allowSlaveDownConnections	
By default, a replication-aware connection will fail to connect when configured slave hosts are all unavailable at initial connection. Setting this property to 'true' allows to establish the initial connection. It won't prevent failures when switching to slaves i.e. by setting the replication connection to read-only state. The property 'readFromMasterWhenNoSlaves' should be used for this purpose.	
Default: false	
Since version: 6.0.2	
ha.enableJMX	
Enables JMX-based management of load-balanced connection groups, including live addition/removal of hosts from load-balancing pool. Enables JMX-based management of replication connection groups, including live slave promotion, addition of new slaves and removal of master or slave hosts from load-balanced master and slave connection pools.	
Default: false	
Since version: 5.1.27	
loadBalanceHostRemovalGracePeriod	
Sets the grace period to wait for a host being removed from a load-balanced connection, to be released when it is currently the active host.	

Properties and Descriptions
Default: 15000
Since version: 6.0.3
readFromMasterWhenNoSlaves
Replication-aware connections distribute load by using the master hosts when in read/write state and by using the slave hosts when in read-only state. If, when setting the connection to read-only state, none of the slave hosts are available, an SQLException is thrown back. Setting this property to 'true' allows to fail over to the master hosts, while setting the connection state to read-only, when no slave hosts are available at switch instant.
Default: false
Since version: 6.0.2
selfDestructOnPingMaxOperations
If set to a non-zero value, the driver will report close the connection and report failure when Connection.ping() or Connection.isValid(int) is called if the connection's count of commands sent to the server exceeds this value.
Default: 0
Since version: 5.1.6
selfDestructOnPingSecondsLifetime
If set to a non-zero value, the driver will close the connection and report failure when Connection.ping() or Connection.isValid(int) is called if the connection's lifetime exceeds this value (in milliseconds).
Default: 0
Since version: 5.1.6
ha.loadBalanceStrategy
If using a load-balanced connection to connect to SQL nodes in a MySQL Cluster/NDB configuration (by using the URL prefix "jdbc:mysql:loadbalance://"), which load balancing algorithm should the driver use: (1) "random" - the driver will pick a random host for each request. This tends to work better than round-robin, as the randomness will somewhat account for spreading loads where requests vary in response time, while round-robin can sometimes lead to overloaded nodes if there are variations in response times across the workload. (2) "bestResponseTime" - the driver will route the request to the host that had the best response time for the previous transaction. (3) "serverAffinity" - the driver initially attempts to enforce server affinity while still respecting and benefiting from the fault tolerance aspects of the load-balancing implementation. The server affinity ordered list is provided using the property 'serverAffinityOrder'. If none of the servers listed in the affinity list is responsive, the driver then refers to the "random" strategy to proceed with choosing the next server.
Default: random
Since version: 5.0.6
loadBalanceAutoCommitStatementRegex
When load-balancing is enabled for auto-commit statements (via loadBalanceAutoCommitStatementThreshold), the statement counter will only increment when the SQL matches the regular expression. By default, every statement issued matches.
Since version: 5.1.15
loadBalanceAutoCommitStatementThreshold

Properties and Descriptions
When auto-commit is enabled, the number of statements which should be executed before triggering load-balancing to rebalance. Default value of 0 causes load-balanced connections to only rebalance when exceptions are encountered, or auto-commit is disabled and transactions are explicitly committed or rolled back.
Default: 0
Since version: 5.1.15
loadBalanceBlacklistTimeout
Time in milliseconds between checks of servers which are unavailable, by controlling how long a server lives in the global blacklist.
Default: 0
Since version: 5.1.0
loadBalanceConnectionGroup
Logical group of load-balanced connections within a classloader, used to manage different groups independently. If not specified, live management of load-balanced connections is disabled.
Since version: 5.1.13
loadBalanceExceptionChecker
Fully-qualified class name of custom exception checker. The class must implement com.mysql.cj.jdbc.ha.LoadBalanceExceptionChecker interface, and is used to inspect SQLExceptions and determine whether they should trigger fail-over to another host in a load-balanced deployment.
Default: com.mysql.cj.jdbc.ha.StandardLoadBalanceExceptionChecker
Since version: 5.1.13
loadBalancePingTimeout
Time in milliseconds to wait for ping response from each of load-balanced physical connections when using load-balanced Connection.
Default: 0
Since version: 5.1.13
loadBalanceSQLExceptionSubclassFailover
Comma-delimited list of classes/interfaces used by default load-balanced exception checker to determine whether a given SQLException should trigger failover. The comparison is done using Class.isInstance(SQLException) using the thrown SQLException.
Since version: 5.1.13
loadBalanceSQLStateFailover
Comma-delimited list of SQLState codes used by default load-balanced exception checker to determine whether a given SQLException should trigger failover. The SQLState of a given SQLException is evaluated to determine whether it begins with any value in the comma-delimited list.
Since version: 5.1.13
loadBalanceValidateConnectionOnSwapServer
Should the load-balanced Connection explicitly check whether the connection is live when swapping to a new physical connection at commit/rollback?

Properties and Descriptions
Default: false
Since version: 5.1.13
pinGlobalTxToPhysicalConnection
When using XAConnections, should the driver ensure that operations on a given XID are always routed to the same physical connection? This allows the XAConnection to support "XA START ... JOIN" after "XA END" has been called
Default: false
Since version: 5.0.1
replicationConnectionGroup
Logical group of replication connections within a classloader, used to manage different groups independently. If not specified, live management of replication connections is disabled.
Since version: 8.0.7
resourceId
A globally unique name that identifies the resource that this datasource or connection is connected to, used for XAResource.isSameRM() when the driver can't determine this value based on hostnames used in the URL
Since version: 5.0.1
serverAffinityOrder
A comma separated list containing the host/port pairs that are to be used in load-balancing "serverAffinity" strategy. Only the sub-set of the hosts enumerated in the main hosts section in this URL will be used and they must be identical in case and type, i.e., can't use an IP address in one place and the corresponding host name in the other.
Since version: 8.0.8

Performance Extensions.

Properties and Descriptions
callableStmtCacheSize
If 'cacheCallableStmts' is enabled, how many callable statements should be cached?
Default: 100
Since version: 3.1.2
metadataCacheSize
The number of queries to cache ResultSetMetadata for if cacheResultSetMetaData is set to 'true' (default 50)
Default: 50
Since version: 3.1.1
useLocalSessionState
Should the driver refer to the internal values of autocommit and transaction isolation that are set by Connection.setAutoCommit() and Connection.setTransactionIsolation() and transaction state as

Properties and Descriptions
<p>maintained by the protocol, rather than querying the database or blindly sending commands to the database for commit() or rollback() method calls?</p> <p>Default: false</p> <p>Since version: 3.1.7</p>
<p>useLocalTransactionState</p> <p>Should the driver use the in-transaction state provided by the MySQL protocol to determine if a commit() or rollback() should actually be sent to the database?</p> <p>Default: false</p> <p>Since version: 5.1.7</p>
<p>prepStmtCacheSize</p> <p>If prepared statement caching is enabled, how many prepared statements should be cached?</p> <p>Default: 25</p> <p>Since version: 3.0.10</p>
<p>prepStmtCacheSqlLimit</p> <p>If prepared statement caching is enabled, what's the largest SQL the driver will cache the parsing for?</p> <p>Default: 256</p> <p>Since version: 3.0.10</p>
<p>parseInfoCacheFactory</p> <p>Name of a class implementing com.mysql.cj.CacheAdapterFactory, which will be used to create caches for the parsed representation of client-side prepared statements.</p> <p>Default: com.mysql.cj.PerConnectionLRUFactory</p> <p>Since version: 5.1.1</p>
<p>serverConfigCacheFactory</p> <p>Name of a class implementing com.mysql.cj.CacheAdapterFactory<String, Map<String, String>>, which will be used to create caches for MySQL server configuration values</p> <p>Default: com.mysql.cj.util.PerVmServerConfigCacheFactory</p> <p>Since version: 5.1.1</p>
<p>alwaysSendSetIsolation</p> <p>Should the driver always communicate with the database when Connection.setTransactionIsolation() is called? If set to false, the driver will only communicate with the database when the requested transaction isolation is different than the whichever is newer, the last value that was set via Connection.setTransactionIsolation(), or the value that was read from the server when the connection was established. Note that useLocalSessionState=true will force the same behavior as alwaysSendSetIsolation=false, regardless of how alwaysSendSetIsolation is set.</p> <p>Default: true</p> <p>Since version: 3.1.7</p>
<p>maintainTimeStats</p>

Properties and Descriptions
Should the driver maintain various internal timers to enable idle time calculations as well as more verbose error messages when the connection to the server fails? Setting this property to false removes at least two calls to System.currentTimeMillis() per query.
Default: true
Since version: 3.1.9
useCursorFetch
Should the driver use cursor-based fetching to retrieve rows? If set to "true" and "defaultFetchSize" > 0 (or setFetchSize() > 0 is called on a statement) then the cursor-based result set will be used. Please note that "useServerPrepStmts" is automatically set to "true" in this case because cursor functionality is available only for server-side prepared statements.
Default: false
Since version: 5.0.0
cacheCallableStmts
Should the driver cache the parsing stage of CallableStatements
Default: false
Since version: 3.1.2
cachePrepStmts
Should the driver cache the parsing stage of PreparedStatements of client-side prepared statements, the "check" for suitability of server-side prepared and server-side prepared statements themselves?
Default: false
Since version: 3.0.10
cacheResultSetMetadata
Should the driver cache ResultSetMetaData for Statements and PreparedStatements? (Req. JDK-1.4+, true/false, default 'false')
Default: false
Since version: 3.1.1
cacheServerConfiguration
Should the driver cache the results of 'SHOW VARIABLES' and 'SHOW COLLATION' on a per-URL basis?
Default: false
Since version: 3.1.5
defaultFetchSize
The driver will call setFetchSize(n) with this value on all newly-created Statements
Default: 0
Since version: 3.1.9
dontCheckOnDuplicateKeyUpdateInSQL

Properties and Descriptions	
	Stops checking if every INSERT statement contains the "ON DUPLICATE KEY UPDATE" clause. As a side effect, obtaining the statement's generated keys information will return a list where normally it wouldn't. Also be aware that, in this case, the list of generated keys returned may not be accurate. The effect of this property is canceled if set simultaneously with 'rewriteBatchedStatements=true'.
Default:	false
Since version:	5.1.32
elideSetAutoCommits	
	If using MySQL-4.1 or newer, should the driver only issue 'set autocommit=n' queries when the server's state doesn't match the requested state by Connection.setAutoCommit(boolean)?
Default:	false
Since version:	3.1.3
enableEscapeProcessing	
	Sets the default escape processing behavior for Statement objects. The method Statement.setEscapeProcessing() can be used to specify the escape processing behavior for an individual Statement object. Default escape processing behavior in prepared statements must be defined with the property 'processEscapeCodesForPrepStmts'.
Default:	true
Since version:	6.0.1
enableQueryTimeouts	
	When enabled, query timeouts set via Statement.setQueryTimeout() use a shared java.util.Timer instance for scheduling. Even if the timeout doesn't expire before the query is processed, there will be memory used by the TimerTask for the given timeout which won't be reclaimed until the time the timeout would have expired if it hadn't been cancelled by the driver. High-load environments might want to consider disabling this functionality.
Default:	true
Since version:	5.0.6
largeRowSizeThreshold	
	What size result set row should the JDBC driver consider "large", and thus use a more memory-efficient way of representing the row internally?
Default:	2048
Since version:	5.1.1
readOnlyPropagatesToServer	
	Should the driver issue appropriate statements to implicitly set the transaction access mode on server side when Connection.setReadOnly() is called? Setting this property to 'true' enables InnoDB read-only potential optimizations but also requires an extra roundtrip to set the right transaction state. Even if this property is set to 'false', the driver will do its best effort to prevent the execution of database-state-changing queries. Requires minimum of MySQL 5.6.
Default:	true
Since version:	5.1.35
rewriteBatchedStatements	

Properties and Descriptions
Should the driver use multiqueries (irregardless of the setting of "allowMultiQueries") as well as rewriting of prepared statements for INSERT into multi-value inserts when executeBatch() is called? Notice that this has the potential for SQL injection if using plain java.sql.Statements and your code doesn't sanitize input correctly. Notice that for prepared statements, server-side prepared statements can not currently take advantage of this rewrite option, and that if you don't specify stream lengths when using PreparedStatement.set*Stream(), the driver won't be able to determine the optimum number of parameters per batch and you might receive an error from the driver that the resultant packet is too large. Statement.getGeneratedKeys() for these rewritten statements only works when the entire batch includes INSERT statements. Please be aware using rewriteBatchedStatements=true with INSERT .. ON DUPLICATE KEY UPDATE that for rewritten statement server returns only one value as sum of all affected (or found) rows in batch and it isn't possible to map it correctly to initial statements; in this case driver returns 0 as a result of each batch statement if total count was 0, and the Statement.SUCCESS_NO_INFO as a result of each batch statement if total count was > 0.
Default: false
Since version: 3.1.13
useReadAheadInput
Use newer, optimized non-blocking, buffered input stream when reading from the server?
Default: true
Since version: 3.1.5

Debugging/Profiling.

Properties and Descriptions
logger
The name of a class that implements "com.mysql.cj.log.Log" that will be used to log messages to. (default is "com.mysql.cj.log.StandardLogger", which logs to STDERR)
Default: com.mysql.cj.log.StandardLogger
Since version: 3.1.1
profilerEventHandler
Name of a class that implements the interface com.mysql.cj.log.ProfilerEventHandler that will be used to handle profiling/tracing events.
Default: com.mysql.cj.log.LoggingProfilerEventHandler
Since version: 5.1.6
useNanosForElapsedTime
For profiling/debugging functionality that measures elapsed time, should the driver try to use nanoseconds resolution if available (JDK >= 1.5)?
Default: false
Since version: 5.0.7
maxQuerySizeToLog
Controls the maximum length of the part of a query that will get logged when profiling or tracing
Default: 2048

Properties and Descriptions
Since version: 3.1.3
profileSQL
Trace queries and their execution/fetch times to the configured 'profilerEventHandler'
Default: false
Since version: 3.1.0
logSlowQueries
Should queries that take longer than 'slowQueryThresholdMillis' or detected by the 'autoSlowLog' monitoring be reported to the registered 'profilerEventHandler'?
Default: false
Since version: 3.1.2
slowQueryThresholdMillis
If 'logSlowQueries' is enabled, how long should a query take (in ms) before it is logged as slow?
Default: 2000
Since version: 3.1.2
slowQueryThresholdNanos
If 'logSlowQueries' is enabled, 'useNanosForElapsedTime' is set to true, and this property is set to a non-zero value, the driver will use this threshold (in nanosecond units) to determine if a query was slow.
Default: 0
Since version: 5.0.7
autoSlowLog
Instead of using slowQueryThreshold* to determine if a query is slow enough to be logged, maintain statistics that allow the driver to determine queries that are outside the 99th percentile?
Default: true
Since version: 5.1.4
explainSlowQueries
If 'logSlowQueries' is enabled, should the driver automatically issue an 'EXPLAIN' on the server and send the results to the configured logger at a WARN level?
Default: false
Since version: 3.1.2
gatherPerfMetrics
Should the driver gather performance metrics, and report them via the configured logger every 'reportMetricsIntervalMillis' milliseconds?
Default: false
Since version: 3.1.2
reportMetricsIntervalMillis

Properties and Descriptions
If 'gatherPerfMetrics' is enabled, how often should they be logged (in ms)?
Default: 30000
Since version: 3.1.2
logXaCommands
Should the driver log XA commands sent by MysqlXaConnection to the server, at the DEBUG level of logging?
Default: false
Since version: 5.0.5
traceProtocol
Should the network protocol be logged at the TRACE level?
Default: false
Since version: 3.1.2
enablePacketDebug
When enabled, a ring-buffer of 'packetDebugBufferSize' packets will be kept, and dumped when exceptions are thrown in key areas in the driver's code
Default: false
Since version: 3.1.3
packetDebugBufferSize
The maximum number of packets to retain when 'enablePacketDebug' is true
Default: 20
Since version: 3.1.3
useUsageAdvisor
Should the driver issue 'usage' warnings advising proper and efficient usage of JDBC and MySQL Connector/J to the 'profilerEventHandler'?
Default: false
Since version: 3.1.1
resultSetSizeThreshold
If 'useUsageAdvisor' is true, how many rows should a result set contain before the driver warns that it is suspiciously large?
Default: 100
Since version: 5.0.5
autoGenerateTestcaseScript
Should the driver dump the SQL it is executing, including server-side prepared statements to STDERR?
Default: false

Properties and Descriptions	
Since version: 3.1.9	
Exceptions/Warnings.	
Properties and Descriptions	
dumpQueriesOnException	
Should the driver dump the contents of the query sent to the server in the message for SQLExceptions?	
Default: false	
Since version: 3.1.3	
exceptionInterceptors	
Comma-delimited list of classes that implement com.mysql.cj.exceptions.ExceptionInterceptor. These classes will be instantiated one per Connection instance, and all SQLExceptions thrown by the driver will be allowed to be intercepted by these interceptors, in a chained fashion, with the first class listed as the head of the chain.	
Since version: 5.1.8	
ignoreNonTxTables	
Ignore non-transactional table warning for rollback? (defaults to 'false').	
Default: false	
Since version: 3.0.9	
includeInnodbStatusInDeadlockExceptions	
Include the output of "SHOW ENGINE INNODB STATUS" in exception messages when deadlock exceptions are detected?	
Default: false	
Since version: 5.0.7	
includeThreadDumpInDeadlockExceptions	
Include a current Java thread dump in exception messages when deadlock exceptions are detected?	
Default: false	
Since version: 5.1.15	
includeThreadNamesAsStatementComment	
Include the name of the current thread as a comment visible in "SHOW PROCESSLIST", or in Innodb deadlock dumps, useful in correlation with "includeInnodbStatusInDeadlockExceptions=true" and "includeThreadDumpInDeadlockExceptions=true".	
Default: false	
Since version: 5.1.15	
useOnlyServerErrorMessages	
Don't prepend 'standard' SQLState error messages to error messages returned by the server.	
Default: true	

Properties and Descriptions

Since version: 3.0.15

Tunes for integration with other products.**Properties and Descriptions****overrideSupportsIntegrityEnhancementFacility**

Should the driver return "true" for DatabaseMetaData.supportsIntegrityEnhancementFacility() even if the database doesn't support it to workaround applications that require this method to return "true" to signal support of foreign keys, even though the SQL specification states that this facility contains much more than just foreign key support (one such application being OpenOffice)?

Default: false

Since version: 3.1.12

ultraDevHack

Create PreparedStatements for prepareCall() when required, because UltraDev is broken and issues a prepareCall() for _all_ statements? (true/false, defaults to 'false')

Default: false

Since version: 2.0.3

JDBC compliance.**Properties and Descriptions****useColumnNamesInFindColumn**

Prior to JDBC-4.0, the JDBC specification had a bug related to what could be given as a "column name" to ResultSet methods like findColumn(), or getters that took a String property. JDBC-4.0 clarified "column name" to mean the label, as given in an "AS" clause and returned by ResultSetMetaData.getColumnLabel(), and if no AS clause, the column name. Setting this property to "true" will give behavior that is congruent to JDBC-3.0 and earlier versions of the JDBC specification, but which because of the specification bug could give unexpected results. This property is preferred over "useOldAliasMetadataBehavior" unless you need the specific behavior that it provides with respect to ResultSetMetadata.

Default: false

Since version: 5.1.7

pedantic

Follow the JDBC spec to the letter.

Default: false

Since version: 3.0.0

useOldAliasMetadataBehavior

Should the driver use the legacy behavior for "AS" clauses on columns and tables, and only return aliases (if any) for ResultSetMetaData.getColumnName() or ResultSetMetaData.getTableName() rather than the original column/table name? In 5.0.x, the default value was true.

Default: false

Since version: 5.0.4

X Protocol and X DevAPI.

Properties and Descriptions	
xdevapi.asyncResponseTimeout	Timeout (in seconds) for getting server response via X Protocol. Default: 300 Since version: 8.0.7
xdevapi.auth	Authentication mechanism to use with the X Protocol. Allowed values are "SHA256_MEMORY", "MYSQL41", "PLAIN", and "EXTERNAL". Value is case insensitive. If the property is not set, the mechanism is chosen depending on the connection type: "PLAIN" is used for TLS connections and "SHA256_MEMORY" or "MYSQL41" is used for unencrypted connections. Default: PLAIN Since version: 8.0.8
xdevapi.connect-timeout	X DevAPI specific timeout for socket connect (in milliseconds), with '0' being no timeout. Defaults to '10000'. If "xdevapi.connect-timeout" is not set explicitly and "connectTimeout" is, "xdevapi.connect-timeout" takes up the value of "connectTimeout". If "xdevapi.useAsyncProtocol=true", both "xdevapi.connect-timeout" and "connectTimeout" are ignored. Default: 10000 Since version: 8.0.13
xdevapi.connection-attributes	An X DevAPI-specific comma-delimited list of user-defined key=value pairs (in addition to standard X Protocol-defined key=value pairs) to be passed to MySQL Server for display as connection attributes in PERFORMANCE_SCHEMA tables session_account_connect_attrs and session_connect_attrs. Example usage: xdevapi.connection-attributes=key1=value1,key2=value2 or xdevapi.connection-attributes=[key1=value1,key2=value2]. This functionality is available for use with MySQL Server version 8.0.16 or later only. Earlier versions of X Protocol do not support connection attributes, causing this configuration option to be ignored. For situations where Session creation/initialization speed is critical, setting xdevapi.connection-attributes=false will cause connection attribute processing to be bypassed. Since version: 8.0.16
xdevapi.dns-srv	X DevAPI-specific option for instructing the driver use the given host name to lookup for DNS SRV records and use the resulting list of hosts in a multi-host failover connection. Note that a single host name and no port must be provided when this option is enabled. Default: false Since version: 8.0.19
xdevapi.ssl-mode	X DevAPI-specific SSL mode setting. If not specified, use "sslMode". Because the "PREFERRED" mode is not applicable to X Protocol, if "xdevapi.ssl-mode" is not set and "sslMode" is set to "PREFERRED", "xdevapi.ssl-mode" is set to "REQUIRED".

Properties and Descriptions
Default: REQUIRED
Since version: 8.0.7
xdevapi.ssl-truststore
X DevAPI-specific URL to the trusted CA certificates key store. If not specified, use trustCertificateKeyStoreUrl value.
Since version: 6.0.6
xdevapi.ssl-truststore-password
X DevAPI-specific password for the trusted CA certificates key store. If not specified, use trustCertificateKeyStorePassword value.
Since version: 6.0.6
xdevapi.ssl-truststore-type
X DevAPI-specific type of the trusted CA certificates key store. If not specified, use trustCertificateKeyStoreType value.
Default: JKS
Since version: 6.0.6
xdevapi.tls-ciphersuites
X DevAPI-specific property overriding the cipher suites enabled for use on the underlying SSL sockets. If not specified, the value of enabledSSLCipherSuites is used.
Since version: 8.0.19
xdevapi.tls-versions
X DevAPI-specific property overriding the TLS protocols enabled for use on the underlying SSL sockets. If not specified, the value of enabledTLSProtocols is used.
Since version: 8.0.19
xdevapi.useAsyncProtocol
Use asynchronous variant of X Protocol
Default: false
Since version: 6.0.0

3.5.4 JDBC API Implementation Notes

MySQL Connector/J, as a rigorous implementation of the [JDBC API](#), passes all of the tests in the publicly available version of Oracle's JDBC compliance test suite. The JDBC specification is flexible on how certain functionality should be implemented. This section gives details on an interface-by-interface level about implementation decisions that might affect how you code applications with MySQL Connector/J.

- **BLOB**

You can emulate BLOBs with locators by adding the property `emulateLocators=true` to your JDBC URL. Using this method, the driver will delay loading the actual BLOB data until you retrieve the other data and then use retrieval methods (`getInputStream()`, `getBytes()`, and so forth) on the BLOB data stream.

You must use a column alias with the value of the column to the actual name of the BLOB, for example:

```
SELECT id, 'data' as blob_data from blobtable
```

You must also follow these rules:

- The `SELECT` must reference only one table. The table must have a [primary key](#).
- The `SELECT` must alias the original BLOB column name, specified as a string, to an alternate name.
- The `SELECT` must cover all columns that make up the primary key.

The BLOB implementation does not allow in-place modification (they are copies, as reported by the `DatabaseMetaData.locatorsUpdateCopies()` method). Because of this, use the corresponding `PreparedStatement.setBlob()` or `ResultSet.updateBlob()` (in the case of updatable result sets) methods to save changes back to the database.

- **Connection**

The `isClosed()` method does not ping the server to determine if it is available. In accordance with the JDBC specification, it only returns true if `closed()` has been called on the connection. If you need to determine if the connection is still valid, issue a simple query, such as `SELECT 1`. The driver will throw an exception if the connection is no longer valid.

- **DatabaseMetaData**

Foreign key information (`getImportedKeys()`/`getExportedKeys()` and `getCrossReference()`) is only available from InnoDB tables. The driver uses `SHOW CREATE TABLE` to retrieve this information, so if any other storage engines add support for foreign keys, the driver would transparently support them as well.

- **PreparedStatement**

Two variants of prepared statements are implemented by Connector/J, the client-side and the server-side prepared statements. Client-side prepared statements are used by default because early MySQL versions did not support the prepared statement feature or had problems with its implementation. Server-side prepared statements and binary-encoded result sets are used when the server supports them. To enable usage of server-side prepared statements, set `useServerPrepStmts=true`.

Be careful when using a server-side prepared statement with **large** parameters that are set using `setBinaryStream()`, `setAsciiStream()`, `setUnicodeStream()`, `setCharacterStream()`, `setNCharacterStream()`, `setBlob()`, `setClob()`, or `setNCLob()`. To re-execute the statement with any large parameter changed to a nonlarge parameter, call `clearParameters()` and set all parameters again. The reason for this is as follows:

- During both server-side prepared statements and client-side emulation, large data is exchanged only when `PreparedStatement.execute()` is called.
- Once that has been done, the stream used to read the data on the client side is closed (as per the JDBC spec), and cannot be read from again.
- If a parameter changes from large to nonlarge, the driver must reset the server-side state of the prepared statement to allow the parameter that is being changed to take the place of the prior large value. This removes all of the large data that has already been sent to the server, thus requiring the data to be re-sent, using the `setBinaryStream()`, `setAsciiStream()`,

`setUnicodeStream()`, `setCharacterStream()`, `setNCharacterStream()`, `setBlob()`, `setClob()`, or `setNCLob()` method.

Consequently, to change the type of a parameter to a nonlarge one, you must call `clearParameters()` and set all parameters of the prepared statement again before it can be re-executed.

- **ResultSet**

By default, ResultSets are completely retrieved and stored in memory. In most cases this is the most efficient way to operate and, due to the design of the MySQL network protocol, is easier to implement. If you are working with ResultSets that have a large number of rows or large values and cannot allocate heap space in your JVM for the memory required, you can tell the driver to stream the results back one row at a time.

To enable this functionality, create a `Statement` instance in the following manner:

```
stmt = conn.createStatement(java.sql.ResultSet.TYPE_FORWARD_ONLY,
                           java.sql.ResultSet.CONCUR_READ_ONLY);
stmt.setFetchSize(Integer.MIN_VALUE);
```

The combination of a forward-only, read-only result set, with a fetch size of `Integer.MIN_VALUE` serves as a signal to the driver to stream result sets row-by-row. After this, any result sets created with the statement will be retrieved row-by-row.

There are some caveats with this approach. You must read all of the rows in the result set (or close it) before you can issue any other queries on the connection, or an exception will be thrown.

The earliest the locks these statements hold can be released (whether they be `MyISAM` table-level locks or row-level locks in some other storage engine such as `InnoDB`) is when the statement completes.

If the statement is within scope of a transaction, then locks are released when the transaction completes (which implies that the statement needs to complete first). As with most other databases, statements are not complete until all the results pending on the statement are read or the active result set for the statement is closed.

Therefore, if using streaming results, process them as quickly as possible if you want to maintain concurrent access to the tables referenced by the statement producing the result set.

Another alternative is to use cursor-based streaming to retrieve a set number of rows each time. This can be done by setting the connection property `useCursorFetch` to true, and then calling `setFetchSize(int)` with `int` being the desired number of rows to be fetched each time:

```
conn = DriverManager.getConnection("jdbc:mysql://localhost/?useCursorFetch=true", "user", "s3cr3t");
stmt = conn.createStatement();
stmt.setFetchSize(100);
rs = stmt.executeQuery("SELECT * FROM your_table_here");
```

- **Statement**

Connector/J includes support for both `Statement.cancel()` and `Statement.setQueryTimeout()`. Both require a separate connection to issue the `KILL QUERY` statement. In the case of `setQueryTimeout()`, the implementation creates an additional thread to handle the timeout functionality.

Note

Failures to cancel the statement for `setQueryTimeout()` may manifest themselves as `RuntimeException` rather than failing silently, as there

There is currently no way to unblock the thread that is executing the query being cancelled due to timeout expiration and have it throw the exception instead.

MySQL does not support SQL cursors, and the JDBC driver does not emulate them, so `setCursorName()` has no effect.

Connector/J also supplies two additional methods:

- `setLocalInfileInputStream()` sets an `InputStream` instance that will be used to send data to the MySQL server for a `LOAD DATA LOCAL INFILE` statement rather than a `FileInputStream` or `URLInputStream` that represents the path given as an argument to the statement.

This stream will be read to completion upon execution of a `LOAD DATA LOCAL INFILE` statement, and will automatically be closed by the driver, so it needs to be reset before each call to `execute*()` that would cause the MySQL server to request data to fulfill the request for `LOAD DATA LOCAL INFILE`.

If this value is set to `NULL`, the driver will revert to using a `FileInputStream` or `URLInputStream` as required.

- `getLocalInfileInputStream()` returns the `InputStream` instance that will be used to send data in response to a `LOAD DATA LOCAL INFILE` statement.

This method returns `NULL` if no such stream has been set using `setLocalInfileInputStream()`.

3.5.5 Java, JDBC, and MySQL Types

MySQL Connector/J is flexible in the way it handles conversions between MySQL data types and Java data types.

In general, any MySQL data type can be converted to a `java.lang.String`, and any numeric type can be converted to any of the Java numeric types, although round-off, overflow, or loss of precision may occur.

Note

All `TEXT` types return `Types.LONGVARCHAR` with different `getPrecision()` values (65535, 255, 16777215, and 2147483647 respectively) with `getColumnType()` returning `-1`. This behavior is intentional even though `TINYTEXT` does not fall, regarding to its size, within the `LONGVARCHAR` category. This is to avoid different handling inside the same base type. And `getColumnType()` returns `-1` because the internal server handling is of type `TEXT`, which is similar to `BLOB`.

Also note that `getColumnTypeName()` will return `VARCHAR` even though `getColumnType()` returns `Types.LONGVARCHAR`, because `VARCHAR` is the designated column database-specific name for this type.

Connector/J issues warnings or throws `DataTruncation` exceptions as is required by the JDBC specification, unless the connection was configured not to do so by using the property `jdbcCompliantTruncation` and setting it to `false`.

The conversions that are always guaranteed to work are listed in the following table. The first column lists one or more MySQL data types, and the second column lists one or more Java types to which the MySQL types can be converted.

Table 3.5 Possible Conversions Between MySQL and Java Data Types

These MySQL Data Types	Can always be converted to these Java types
CHAR, VARCHAR, BLOB, TEXT, ENUM, and SET	java.lang.String, java.io.InputStream, java.io.Reader, java.sql.Blob, java.sql.Clob
FLOAT, REAL, DOUBLE PRECISION, NUMERIC, DECIMAL, TINYINT, SMALLINT, MEDIUMINT, INTEGER, BIGINT	java.lang.String, java.lang.Short, java.lang.Integer, java.lang.Long, java.lang.Double, java.math.BigDecimal
DATE, TIME, DATETIME, TIMESTAMP	java.lang.String, java.sql.Date, java.sql.Timestamp

Note

Round-off, overflow or loss of precision may occur if you choose a Java numeric data type that has less precision or capacity than the MySQL data type you are converting to/from.

The `ResultSet.getObject()` method uses the type conversions between MySQL and Java types, following the JDBC specification where appropriate.

The values returned by `ResultSetMetaData.getColumnTypeName()` and `ResultSetMetaData.getColumnClassName()` are shown in the table below. For more information on the JDBC types, see the reference on the `java.sql.Types` class.

Table 3.6 MySQL Types and Return Values for ResultSetMetaData.getColumnTypeName() and ResultSetMetaData.getColumnClassName()

MySQL Type Name	Return value of <code>getColumnTypeName()</code>	Return value of <code>getColumnClassName()</code>
BIT(1)	BIT	java.lang.Boolean
BIT(> 1)	BIT	byte[]
TINYINT	TINYINT	java.lang.Boolean if the configuration property <code>tinyIntIsBit</code> is set to <code>true</code> (the default) and the storage size is 1, or <code>java.lang.Integer</code> if not.
BOOL, BOOLEAN	TINYINT	See TINYINT, above as these are aliases for TINYINT(1), currently.
SMALLINT[(M)] [UNSIGNED]	SMALLINT [UNSIGNED]	java.lang.Integer (regardless of whether it is UNSIGNED or not)
MEDIUMINT[(M)] [UNSIGNED]	MEDIUMINT [UNSIGNED]	java.lang.Integer (regardless of whether it is UNSIGNED or not)
INT, INTEGER[(M)] [UNSIGNED]	INTEGER [UNSIGNED]	java.lang.Integer, if UNSIGNED java.lang.Long
BIGINT[(M)] [UNSIGNED]	BIGINT [UNSIGNED]	java.lang.Long, if UNSIGNED java.math.BigInteger
FLOAT[(M,D)]	FLOAT	java.lang.Float
DOUBLE[(M,B)]	DOUBLE	java.lang.Double
DECIMAL[(M[,D])]	DECIMAL	java.math.BigDecimal
DATE	DATE	java.sql.Date
DATETIME	DATETIME	java.sql.Timestamp
TIMESTAMP[(M)]	TIMESTAMP	java.sql.Timestamp
TIME	TIME	java.sql.Time

MySQL Type Name	Return value of <code>GetColumnNameType</code>	Return value of <code>GetColumnNameClassName</code>
<code>YEAR(2 4)</code>	<code>YEAR</code>	If <code>yearIsDateType</code> configuration property is set to <code>false</code> , then the returned object type is <code>java.sql.Short</code> . If set to <code>true</code> (the default), then the returned object is of type <code>java.sql.Date</code> with the date set to January 1st, at midnight.
<code>CHAR(M)</code>	<code>CHAR</code>	<code>java.lang.String</code> (unless the character set for the column is <code>BINARY</code> , then <code>byte[]</code> is returned.)
<code>VARCHAR(M)[BINARY]</code>	<code>VARCHAR</code>	<code>java.lang.String</code> (unless the character set for the column is <code>BINARY</code> , then <code>byte[]</code> is returned.)
<code>BINARY(M)</code>	<code>BINARY</code>	<code>byte[]</code>
<code>VARBINARY(M)</code>	<code>VARBINARY</code>	<code>byte[]</code>
<code>TINYBLOB</code>	<code>TINYBLOB</code>	<code>byte[]</code>
<code>TINYTEXT</code>	<code>VARCHAR</code>	<code>java.lang.String</code>
<code>BLOB</code>	<code>BLOB</code>	<code>byte[]</code>
<code>TEXT</code>	<code>VARCHAR</code>	<code>java.lang.String</code>
<code>MEDIUMBLOB</code>	<code>MEDIUMBLOB</code>	<code>byte[]</code>
<code>MEDIUMTEXT</code>	<code>VARCHAR</code>	<code>java.lang.String</code>
<code>LONGBLOB</code>	<code>LONGBLOB</code>	<code>byte[]</code>
<code>LONGTEXT</code>	<code>VARCHAR</code>	<code>java.lang.String</code>
<code>ENUM('value1','value2...')</code>		<code>java.lang.String</code>
<code>SET('value1','value2...')</code>		<code>java.lang.String</code>

3.5.6 Using Character Sets and Unicode

All strings sent from the JDBC driver to the server are converted automatically from native Java Unicode form to the client character encoding, including all queries sent using `Statement.execute()`, `Statement.executeUpdate()`, and `Statement.executeQuery()`, as well as all `PreparedStatement` and `CallableStatement` parameters, excluding parameters set using `setBytes()`, `setBinaryStream()`, `setAsciiStream()`, `setUnicodeStream()`, and `setBlob()`.

Number of Encodings Per Connection

Connector/J supports a single character encoding between client and server, and any number of character encodings for data returned by the server to the client in `ResultSets`.

Setting the Character Encoding

The character encoding between client and server is automatically detected upon connection (provided that the Connector/J connection properties `characterEncoding` and `connectionCollation` are not set). You specify the encoding on the server using the system variable `character_set_server` (for more information, see [Server Character Set and Collation](#)). The driver automatically uses the encoding specified by the server. For example, to use the 4-byte UTF-8 character set with Connector/J, configure the MySQL server with `character_set_server=utf8mb4`, and leave `characterEncoding` and `connectionCollation` out of the Connector/J connection string. Connector/J will then autodetect the UTF-8 setting.

To override the automatically detected encoding on the client side, use the `characterEncoding` property in the connection URL to the server. Use Java-style names when specifying character

encodings. The following table lists MySQL character set names and their corresponding Java-style names:

Table 3.7 MySQL to Java Encoding Name Translations

MySQL Character Set Name	Java-Style Character Encoding Name
ascii	US-ASCII
big5	Big5
gbk	GBK
sjis	SJIS or Cp932
cp932	Cp932 or MS932
gb2312	EUC_CN
ujis	EUC_JP
euckr	EUC_KR
latin1	Cp1252
latin2	ISO8859_2
greek	ISO8859_7
hebrew	ISO8859_8
cp866	Cp866
tis620	TIS620
cp1250	Cp1250
cp1251	Cp1251
cp1257	Cp1257
macroman	MacRoman
macce	MacCentralEurope
<i>For 8.0.12 and earlier: utf8</i>	UTF-8
<i>For 8.0.13 and later: utf8mb4</i>	
ucs2	UnicodeBig

Notes

For Connector/J 8.0.12 and earlier: In order to use the `utf8mb4` character set for the connection, the server MUST be configured with `character_set_server=utf8mb4`; if that is not the case, when `UTF-8` is used for `characterEncoding` in the connection string, it will map to the MySQL character set name `utf8`, which is an alias for `utf8mb3`.

For Connector/J 8.0.13 and later:

- When `UTF-8` is used for `characterEncoding` in the connection string, it maps to the MySQL character set name `utf8mb4`.
- If the connection option `connectionCollation` is also set alongside `characterEncoding` and is incompatible with it, `characterEncoding` will be overridden with the encoding corresponding to `connectionCollation`.
- Because there is no Java-style character set name for `utf8mb3` that you can use with the connection option `characterEncoding`, the only way to use `utf8mb3` as your connection character set is to use a `utf8mb3` collation (for example, `utf8_general_ci`) for the connection option

`connectionCollation`, which forces a `utf8mb3` character set to be used, as explained in the last bullet.

Warning

Do not issue the query `SET NAMES` with Connector/J, as the driver will not detect that the character set has been changed by the query, and will continue to use the character set configured when the connection was first set up.

3.5.7 Connecting Securely Using SSL

Connector/J can encrypt all data communicated between the JDBC driver and the server (except for the initial handshake) using SSL. There is a performance penalty for enabling connection encryption, the severity of which depends on multiple factors including (but not limited to) the size of the query, the amount of data returned, the server hardware, the SSL library used, the network bandwidth, and so on.

The system works through two Java keystore files: one file contains the certificate information for the server (`truststore` in the examples below), and another contains the keys and certificate for the client (`keystore` in the examples below). All Java keystore files are protected by the password supplied to the `keytool` when you created the files. You need the file names and the associated passwords to create an SSL connection.

For SSL support to work, you must have the following:

- A MySQL server that supports SSL, and compiled and configured to do so. For more information, see [Using Encrypted Connections](#) and [Configuring SSL Library Support](#).
- A signed client certificate, if using [mutual \(two-way\) authentication](#).

By default, Connector/J establishes secure connections with the MySQL servers. Note that MySQL servers 5.7 and 8.0, when compiled with OpenSSL, can automatically generate missing SSL files at startup and configure the SSL connection accordingly.

For 8.0.12 and earlier: As long as the server is correctly configured to use SSL, there is no need to configure anything on the Connector/J client to use encrypted connections (the exception is when Connector/J is connecting to very old server versions like 5.6.25 and earlier or 5.7.5 and earlier, in which case the client must set the connection property `useSSL=true` in order to use encrypted connections). The client can demand SSL to be used by setting the connection property `requireSSL=true`; the connection then fails if the server is not configured to use SSL. Without `requireSSL=true`, the connection just falls back to non-encrypted mode if the server is not configured to use SSL.

For 8.0.13 and later: As long as the server is correctly configured to use SSL, there is no need to configure anything on the Connector/J client to use encrypted connections. The client can demand SSL to be used by setting the connection property `sslMode=REQUIRED, VERIFY_CA`, or `VERIFY_IDENTITY`; the connection then fails if the server is not configured to use SSL. With `sslMode=PREFERRED`, the connection just falls back to non-encrypted mode if the server is not configured to use SSL. For X-Protocol connections, the connection property `xdevapi.ssl-mode` specifies the SSL Mode setting, just like `sslMode` does for MySQL-protocol connections (except that `PREFERRED` is not supported by X Protocol); if not explicitly set, `xdevapi.ssl-mode` takes up the value of `sslMode` (if `xdevapi.ssl-mode` is not set and `sslMode` is set to `PREFERRED`, `xdevapi.ssl-mode` is set to `REQUIRED`).

For additional security, you can setup the client for a one-way (server or client) or two-way (server and client) SSL authentication, allowing the client or the server to authenticate each other's identity.

TLS versions: The allowable versions of TLS protocol can be restricted using the connection properties `enabledTLSProtocols` and, for X DevAPI connections and for release 8.0.19 and later, `xdevapi.tls-versions` (when `xdevapi.tls-versions` is not specified, it takes up the value of `enabledTLSProtocols`). If no such restrictions have been specified, Connector/J attempts to connect to the server with the following TLS versions:

- `TLSv1`, `TLSv1.1`, `TLSv1.2`, `TLSv1.3` for MySQL Community Servers 8.0, 5.7.28 and later, and 5.6.46 and later, and for all commercial versions of MySQL Servers.
- `TLSv1`, `TLSv1.1` for all other versions of MySQL Servers.

Note

For Connector/J 8.0.18 and earlier when connecting to MySQL Community Server 5.6 and 5.7 using the JDBC API: Due to compatibility issues with MySQL Server compiled with yaSSL, Connector/J does not enable connections with TLSv1.2 and higher by default. When connecting to servers that restrict connections to use those higher TLS versions, enable them explicitly by setting the Connector/J connection property `enabledTLSProtocols` (e.g., set `enabledTLSProtocols=TLSv1,TLSv1.1,TLSv1.2`).

Cipher Suites: Since release 8.0.19, the cipher suites usable by Connector/J are pre-restricted by a properties file that can be found at `src/main/resources/com/mysql/cj/TlsSettings.properties` inside the `src` folder on the source tree or in the platform-independent distribution archive (in `.tar.gz` or `.zip` format) for Connector/J. The file contains four sections, listing in each the mandatory, approved, deprecated, and unacceptable ciphers. Only suites listed in the first three sections can be used. The last section (unacceptable) defines patterns or masks that blacklist unsafe cipher suites. Practically, with the whitelist already given in the first three sections, the blacklist patterns in the forth section are redundant; but they are there as an extra safeguard against unwanted ciphers. The whitelist and blacklist of cipher suites apply to both JDBC and X DevAPI connections.

The allowable cipher suites for SSL connections can be restricted using the connection properties `enabledSSLCipherSuites` and, for X DevAPI connections and for release 8.0.19 and later, `xdevapi.tls-ciphersuites` (when `xdevapi.tls-ciphersuites` is not specified, it takes up the value of `enabledSSLCipherSuites`). If no such restrictions have been specified, Connector/J attempts to establish SSL connections with any whitelisted cipher suites that the server accepts.

Setting up Server Authentication

For 8.0.12 and earlier: Server authentication via server certificate verification is enabled when the Connector/J connection properties `useSSL` AND `verifyServerCertificate` are both true. Hostname verification is not supported—host authentication is by certificates only.

For 8.0.13 and later: Server authentication via server certificate verification is enabled when the Connector/J connection property `sslMode` is set to `VERIFY_CA` or `VERIFY_IDENTITY`. If `sslMode` is not set, server authentication via server certificate verification is enabled when the legacy properties `useSSL` AND `verifyServerCertificate` are both true.

Certificates signed by a trusted CA. When server authentication via server certificate verification is enabled, if no additional configurations are made regarding server authentication, Java verifies the server certificate using its default trusted CA certificates, usually from `$JAVA_HOME/lib/security/cacerts`.

Using self-signed certificates. It is pretty common though for MySQL server certificates to be self-signed or signed by a self-signed CA certificate; the auto-generated certificates and keys created by the MySQL server are based on the latter—that is, the server generates all required keys and a self-signed CA certificate that is used to sign a server and a client certificate. The server then configures itself to use the CA certificate and the server certificate. Although the client certificate file is placed in the same directory, it is not used by the server.

To verify the server certificate, Connector/J needs to be able to read the certificate that signed it, that is, the server certificate that signed itself or the self-signed CA certificate. This can be accomplished by either importing the certificate (`ca.pem` or any other certificate) into the Java default truststore (although tampering the default truststore is not recommended) or by importing it into a custom Java truststore file and configuring the Connector/J driver accordingly. Use Java's keytool (typically located in the `bin` subdirectory of your JDK or JRE installation) to import the server certificates:

```
shell> keytool -importcert -alias MySQLCACert -file ca.pem \
    -keystore truststore -storepass mypassword
```

Supply the proper arguments for the command options. If the truststore file does not already exist, a new one will be created; otherwise the certificate will be added to the existing file. Interaction with `keytool` looks like this:

```
Owner: CN=MySQL_Server_5.7.17_Auto_Generated_CA_Certificate
Issuer: CN=MySQL_Server_5.7.17_Auto_Generated_CA_Certificate
Serial number: 1
Valid from: Thu Feb 16 11:42:43 EST 2017 until: Sun Feb 14 11:42:43 EST 2027
Certificate fingerprints:
    MD5: 18:87:97:37:EA:CB:0B:5A:24:AB:27:76:45:A4:78:C1
    SHA1: 2B:0D:D9:69:2C:99:BF:1E:2A:25:4E:8D:2D:38:B8:70:66:47:FA:ED
    SHA256: C3:29:67:1B:E5:37:06:F7:A9:93:DF:C7:B3:27:5E:09:C7:FD:EE:2D:18:86:F4:9C:40:D8:26:CB:DA:95:A0...
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 1
Trust this certificate? [no]: yes
Certificate was added to keystore
```

The output of the command shows all details about the imported certificate. Make sure you remember the password you have supplied. Also, be mindful that the password will have to be written as plain text in your Connector/J configuration file or application source code.

The next step is to configure Java or Connector/J to read the truststore you just created or modified. This can be done by using one of the following three methods:

- Using the Java command line arguments:

```
-Djavax.net.ssl.trustStore=path_to_truststore_file
-Djavax.net.ssl.trustStorePassword=mypassword
```

- Setting the system properties directly in the client code:

```
System.setProperty("javax.net.ssl.trustStore", "path_to_truststore_file");
System.setProperty("javax.net.ssl.trustStorePassword", "mypassword");
```

- Setting the Connector/J connection properties:

```
clientCertificateKeyStoreUrl=file:path_to_truststore_file
clientCertificateKeyStorePassword=mypassword
```

Notice that when used together, the connection properties override the values set by the other two methods. Also, whatever values set with connection properties are used in that connection only, while values set using the system-wide values are used for all connections (unless overridden by the connection properties).

With the above setup and the server authentication enabled, all connections established are going to be SSL-encrypted, with the server being authenticated in the SSL handshake process, and the client can now safely trust the server it is connecting to.

For X-Protocol connections, the connection properties `xdevapi.ssl-truststore`, `xdevapi.ssl-truststore-type`, and `xdevapi.ssl-truststore-password` specify the truststore settings, just like `trustCertificateKeyStoreUrl`, `trustCertificateKeyStoreType`, and `trustCertificateKeyStorePassword` do for MySQL-protocol connections; if not explicitly set, `xdevapi.ssl-truststore`, `xdevapi.ssl-truststore-type`, and `xdevapi.ssl-truststore-password` take up the values of `trustCertificateKeyStoreUrl`, `trustCertificateKeyStoreType`, and `trustCertificateKeyStorePassword`, respectively.

Service Identity Verification. *For 8.0.13 and later:* Beyond server authentication via server certificate verification, when `sslMode` is set to `VERIFY_IDENTITY`, Connector/J also performs host name identity verification by checking whether the host name that it uses for connecting matches the Common Name value in the server certificate.

Setting up Client Authentication

The server may want to authenticate a client and require the client to provide an SSL certificate to it, which it verifies against its known certificate authorities or performs additional checks on the client identity if needed (see [CREATE USER SSL/TLS Options](#) for details). In that case, Connector/J needs to have access to the client certificate, so it can be sent to the server while establishing new database connections. This is done using the Java keystore files.

To allow client authentication, the client connecting to the server must have its own set of keys and an SSL certificate. The client certificate must be signed so that the server can verify it. While you can have the client certificates signed by official certificate authorities, it is more common to use an intermediate, private, CA certificate to sign client certificates. Such an intermediate CA certificate may be self-signed or signed by a trusted root CA. The requirement is that the server knows a CA certificate that is capable of validating the client certificate.

Some MySQL server builds are able to generate SSL keys and certificates for communication encryption, including a certificate and a private key (contained in the `client-cert.pem` and `client-key.pem` files), which can be used by any client. This SSL certificate is already signed by the self-signed CA certificate `ca.pem`, which the server may have already been configured to use.

If you do not want to use the client keys and certificate files generated by the server, you can also generate new ones using the procedures described in [Creating SSL and RSA Certificates and Keys](#). Notice that, according to the setup of the server, you may have to reuse the already existing CA certificate the server is configured to work with to sign the new client certificate, instead of creating a new one.

Once you have the client private key and certificate files you want to use, you need to import them into a Java keystore so that they can be used by the Java SSL library and Connector/J. The following instructions explain how to create the keystore file:

- Convert the client key and certificate files to a PKCS #12 archive:

```
shell> openssl pkcs12 -export -in client-cert.pem -inkey client-key.pem \
    -name "mysqlclient" -passout pass:mypassword -out client-keystore.p12
```

- Import the client key and certificate into a Java keystore:

```
shell> keytool -importkeystore -srckeystore client-keystore.p12 -srcstoretype pkcs12 \
    -srcstorepass mypassword -destkeystore keystore -deststoretype JKS -deststorepass mypassword
```

Supply the proper arguments for the command options. If the keystore file does not already exist, a new one will be created; otherwise the certificate will be added to the existing file. Output by `keytool` looks like this:

```
Entry for alias mysqlclient successfully imported.
Import command completed: 1 entries successfully imported, 0 entries failed or cancelled
```

Make sure you remember the password you have chosen. Also, be mindful that the password will have to be written as plain text in your Connector/J configuration file or application source code.

After the step, you can delete the PKCS #12 archive (`client-keystore.p12` in the example).

The next step is to configure Java or Connector/J so that it reads the truststore you just created or modified. This can be done by using one of the following three methods:

- Using the Java command line arguments:

```
-Djavax.net.ssl.keyStore=path_to_keystore_file
-Djavax.net.ssl.keyStorePassword=mypassword
```

- Setting the system properties directly in the client code:

```
System.setProperty("javax.net.ssl.keyStore", "path_to_keystore_file");
```

```
System.setProperty("javax.net.ssl.keyStorePassword", "mypassword");
```

- Through Connector/J connection properties:

```
clientCertificateKeyStoreUrl=file:path_to_truststore_file  
clientCertificateKeyStorePassword=mypassword
```

Notice that when used together, the connection properties override the values set by the other two methods. Also, whatever values set with connection properties are used in that connection only, while values set using the system-wide values are used for all connections (unless overridden by the connection properties).

With the above setups , all connections established are going to be SSL-encrypted with the client being authenticated in the SSL handshake process, and the server can now safely trust the client that is requesting a connection to it.

Setting up 2-Way Authentication

Apply the steps outlined in both [Setting up Server Authentication](#) and [Setting up Client Authentication](#) to set up a mutual, two-way authentication process in which the server and the client authenticate each other before establishing a connection.

Although the typical setup described above uses the same CA certificate in both ends for mutual authentication, it does not have to be the case. The only requirements are that the CA certificate configured in the server must be able to validate the client certificate and the CA certificate imported into the client truststore must be able to validate the server certificate; the two CA certificates used on the two ends can be distinct.

Debugging an SSL Connection

JSSE provides debugging information to `stdout` when you set the system property – `Djavax.net.debug=all`. Java then tells you what keystores and truststores are being used, as well as what is going on during the SSL handshake and certificate exchange. That will be helpful when you are trying to debug a failed SSL connection.

3.5.8 Connecting Using Unix Domain Sockets

Connector/J does not natively support connections to MySQL Servers with Unix domain sockets. However, there is provision for using 3rd-party libraries that supply the function via a pluggable socket factory. Such a custom factory should implement the `com.mysql.cj.protocol.SocketFactory` interface or the legacy `com.mysql.jdbc.SocketFactory` interface of Connector/J. Follow these requirements when you use such a custom socket factory for Unix sockets :

- The MySQL Server must be configured with the system variable `--socket` (for native protocol connections using the JDBC API) or `--mysqlx-socket` (for X Protocol connections using the X DevAPI), which must contain the file path of the Unix socket file.
- The fully-qualified class name of the custom factory should be passed to Connector/J via the connection property `socketFactory`. For example, with the junixsocket library, set:

```
socketFactory=org.newsclub.net.mysql.AFUNIXDatabaseSocketFactory
```

You might also need to pass other parameters to the custom factory as connection properties. For example, for the junixsocket library, provide the file path of the socket file with the property `junixsocket.file`:

```
junixsocket.file=path_to_socket_file
```

- When using the X Protocol, set the connection property `xdevapi.useAsyncProtocol=false` (that is the default setting for Connector/J 8.0.12 and later). Unix socket is not supported for asynchronous socket channels. When `xdevapi.useAsyncProtocol=true`, the `socketFactory` property is ignored.

Note

For X Protocol connections, the provision to use custom socket factory for Unix socket connections is only available for Connector/J 8.0.12 and later.

3.5.9 Connecting Using Named Pipes

Important

For MySQL 8.0.14 and later, 5.7.25 and later, and 5.6.43 and later, minimal permissions on named pipes are granted to clients that use them to connect to the server. Connector/J, however, can only use named pipes when granted full access on them. As a workaround, the MySQL Server that Connector/J wants to connect to must be started with the system variable `named_pipe_full_access_group`, which specifies a Windows local group containing the user by which the client application JVM (and thus Connector/J) is being executed; see the description for `named_pipe_full_access_group` for more details.

Note

Support for named pipes is not available for X Protocol connections.

Connector/J also supports access to MySQL using named pipes on Windows platforms with the `NamedPipeSocketFactory` as a plugin-sockets factory. If you do not use a `namedPipePath` property, the default of '`\.\pipe\MySQL`' is used. If you use the `NamedPipeSocketFactory`, the host name and port number values in the JDBC URL are ignored. To enable this feature, set the `socketFactory` property:

```
socketFactory=com.mysql.cj.protocol.NamedPipeSocketFactory
```

Set this property, as well as the path of the named pipe, with the following connection URL:

```
jdbc:mysql:///test?socketFactory=com.mysql.cj.protocol.NamedPipeSocketFactory&namedPipePath=\.\pipe\MySQL
```

To create your own socket factories, follow the sample code in `com.mysql.cj.protocol.NamedPipeSocketFactory` or `com.mysql.cj.protocol.StandardSocketFactory`.

An alternate approach is to use the following two properties in connection URLs for establishing named pipe connections on Windows platforms:

- (`protocol=pipe`) for named pipes (default value for the property is `tcp`).
- (`path=path_to_pipe`) for path of named pipes. Default value for the path is `\.\pipe\MySQL`.

The “address-equals” or “key-value” form of host specification (see [Single host \[42\]](#) for details) greatly simplifies the URL for a named pipe connection on Windows. For example, to use the default named pipe of “`\.\pipe\MySQL`,” just specify:

```
jdbc:mysql://address=(protocol=pipe)/test
```

To use the custom named pipe of “`\.\pipe\MySQL80`”:

```
jdbc:mysql://address=(protocol=pipe)(path=\.\pipe\MySQL80)/test
```

With (`protocol=pipe`), the `NamedPipeSocketFactory` is automatically selected.

Named pipes only work when connecting to a MySQL server on the same physical machine where the JDBC driver is running. In simple performance tests, named pipe access is between 30%-50% faster than the standard TCP/IP access. However, this varies per system, and named pipes are slower than TCP/IP in many Windows configurations.

3.5.10 Connecting Using PAM Authentication

Java applications using Connector/J can connect to MySQL servers that use the pluggable authentication module (PAM) authentication scheme.

For PAM authentication to work, you must have the following:

- A MySQL server that supports PAM authentication. See [PAM Pluggable Authentication](#) for more information. Connector/J implements the same cleartext authentication method as in [Client-Side Cleartext Pluggable Authentication](#).
- SSL capability, as explained in [Section 3.5.7, “Connecting Securely Using SSL”](#). Because the PAM authentication scheme sends the original password to the server, the connection to the server must be encrypted.

PAM authentication support is enabled by default in Connector/J 8.0, so no extra configuration is needed.

To disable the PAM authentication feature, specify `mysql_clear_password` (the method) or `com.mysql.cj.protocol.a.authentication.MysqlClearPasswordPlugin` (the class name) in the comma-separated list of arguments for the `disabledAuthenticationPlugins` connection option. See [Section 3.5.3, “Configuration Properties”](#) for details about that connection option.

3.5.11 Using Master/Slave Replication with ReplicationConnection

See [Section 3.8.4, “Configuring Master/Slave Replication with Connector/J”](#) for details on the topic.

3.5.12 Support for DNS SRV Records

Connector/J supports the use of DNS SRV records for connections since release 8.0.19.

Where multiple MySQL instances provide the same service for your applications, DNS SRV records can be used to provide failover, load balancing, and replication services. They remove the need for clients to identify each possible host in the connection string, or for connections to be handled by an additional software component. Here is a summary for Connector/J's support for DNS SRV records:

- These new schemas in the connection URLs enable DNS SRV record support:
 - `jdbc:mysql+srv`: For ordinary and basic failover JDBC connections that make use of DNS SRV records.
 - `jdbc:mysql+srv:loadbalance`: For load-balancing JDBC connections that make use of DNS SRV records.
 - `jdbc:mysql+srv:replication`: For replication JDBC connections that make use of DNS SRV records.
 - `mysqlx+srv`: For X DevAPI connections that make use of DNS SRV records.
- Besides using the new schemas in the connection URLs, DNS SRV record support can be enabled or disabled using the two new connection properties, `dnsSrv` and `xdevapi.dns-srv`, for JDBC and X DevAPI connections respectively. For example, this connection URL enables DNS SRV record support:

```
mysqlx://johndoe:secret@_mysql._tcp.mycompany.local/db?xdevapi.dns-srv=true
```

However, using the DNS SRV schema with the DNS SRV connection properties set to `false` results in an error; for example:

```
mysqlx+srv://johndoe:secret@_mysql._tcp.mycompany.local/db?xdevapi.dns-srv=false  
# The connection URL causes Connector/J to throw an error
```

Here are some requirements and restrictions on the DNS SRV record support by Connector/J:

- Connection/J throws an exception if multiple hosts are specified in the connection URL for a DNS SRV connection (except for a replication set up, created using `jdbc:mysql+srv:replication`, which requires exactly one master and one slave server to be specified).
- Connection/J throws an exception if a port number is specified in the connection URL for a DNS SRV connection.
- DNS SRV records are supported only for TCP/IP connections. Connection/J throws an exception if you attempt to enable DNS SRV record support Windows named pipe connections.

DNS SRV Record Support for Load Balancing and Failover. For load-balancing and failover connections, Connector/J uses the `priority` field of the DNS SRV records to decide on the priorities for connection attempts for hosts.

DNS SRV Record Support for Connection Pooling. In an X DevAPI connection pooling setup, Connector/J re-query the DNS SRV records regularly and phase out gracefully any connections whose hosts no longer appear in the records, and readmit the connections into the pool when their hosts reappear in the records.

Looking up DNS SRV Records. It is the users' responsibility to provide a full service host name; Connector/J does not append any prefix nor validate the host name structure. The following are examples of valid service host name patterns:

- `foo.domain.local`
- `_mysql._tcp.foo.domain.local`
- `_mysqlx._tcp.foo.domain.local`
- `_readonly._tcp.foo.domain.local`
- `_readwrite._tcp.foo.domain.local`

See *Connections Using DNS SRV Records* in the [X DevAPI User Guide](#) for details.

3.5.13 Mapping MySQL Error Numbers to JDBC SQLState Codes

The table below provides a mapping of the MySQL error numbers to JDBC `SQLState` values.

Table 3.8 Mapping of MySQL Error Numbers to SQLStates

MySQL Error Number	MySQL Error Name	SQL Standard SQLState
1022	ER_DUP_KEY	23000
1037	ER_OUTOFMEMORY	HY001
1038	ER_OUT_OF_SORTMEMORY	HY001
1040	ER_CON_COUNT_ERROR	08004
1042	ER_BAD_HOST_ERROR	08S01
1043	ER_HANDSHAKE_ERROR	08S01
1044	ER_DBACCESS_DENIED_ERROR	42000
1045	ER_ACCESS_DENIED_ERROR	28000
1046	ER_NO_DB_ERROR	3D000
1047	ER_UNKNOWN_COM_ERROR	08S01
1048	ER_BAD_NULL_ERROR	23000
1049	ER_BAD_DB_ERROR	42000
1050	ER_TABLE_EXISTS_ERROR	42S01

MySQL Error Number	MySQL Error Name	SQL Standard SQLState
1051	ER_BAD_TABLE_ERROR	42S02
1052	ER_NON_UNIQ_ERROR	23000
1053	ER_SERVER_SHUTDOWN	08S01
1054	ER_BAD_FIELD_ERROR	42S22
1055	ER_WRONG_FIELD_WITH_GROUP	42000
1056	ER_WRONG_GROUP_FIELD	42000
1057	ER_WRONG_SUM_SELECT	42000
1058	ER_WRONG_VALUE_COUNT	21S01
1059	ER_TOO_LONG_IDENT	42000
1060	ER_DUP_FIELDNAME	42S21
1061	ER_DUP_KEYNAME	42000
1062	ER_DUP_ENTRY	23000
1063	ER_WRONG_FIELD_SPEC	42000
1064	ER_PARSE_ERROR	42000
1065	ER_EMPTY_QUERY	42000
1066	ER_NONUNIQ_TABLE	42000
1067	ER_INVALID_DEFAULT	42000
1068	ER_MULTIPLE_PRI_KEY	42000
1069	ER_TOO_MANY_KEYS	42000
1070	ER_TOO_MANY_KEY_PARTS	42000
1071	ER_TOO_LONG_KEY	42000
1072	ER_KEY_COLUMN_DOES_NOT_EXISTS	42000
1073	ER_BLOB_USED_AS_KEY	42000
1074	ER_TOO_BIG_FIELDLENGTH	42000
1075	ER_WRONG_AUTO_KEY	42000
1080	ER_FORCING_CLOSE	08S01
1081	ER_IPSOCK_ERROR	08S01
1082	ER_NO_SUCH_INDEX	42S12
1083	ER_WRONG_FIELD_TERMINATORS	42000
1084	ER_BLOBS_AND_NO_TERMINATED	42000
1090	ER_CANT_REMOVE_ALL_FIELDS	42000
1091	ER_CANT_DROP_FIELD_OR_KEY	42000
1101	ER_BLOB_CANT_HAVE_DEFAULT	42000
1102	ER_WRONG_DB_NAME	42000
1103	ER_WRONG_TABLE_NAME	42000
1104	ER_TOO_BIG_SELECT	42000
1106	ER_UNKNOWN_PROCEDURE	42000
1107	ER_WRONG_PARAMCOUNT_TO_PROCEDURE	42000
1109	ER_UNKNOWN_TABLE	42S02

MySQL Error Number	MySQL Error Name	SQL Standard SQLState
1110	ER_FIELD_SPECIFIED_TWICE	42000
1112	ER_UNSUPPORTED_EXTENSION	42000
1113	ER_TABLE_MUST_HAVE_COLUMNS	42000
1115	ER_UNKNOWN_CHARACTER_SET	42000
1118	ER_TOO_BIG_ROWSIZE	42000
1120	ER_WRONG_OUTER_JOIN	42000
1121	ER_NULL_COLUMN_IN_INDEX	42000
1131	ER_PASSWORD_ANONYMOUS_USER	42000
1132	ER_PASSWORD_NOT_ALLOWED	42000
1133	ER_PASSWORD_NO_MATCH	42000
1136	ER_WRONG_VALUE_COUNT_ON_ROW	21S01
1138	ER_INVALID_USE_OF_NULL	22004
1139	ER_REGEXP_ERROR	42000
1140	ER_MIX_OF_GROUP_FUNC_AND_FIELDS	42000
1141	ER_NONEXISTING_GRANT	42000
1142	ER_TABLEACCESS_DENIED_ERROR	42000
1143	ER_COLUMNACCESS_DENIED_ERROR	42000
1144	ER_ILLEGAL_GRANT_FOR_TABLE	42000
1145	ER_GRANT_WRONG_HOST_OR_USER	42000
1146	ER_NO_SUCH_TABLE	42S02
1147	ER_NONEXISTING_TABLE_GRANT	42000
1148	ER_NOT_ALLOWED_COMMAND	42000
1149	ER_SYNTAX_ERROR	42000
1152	ER_ABORTING_CONNECTION	08S01
1153	ER_NET_PACKET_TOO_LARGE	08S01
1154	ER_NET_READ_ERROR_FROM_PIPE	08S01
1155	ER_NET_FCNTL_ERROR	08S01
1156	ER_NET_PACKETS_OUT_OF_ORDER	08S01
1157	ER_NET_UNCOMPRESS_ERROR	08S01
1158	ER_NET_READ_ERROR	08S01
1159	ER_NET_READ_INTERRUPTED	08S01
1160	ER_NET_ERROR_ON_WRITE	08S01
1161	ER_NET_WRITE_INTERRUPTED	08S01
1162	ER_TOO_LONG_STRING	42000
1163	ER_TABLE_CANT_HANDLE_BLOB	42000
1164	ER_TABLE_CANT_HANDLE_AUTO_INCREMENT	42000
1166	ER_WRONG_COLUMN_NAME	42000
1167	ER_WRONG_KEY_COLUMN	42000
1169	ER_DUP_UNIQUE	23000

MySQL Error Number	MySQL Error Name	SQL Standard SQLState
1170	ER_BLOB_KEY_WITHOUT_LENGTH	42000
1171	ER_PRIMARY_CANT_HAVE_NULL	42000
1172	ER_TOO_MANY_ROWS	42000
1173	ER_REQUIRES_PRIMARY_KEY	42000
1176	ER_KEY_DOES_NOT_EXISTS	42000
1177	ER_CHECK_NO SUCH_TABLE	42000
1178	ER_CHECK_NOT_IMPLEMENTED	42000
1179	ER_CANT_DO_THIS_DURING_AN_TRANSACTION	25000
1184	ER_NEW_ABORTING_CONNECTION	08S01
1189	ER_MASTER_NET_READ	08S01
1190	ER_MASTER_NET_WRITE	08S01
1203	ER_TOO_MANY_USER_CONNECTIONS	42000
1205	ER_LOCK_WAIT_TIMEOUT	40001
1207	ER_READ_ONLY_TRANSACTION	25000
1211	ER_NO_PERMISSION_TO_CREATE_USER	42000
1213	ER_LOCK_DEADLOCK	40001
1216	ER_NO_REFERENCED_ROW	23000
1217	ER_ROW_IS_REFERENCED	23000
1218	ER_CONNECT_TO_MASTER	08S01
1222	ER_WRONG_NUMBER_OF_COLUMNS_IN_SELECT	21000
1226	ER_USER_LIMIT_REACHED	42000
1227	ER_SPECIFIC_ACCESS_DENIED_ERROR	42000
1230	ER_NO_DEFAULT	42000
1231	ER_WRONG_VALUE_FOR_VAR	42000
1232	ER_WRONG_TYPE_FOR_VAR	42000
1234	ER_CANT_USE_OPTION_HERE	42000
1235	ER_NOT_SUPPORTED_YET	42000
1239	ER_WRONG_FK_DEF	42000
1241	ER_OPERAND_COLUMNS	21000
1242	ER_SUBQUERY_NO_1_ROW	21000
1247	ER_ILLEGAL_REFERENCE	42S22
1248	ER_DERIVED_MUST_HAVE_ALIAS	42000
1249	ER_SELECT_REDUCED	01000
1250	ER_TABLENAME_NOT_ALLOWED_HERE	42000
1251	ER_NOT_SUPPORTED_AUTH_MODE	08004
1252	ER_SPATIAL_CANT_HAVE_NULL	42000
1253	ER_COLLATION_CHARSET_MISMATCH	42000
1261	ER_WARN_TOO_FEW_RECORDS	01000
1262	ER_WARN_TOO_MANY_RECORDS	01000

MySQL Error Number	MySQL Error Name	SQL Standard SQLState
1263	ER_WARN_NULL_TO_NOTNULL	22004
1264	ER_WARN_DATA_OUT_OF_RANGE	22003
1265	ER_WARN_DATA_TRUNCATED	01000
1280	ER_WRONG_NAME_FOR_INDEX	42000
1281	ER_WRONG_NAME_FOR_CATALOG	42000
1286	ER_UNKNOWN_STORAGE_ENGINE	42000
1292	ER_TRUNCATED_WRONG_VALUE	22007
1303	ER_SP_NO_RECURSIVE_CREATE	2F003
1304	ER_SP_ALREADY_EXISTS	42000
1305	ER_SP_DOES_NOT_EXIST	42000
1308	ER_SP_LILABEL_MISMATCH	42000
1309	ER_SP_LABEL_REDEFINE	42000
1310	ER_SP_LABEL_MISMATCH	42000
1311	ER_SP_UNINIT_VAR	01000
1312	ER_SP_BADSELECT	0A000
1313	ER_SP_BADRETURN	42000
1314	ER_SP_BADSTATEMENT	0A000
1315	ER_UPDATE_LOG_DEPRECATED_IGNORED	42000
1316	ER_UPDATE_LOG_DEPRECATED_TRANSLATED	42000
1317	ER_QUERY_INTERRUPTED	70100
1318	ER_SP_WRONG_NO_OF_ARGS	42000
1319	ER_SP_COND_MISMATCH	42000
1320	ER_SP_NORETURN	42000
1321	ER_SP_NORETURNEND	2F005
1322	ER_SP_BAD_CURSOR_QUERY	42000
1323	ER_SP_BAD_CURSOR_SELECT	42000
1324	ER_SP_CURSOR_MISMATCH	42000
1325	ER_SP_CURSOR_ALREADY_OPEN	24000
1326	ER_SP_CURSOR_NOT_OPEN	24000
1327	ER_SP_UNDECLARED_VAR	42000
1329	ER_SP_FETCH_NO_DATA	02000
1330	ER_SP_DUP_PARAM	42000
1331	ER_SP_DUP_VAR	42000
1332	ER_SP_DUP_COND	42000
1333	ER_SP_DUP_CURS	42000
1335	ER_SP_SUBSELECT_NYI	0A000
1336	ER_STMT_NOT_ALLOWED_IN_SF_OR_TRG	0A000
1337	ER_SP_VARCOND_AFTER_CURSHNDLR	42000
1338	ER_SP_CURSOR_AFTER_HANDLER	42000

MySQL Error Number	MySQL Error Name	SQL Standard SQLState
1339	ER_SP_CASE_NOT_FOUND	20000
1365	ER_DIVISION_BY_ZERO	22012
1367	ER_ILLEGAL_VALUE_FOR_TYPE	22007
1370	ER_PROCACCESS_DENIED_ERROR	42000
1397	ER_XAER_NOTA	XAE04
1398	ER_XAER_INVAL	XAE05
1399	ER_XAER_RMFAIL	XAE07
1400	ER_XAER_OUTSIDE	XAE09
1401	ER_XA_RMERR	XAE03
1402	ER_XA_RBROLLBACK	XA100
1403	ER_NONEXISTING_PROC_GRANT	42000
1406	ER_DATA_TOO_LONG	22001
1407	ER_SP_BAD_SQLSTATE	42000
1410	ER_CANT_CREATE_USER_WITH_GRANT	42000
1413	ER_SP_DUP_HANDLER	42000
1414	ER_SP_NOT_VAR_ARG	42000
1415	ER_SP_NO_RETSET	0A000
1416	ER_CANT_CREATE_GEOMETRY_OBJECT	22003
1425	ER_TOO_BIG_SCALE	42000
1426	ER_TOO_BIG_PRECISION	42000
1427	ER_M_BIGGER_THAN_D	42000
1437	ER_TOO_LONG_BODY	42000
1439	ER_TOO_BIG_DISPLAYWIDTH	42000
1440	ER_XAER_DUPID	XAE08
1441	ER_DATETIME_FUNCTION_OVERFLOW	22008
1451	ER_ROW_IS_REFERENCED_2	23000
1452	ER_NO_REFERENCED_ROW_2	23000
1453	ER_SP_BAD_VAR_SHADOW	42000
1458	ER_SP_WRONG_NAME	42000
1460	ER_SP_NO_AGGREGATE	42000
1461	ER_MAX_PREPARED_STMT_COUNT_REACHED	42000
1463	ER_NON_GROUPING_FIELD_USED	42000
1557	ER_FOREIGN_DUPLICATE_KEY	23000
1568	ER_CANT_CHANGE_TX_ISOLATION	25001
1582	ER_WRONG_PARAMCOUNT_TO_NATIVE_FCT	42000
1583	ER_WRONG_PARAMETERS_TO_NATIVE_FCT	42000
1584	ER_WRONG_PARAMETERS_TO_STORED_FCT	42000
1586	ER_DUP_ENTRY_WITH_KEY_NAME	23000
1613	ER_XA_RBTIMEOUT	XA106

MySQL Error Number	MySQL Error Name	SQL Standard SQLState
1614	ER_XA_RBDEADLOCK	XA102
1630	ER_FUNC_INEXISTENT_NAME_COLLISION	42000
1641	ER_DUP_SIGNAL_SET	42000
1642	ER_SIGNAL_WARN	01000
1643	ER_SIGNAL_NOT_FOUND	02000
1645	ER_RESIGNAL_WITHOUT_ACTIVE_HANDLER	0K000
1687	ER_SPATIAL_MUST_HAVE_GEOM_COL	42000
1690	ER_DATA_OUT_OF_RANGE	22003
1698	ER_ACCESS_DENIED_NO_PASSWORD_ERROR	28000
1701	ER_TRUNCATE_ILLEGAL_FK	42000
1758	ER_DA_INVALID_CONDITION_NUMBER	35000
1761	ER_FOREIGN_DUPLICATE_KEY_WITH_CHILD_INFO	23000
1762	ER_FOREIGN_DUPLICATE_KEY_WITHOUT_CHILD_INFO	23000
1792	ER_CANT_EXECUTE_IN_READ_ONLY_TRANSACTION	25006
1845	ER_ALTER_OPERATION_NOT_SUPPORTED	0A000
1846	ER_ALTER_OPERATION_NOT_SUPPORTED_REASON	0A000
1859	ER_DUP_UNKNOWN_IN_INDEX	23000
1873	ER_ACCESS_DENIED_CHANGE_USER_ERROR	28000
1887	ER_GET_STACKED_DA_WITHOUT_ACTIVE_HANDLER	0Z002
1903	ER_INVALID_ARGUMENT_FOR_LOGARITHM	2201E

3.6 JDBC Concepts

This section provides some general JDBC background.

3.6.1 Connecting to MySQL Using the JDBC `DriverManager` Interface

When you are using JDBC outside of an application server, the `DriverManager` class manages the establishment of connections.

Specify to the `DriverManager` which JDBC drivers to try to make Connections with. The easiest way to do this is to use `Class.forName()` on the class that implements the `java.sql.Driver` interface. With MySQL Connector/J, the name of this class is `com.mysql.cj.jdbc.Driver`. With this method, you could use an external configuration file to supply the driver class name and driver parameters to use when connecting to a database.

The following section of Java code shows how you might register MySQL Connector/J from the `main()` method of your application. If testing this code, first read the installation section at [Section 3.3, “Connector/J Installation”](#), to make sure you have connector installed correctly and the `CLASSPATH` set up. Also, ensure that MySQL is configured to accept external TCP/IP connections.

```
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.SQLException;
// Notice, do not import com.mysql.cj.jdbc.*
// or you will have problems!
public class LoadDriver {
    public static void main(String[] args) {
```

```
    try {
        // The newInstance() call is a work around for some
        // broken Java implementations
        Class.forName("com.mysql.cj.jdbc.Driver").newInstance();
    } catch (Exception ex) {
        // handle the error
    }
}
```

After the driver has been registered with the `DriverManager`, you can obtain a `Connection` instance that is connected to a particular database by calling `DriverManager.getConnection()`:

Example 3.1 Connector/J: Obtaining a connection from the `DriverManager`

If you have not already done so, please review the portion of [Section 3.6.1, “Connecting to MySQL Using the JDBC `DriverManager` Interface”](#) above before working with the example below.

This example shows how you can obtain a `Connection` instance from the `DriverManager`. There are a few different signatures for the `getConnection()` method. Consult the API documentation that comes with your JDK for more specific information on how to use them.

```
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.SQLException;
Connection conn = null;
...
try {
    conn =
        DriverManager.getConnection("jdbc:mysql://localhost/test?" +
            "user=minty&password=greatsqladb");
    // Do something with the Connection
    ...
} catch (SQLException ex) {
    // handle any errors
    System.out.println("SQLException: " + ex.getMessage());
    System.out.println("SQLState: " + ex.getSQLState());
    System.out.println("VendorError: " + ex.getErrorCode());
}
```

Once a `Connection` is established, it can be used to create `Statement` and `PreparedStatement` objects, as well as retrieve metadata about the database. This is explained in the following sections.

3.6.2 Using JDBC `Statement` Objects to Execute SQL

`Statement` objects allow you to execute basic SQL queries and retrieve the results through the `ResultSet` class, which is described later.

To create a `Statement` instance, you call the `createStatement()` method on the `Connection` object you have retrieved using one of the `DriverManager.getConnection()` or `DataSource.getConnection()` methods described earlier.

Once you have a `Statement` instance, you can execute a `SELECT` query by calling the `executeQuery(String)` method with the SQL you want to use.

To update data in the database, use the `executeUpdate(String SQL)` method. This method returns the number of rows matched by the update statement, not the number of rows that were modified.

If you do not know ahead of time whether the SQL statement will be a `SELECT` or an `UPDATE/INSERT`, then you can use the `execute(String SQL)` method. This method will return true if the SQL query was a `SELECT`, or false if it was an `UPDATE`, `INSERT`, or `DELETE` statement. If the statement was a `SELECT` query, you can retrieve the results by calling the `getResultSet()` method. If the statement

was an `UPDATE`, `INSERT`, or `DELETE` statement, you can retrieve the affected rows count by calling `getUpdateCount()` on the `Statement` instance.

Example 3.2 Connector/J: Using `java.sql.Statement` to execute a `SELECT` query

```
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.SQLException;
import java.sql.Statement;
import java.sql.ResultSet;
// assume that conn is an already created JDBC connection (see previous examples)
Statement stmt = null;
ResultSet rs = null;
try {
    stmt = conn.createStatement();
    rs = stmt.executeQuery("SELECT foo FROM bar");
    // or alternatively, if you don't know ahead of time that
    // the query will be a SELECT...
    if (stmt.execute("SELECT foo FROM bar")) {
        rs = stmt.getResultSet();
    }
    // Now do something with the ResultSet ....
}
catch (SQLException ex){
    // handle any errors
    System.out.println("SQLException: " + ex.getMessage());
    System.out.println("SQLState: " + ex.getSQLState());
    System.out.println("VendorError: " + ex.getErrorCode());
}
finally {
    // it is a good idea to release
    // resources in a finally{} block
    // in reverse-order of their creation
    // if they are no-longer needed
    if (rs != null) {
        try {
            rs.close();
        } catch (SQLException sqlEx) { } // ignore
        rs = null;
    }
    if (stmt != null) {
        try {
            stmt.close();
        } catch (SQLException sqlEx) { } // ignore
        stmt = null;
    }
}
```

3.6.3 Using JDBC `CallableStatements` to Execute Stored Procedures

Connector/J fully implements the `java.sql.CallableStatement` interface.

For more information on MySQL stored procedures, please refer to [Using Stored Routines](#).

Connector/J exposes stored procedure functionality through JDBC's `CallableStatement` interface.

The following example shows a stored procedure that returns the value of `inOutParam` incremented by 1, and the string passed in using `inputParam` as a `ResultSet`:

Example 3.3 Connector/J: Calling Stored Procedures

```
CREATE PROCEDURE demoSp(IN inputParam VARCHAR(255), \
                       INOUT inOutParam INT)
BEGIN
    DECLARE z INT;
    SET z = inOutParam + 1;
```

```
SET inOutParam = z;
SELECT inputParam;
SELECT CONCAT('zyxw', inputParam);
END
```

To use the `demoSp` procedure with Connector/J, follow these steps:

1. Prepare the callable statement by using `Connection.prepareCall()`.

Notice that you have to use JDBC escape syntax, and that the parentheses surrounding the parameter placeholders are not optional:

Example 3.4 Connector/J: Using `Connection.prepareCall()`

```
import java.sql.CallableStatement;
...
// Prepare a call to the stored procedure 'demoSp'
// with two parameters
//
// Notice the use of JDBC-escape syntax ({call ...})
//
CallableStatement cStmt = conn.prepareCall("{call demoSp(?, ?)}");
cStmt.setString(1, "abcdefg");
```

Note

`Connection.prepareCall()` is an expensive method, due to the metadata retrieval that the driver performs to support output parameters. For performance reasons, minimize unnecessary calls to `Connection.prepareCall()` by reusing `CallableStatement` instances in your code.

2. Register the output parameters (if any exist)

To retrieve the values of output parameters (parameters specified as `OUT` or `INOUT` when you created the stored procedure), JDBC requires that they be specified before statement execution using the various `registerOutputParameter()` methods in the `CallableStatement` interface:

Example 3.5 Connector/J: Registering output parameters

```
import java.sql.Types;
...
// Connector/J supports both named and indexed
// output parameters. You can register output
// parameters using either method, as well
// as retrieve output parameters using either
// method, regardless of what method was
// used to register them.
//
// The following examples show how to use
// the various methods of registering
// output parameters (you should of course
// use only one registration per parameter).
//
//
// Registers the second parameter as output, and
// uses the type 'INTEGER' for values returned from
// getObject()
//
cStmt.registerOutParameter(2, Types.INTEGER);
//
// Registers the named parameter 'inOutParam', and
// uses the type 'INTEGER' for values returned from
// getObject()
//
```

```
cStmt.registerOutParameter("inOutParam", Types.INTEGER);
...
```

3. Set the input parameters (if any exist)

Input and in/out parameters are set as for [PreparedStatement](#) objects. However, [CallableStatement](#) also supports setting parameters by name:

Example 3.6 Connector/J: Setting CallableStatement input parameters

```
...
// Set a parameter by index
// 
cStmt.setString(1, "abcdefg");
//
// Alternatively, set a parameter using
// the parameter name
//
cStmt.setString("inputParam", "abcdefg");
//
// Set the 'in/out' parameter using an index
// 
cStmt.setInt(2, 1);
//
// Alternatively, set the 'in/out' parameter
// by name
//
cStmt.setInt("inOutParam", 1);
...
```

4. Execute the CallableStatement, and retrieve any result sets or output parameters.

Although [CallableStatement](#) supports calling any of the [Statement](#) execute methods ([executeUpdate\(\)](#), [executeQuery\(\)](#) or [execute\(\)](#)), the most flexible method to call is [execute\(\)](#), as you do not need to know ahead of time if the stored procedure returns result sets:

Example 3.7 Connector/J: Retrieving results and output parameter values

```
...
boolean hadResults = cStmt.execute();
//
// Process all returned result sets
//
while (hadResults) {
    ResultSet rs = cStmt.getResultSet();
    // process result set
    ...
    hadResults = cStmt.getMoreResults();
}
//
// Retrieve output parameters
//
// Connector/J supports both index-based and
// name-based retrieval
//
int outputValue = cStmt.getInt(2); // index-based
outputValue = cStmt.getInt("inOutParam"); // name-based
...
```

3.6.4 Retrieving AUTO_INCREMENT Column Values through JDBC

[getGeneratedKeys\(\)](#) is the preferred method to use if you need to retrieve [AUTO_INCREMENT](#) keys and through JDBC; this is illustrated in the first example below. The second example shows how you can retrieve the same value using a standard [SELECT LAST_INSERT_ID\(\)](#) query. The final example shows how updatable result sets can retrieve the [AUTO_INCREMENT](#) value when using the [insertRow\(\)](#) method.

Example 3.8 Connector/J: Retrieving AUTO_INCREMENT column values using Statement.getGeneratedKeys()

```
Statement stmt = null;
ResultSet rs = null;
try {
    //
    // Create a Statement instance that we can use for
    // 'normal' result sets assuming you have a
    // Connection 'conn' to a MySQL database already
    // available
    stmt = conn.createStatement();
    //
    // Issue the DDL queries for the table for this example
    //
    stmt.executeUpdate("DROP TABLE IF EXISTS autoIncTutorial");
    stmt.executeUpdate(
        "CREATE TABLE autoIncTutorial ("
        + "priKey INT NOT NULL AUTO_INCREMENT, "
        + "dataField VARCHAR(64), PRIMARY KEY (priKey))");

    //
    // Insert one row that will generate an AUTO INCREMENT
    // key in the 'priKey' field
    //
    stmt.executeUpdate(
        "INSERT INTO autoIncTutorial (dataField) "
        + "values ('Can I Get the Auto Increment Field?')");
    stmt.execute("SELECT LAST_INSERT_ID()");

    //
    // Example of using Statement.getGeneratedKeys()
    // to retrieve the value of an auto-increment
    // value
    //
    int autoIncKeyFromApi = -1;
    rs = stmt.getGeneratedKeys();
    if (rs.next()) {
        autoIncKeyFromApi = rs.getInt(1);
    } else {
        // throw an exception from here
    }
    System.out.println("Key returned from getGeneratedKeys():"
        + autoIncKeyFromApi);
} finally {
    if (rs != null) {
        try {
            rs.close();
        } catch (SQLException ex) {
            // ignore
        }
    }
    if (stmt != null) {
        try {
            stmt.close();
        } catch (SQLException ex) {
            // ignore
        }
    }
}
```

Example 3.9 Connector/J: Retrieving AUTO_INCREMENT column values using SELECT LAST_INSERT_ID()

```
Statement stmt = null;
ResultSet rs = null;
try {
    //
    // Create a Statement instance that we can use for
    // 'normal' result sets.
    stmt = conn.createStatement();
    //
    // Issue the DDL queries for the table for this example
    //
```

```

stmt.executeUpdate("DROP TABLE IF EXISTS autoIncTutorial");
stmt.executeUpdate(
    "CREATE TABLE autoIncTutorial (" +
    "priKey INT NOT NULL AUTO_INCREMENT, " +
    "dataField VARCHAR(64), PRIMARY KEY (priKey))";
//
// Insert one row that will generate an AUTO INCREMENT
// key in the 'priKey' field
//
stmt.executeUpdate(
    "INSERT INTO autoIncTutorial (dataField) " +
    "values ('Can I Get the Auto Increment Field?')");
//
// Use the MySQL LAST_INSERT_ID()
// function to do the same thing as getGeneratedKeys()
//
int autoIncKeyFromFunc = -1;
rs = stmt.executeQuery("SELECT LAST_INSERT_ID()");
if (rs.next()) {
    autoIncKeyFromFunc = rs.getInt(1);
} else {
    // throw an exception from here
}
System.out.println("Key returned from " +
    "'SELECT LAST_INSERT_ID()': " +
    autoIncKeyFromFunc);
} finally {
    if (rs != null) {
        try {
            rs.close();
        } catch (SQLException ex) {
            // ignore
        }
    }
    if (stmt != null) {
        try {
            stmt.close();
        } catch (SQLException ex) {
            // ignore
        }
    }
}
}

```

Example 3.10 Connector/J: Retrieving [AUTO_INCREMENT](#) column values in [Updatable ResultSets](#)

```

Statement stmt = null;
ResultSet rs = null;
try {
    //
    // Create a Statement instance that we can use for
    // 'normal' result sets as well as an 'updatable'
    // one, assuming you have a Connection 'conn' to
    // a MySQL database already available
    //
    stmt = conn.createStatement(java.sql.ResultSet.TYPE_FORWARD_ONLY,
                               java.sql.ResultSet.CONCUR_UPDATABLE);
    //
    // Issue the DDL queries for the table for this example
    //
    stmt.executeUpdate("DROP TABLE IF EXISTS autoIncTutorial");
    stmt.executeUpdate(
        "CREATE TABLE autoIncTutorial (" +
        "priKey INT NOT NULL AUTO_INCREMENT, " +
        "dataField VARCHAR(64), PRIMARY KEY (priKey))");
    //
    // Example of retrieving an AUTO INCREMENT key
    // from an updatable result set
    //
    rs = stmt.executeQuery("SELECT priKey, dataField " +
        "FROM autoIncTutorial");
    rs.moveToInsertRow();
}

```

```
rs.updateString("dataField", "AUTO INCREMENT here?");
rs.insertRow();
//
// the driver adds rows at the end
//
rs.last();
//
// We should now be on the row we just inserted
//
int autoIncKeyFromRS = rs.getInt("priKey");
System.out.println("Key returned for inserted row: "
    + autoIncKeyFromRS);
} finally {
    if (rs != null) {
        try {
            rs.close();
        } catch (SQLException ex) {
            // ignore
        }
    }
    if (stmt != null) {
        try {
            stmt.close();
        } catch (SQLException ex) {
            // ignore
        }
    }
}
```

Running the preceding example code should produce the following output:

```
Key returned from getGeneratedKeys(): 1
Key returned from SELECT LAST_INSERT_ID(): 1
Key returned for inserted row: 1
```

At times, it can be tricky to use the `SELECT LAST_INSERT_ID()` query, as that function's value is scoped to a connection. So, if some other query happens on the same connection, the value is overwritten. On the other hand, the `getGeneratedKeys()` method is scoped by the `Statement` instance, so it can be used even if other queries happen on the same connection, but not on the same `Statement` instance.

3.7 Connection Pooling with Connector/J

Connection pooling is a technique of creating and managing a pool of connections that are ready for use by any `thread` that needs them. Connection pooling can greatly increase the performance of your Java application, while reducing overall resource usage.

How Connection Pooling Works

Most applications only need a thread to have access to a JDBC connection when they are actively processing a `transaction`, which often takes only milliseconds to complete. When not processing a transaction, the connection sits idle. Connection pooling enables the idle connection to be used by some other thread to do useful work.

In practice, when a thread needs to do work against a MySQL or other database with JDBC, it requests a connection from the pool. When the thread is finished using the connection, it returns it to the pool, so that it can be used by any other threads.

When the connection is loaned out from the pool, it is used exclusively by the thread that requested it. From a programming point of view, it is the same as if your thread called `DriverManager.getConnection()` every time it needed a JDBC connection. With connection pooling, your thread may end up using either a new connection or an already-existing connection.

Benefits of Connection Pooling

The main benefits to connection pooling are:

- Reduced connection creation time.

Although this is not usually an issue with the quick connection setup that MySQL offers compared to other databases, creating new JDBC connections still incurs networking and JDBC driver overhead that will be avoided if connections are recycled.

- Simplified programming model.

When using connection pooling, each individual thread can act as though it has created its own JDBC connection, allowing you to use straightforward JDBC programming techniques.

- Controlled resource usage.

If you create a new connection every time a thread needs one rather than using connection pooling, your application's resource usage can be wasteful, and it could lead to unpredictable behaviors for your application when it is under a heavy load.

Using Connection Pooling with Connector/J

The concept of connection pooling in JDBC has been standardized through the JDBC 2.0 Optional interfaces, and all major application servers have implementations of these APIs that work with MySQL Connector/J.

Generally, you configure a connection pool in your application server configuration files, and access it through the Java Naming and Directory Interface (JNDI). The following code shows how you might use a connection pool from an application deployed in a J2EE application server:

Example 3.11 Connector/J: Using a connection pool with a J2EE application server

```
import java.sql.Connection;
import java.sql.SQLException;
import java.sql.Statement;
import javax.naming.InitialContext;
import javax.sql.DataSource;
public class MyServletJspOrEjb {
    public void doSomething() throws Exception {
        /*
         * Create a JNDI Initial context to be able to
         * lookup the DataSource
         *
         * In production-level code, this should be cached as
         * an instance or static variable, as it can
         * be quite expensive to create a JNDI context.
         *
         * Note: This code only works when you are using servlets
         * or EJBs in a J2EE application server. If you are
         * using connection pooling in standalone Java code, you
         * will have to create/configure datasources using whatever
         * mechanisms your particular connection pooling library
         * provides.
         */
        InitialContext ctx = new InitialContext();
        /*
         * Lookup the DataSource, which will be backed by a pool
         * that the application server provides. DataSource instances
         * are also a good candidate for caching as an instance
         * variable, as JNDI lookups can be expensive as well.
         */
        DataSource ds =
            (DataSource)ctx.lookup("java:comp/env/jdbc/MySQLDB");
        /*
         * The following code is what would actually be in your
         * Servlet, JSP or EJB 'service' method...where you need
         * to work with a JDBC connection.
         */
        Connection conn = null;
        Statement stmt = null;
```

```
try {
    conn = ds.getConnection();
    /*
     * Now, use normal JDBC programming to work with
     * MySQL, making sure to close each resource when you're
     * finished with it, which permits the connection pool
     * resources to be recovered as quickly as possible
     */
    stmt = conn.createStatement();
    stmt.execute("SOME SQL QUERY");
    stmt.close();
    stmt = null;
    conn.close();
    conn = null;
} finally {
    /*
     * close any jdbc instances here that weren't
     * explicitly closed during normal code path, so
     * that we don't 'leak' resources...
     */
    if (stmt != null) {
        try {
            stmt.close();
        } catch (SQLException sqlex) {
            // ignore, as we can't do anything about it here
        }
        stmt = null;
    }
    if (conn != null) {
        try {
            conn.close();
        } catch (SQLException sqlex) {
            // ignore, as we can't do anything about it here
        }
        conn = null;
    }
}
```

As shown in the example above, after obtaining the JNDI [InitialContext](#), and looking up the [DataSource](#), the rest of the code follows familiar JDBC conventions.

When using connection pooling, always make sure that connections, and anything created by them (such as statements or result sets) are closed. This rule applies no matter what happens in your code (exceptions, flow-of-control, and so forth). When these objects are closed, they can be re-used; otherwise, they will be stranded, which means that the MySQL server resources they represent (such as buffers, locks, or sockets) are tied up for some time, or in the worst case can be tied up forever.

Sizing the Connection Pool

Each connection to MySQL has overhead (memory, CPU, context switches, and so forth) on both the client and server side. Every connection limits how many resources there are available to your application as well as the MySQL server. Many of these resources will be used whether or not the connection is actually doing any useful work! Connection pools can be tuned to maximize performance, while keeping resource utilization below the point where your application will start to fail rather than just run slower.

The optimal size for the connection pool depends on anticipated load and average database transaction time. In practice, the optimal connection pool size can be smaller than you might expect. If you take Oracle's Java Petstore blueprint application for example, a connection pool of 15-20 connections can serve a relatively moderate load (600 concurrent users) using MySQL and Tomcat with acceptable response times.

To correctly size a connection pool for your application, create load test scripts with tools such as Apache JMeter or The Grinder, and load test your application.

An easy way to determine a starting point is to configure your connection pool's maximum number of connections to be unbounded, run a load test, and measure the largest amount of concurrently used connections. You can then work backward from there to determine what values of minimum and maximum pooled connections give the best performance for your particular application.

Validating Connections

MySQL Connector/J can validate the connection by executing a lightweight ping against a server. In the case of load-balanced connections, this is performed against all active pooled internal connections that are retained. This is beneficial to Java applications using connection pools, as the pool can use this feature to validate connections. Depending on your connection pool and configuration, this validation can be carried out at different times:

1. Before the pool returns a connection to the application.
2. When the application returns a connection to the pool.
3. During periodic checks of idle connections.

To use this feature, specify a validation query in your connection pool that starts with `/* ping */`. Note that the syntax must be exactly as specified. This will cause the driver send a ping to the server and return a dummy lightweight result set. When using a [ReplicationConnection](#) or [LoadBalancedConnection](#), the ping will be sent across all active connections.

It is critical that the syntax be specified correctly. The syntax needs to be exact for reasons of efficiency, as this test is done for every statement that is executed:

```
protected static final String PING_MARKER = "/* ping */";
...
if (sql.charAt(0) == '/') {
if (sql.startsWith(PING_MARKER)) {
doPingInstead();
...
}
```

None of the following snippets will work, because the ping syntax is sensitive to whitespace, capitalization, and placement:

```
sql = "/* PING */ SELECT 1";
sql = "SELECT 1 /* ping*/";
sql = "/*ping*/ SELECT 1";
sql = " /* ping */ SELECT 1";
sql = "/*to ping or not to ping*/ SELECT 1";
```

All of the previous statements will issue a normal [SELECT](#) statement and will **not** be transformed into the lightweight ping. Further, for load-balanced connections, the statement will be executed against one connection in the internal pool, rather than validating each underlying physical connection. This results in the non-active physical connections assuming a stale state, and they may die. If Connector/J then re-balances, it might select a dead connection, resulting in an exception being passed to the application. To help prevent this, you can use [loadBalanceValidateConnectionOnSwapServer](#) to validate the connection before use.

If your Connector/J deployment uses a connection pool that allows you to specify a validation query, take advantage of it, but ensure that the query starts *exactly* with `/* ping */`. This is particularly important if you are using the load-balancing or replication-aware features of Connector/J, as it will help keep alive connections which otherwise will go stale and die, causing problems later.

3.8 Multi-Host Connections

The following sections discuss a number of topics that involve multi-host connections, namely, server load-balancing, failover, and replication.

Developers should know the following things about multi-host connections that are managed through Connector/J:

- Each multi-host connection is a wrapper of the underlying physical connections.
- Each of the underlying physical connections has its own session. Sessions cannot be tracked, shared, or copied, given the MySQL architecture.
- Every switch between physical connections means a switch between sessions.
- Within a transaction boundary, there are no switches between physical connections. Beyond a transaction boundary, there is no guarantee that a switch does not occur.

Note

If an application reuses session-scope data (for example, variables, SSPs) beyond a transaction boundary, failures are possible, as a switch between the physical connections (which is also a switch between sessions) might occur. Therefore, the application should re-prepare the session data and also restart the last transaction in case of an exception, or it should re-prepare session data for each new transaction if it does not want to deal with exception handling.

3.8.1 Configuring Server Failover for Connections Using JDBC

MySQL Connector/J supports server failover. A failover happens when connection-related errors occur for an underlying, active connection. The connection errors are, by default, propagated to the client, which has to handle them by, for example, recreating the working objects (`Statement`, `ResultSet`, etc.) and restarting the processes. Sometimes, the driver might eventually fall back to the original host automatically before the client application continues to run, in which case the host switch is transparent and the client application will not even notice it.

A connection using failover support works just like a standard connection: the client does not experience any disruptions in the failover process. This means the client can rely on the same connection instance even if two successive statements might be executed on two different physical hosts. However, this does not mean the client does not have to deal with the exception that triggered the server switch.

The failover is configured at the initial setup stage of the server connection by the connection URL (see explanations for its format [here](#)):

```
jdbc:mysql://[primary host][:port],[secondary host 1][:port][,[secondary host 2][:port]]...[/[database]
[?propertyName1=propertyValue1[&propertyName2=propertyValue2]...]
```

The host list in the connection URL comprises of two types of hosts, the primary and the secondary. When starting a new connection, the driver always tries to connect to the primary host first and, if required, fails over to the secondary hosts on the list sequentially when communication problems are experienced. Even if the initial connection to the primary host fails and the driver gets connected to a secondary host, the primary host never loses its special status: for example, it can be configured with an access mode distinct from those of the secondary hosts, and it can be put on a higher priority when a host is to be picked during a failover process.

The failover support is configured by the following connection properties (their functions are explained in the paragraphs below):

- `failOverReadOnly`
- `secondsBeforeRetryMaster`
- `queriesBeforeRetryMaster`
- `retriesAllDown`
- `autoReconnect`

- `autoReconnectForPools`

Configuring Connection Access Mode

As with any standard connection, the initial connection to the primary host is in read/write mode. However, if the driver fails to establish the initial connection to the primary host and it automatically switches to the next host on the list, the access mode now depends on the value of the property `failOverReadOnly`, which is “true” by default. The same happens if the driver is initially connected to the primary host and, because of some connection failure, it fails over to a secondary host. Every time the connection falls back to the primary host, its access mode will be read/write, irrespective of whether or not the primary host has been connected to before. The connection access mode can be changed any time at runtime by calling the method `Connection.setReadOnly(boolean)`, which partially overrides the property `failOverReadOnly`. When `failOverReadOnly=false` and the access mode is explicitly set to either true or false, it becomes the mode for every connection after a host switch, no matter what host type are being connected to; but, if `failOverReadOnly=true`, changing the access mode to read/write is only possible if the driver is connecting to the primary host; however, even if the access mode cannot be changed for the current connection, the driver remembers the client's last intention and, when falling back to the primary host, that is the mode that will be used. For an illustration, see the following successions of events with a two-host connection.

- Sequence A, with `failOverReadOnly=true`:
 1. Connects to primary host in read/write mode
 2. Sets `Connection.setReadOnly(true)`; primary host now in read-only mode
 3. Failover event; connects to secondary host in read-only mode
 4. Sets `Connection.setReadOnly(false)`; secondary host remains in read-only mode
 5. Falls back to primary host; connection now in read/write mode
- Sequence B, with `failOverReadOnly=false`
 1. Connects to primary host in read/write mode
 2. Sets `Connection.setReadOnly(true)`; primary host now in read-only mode
 3. Failover event; connects to secondary host in read-only mode
 4. Set `Connection.setReadOnly(false)`; connection to secondary host switches to read/write mode
 5. Falls back to primary host; connection now in read/write mode

The difference between the two scenarios is in step 4: the access mode for the secondary host in sequence A does not change at that step, but the driver remembers and uses the set mode when falling back to the primary host, which would be read-only otherwise; but in sequence B, the access mode for the secondary host changes immediately.

Configuring Fallback to Primary Host

As already mentioned, the primary host is special in the failover arrangement when it comes to the host's access mode. Additionally, the driver tries to fall back to the primary host as soon as possible by default, even if no communication exception occurs. Two properties, `secondsBeforeRetryMaster` and `queriesBeforeRetryMaster`, determine when the driver is ready to retry a reconnection to the primary host (the `Master` in the property names stands for the primary host of our connection URL, which is not necessarily a master host in a replication setup):

- `secondsBeforeRetryMaster` determines how much time the driver waits before trying to fall back to the primary host

- `queriesBeforeRetryMaster` determines the number of queries that are executed before the driver tries to fall back to the primary host. Note that for the driver, each call to a `Statement.execute*()` method increments the query execution counter; therefore, when calls are made to `Statement.executeBatch()` or if `allowMultiQueries` or `rewriteBatchStatements` are enabled, the driver may not have an accurate count of the actual number of queries executed on the server. Also, the driver calls the `Statement.execute*()` methods internally in several occasions. All these mean you can only use `queriesBeforeRetryMaster` only as a coarse specification for when to fall back to the primary host.

In general, an attempt to fallback to the primary host is made when at least one of the conditions specified by the two properties is met, and the attempt always takes place at transaction boundaries. However, if auto-commit is turned off, the check happens only when the method `Connection.commit()` or `Connection.rollback()` is called. The automatic fallback to the primary host can be turned off by setting simultaneously `secondsBeforeRetryMaster` and `queriesBeforeRetryMaster` to "0". Setting only one of the properties to "0" only disables one part of the check.

Configuring Reconnection Attempts

When establishing a new connection or when a failover event occurs, the driver tries to connect successively to the next candidate on the host list. When the end of the list has been reached, it restarts all over again from the beginning of the list; however, the primary host is skipped over, if (a) NOT all the secondary hosts have already been tested at least once, AND (b) the fallback conditions defined by `secondsBeforeRetryMaster` and `queriesBeforeRetryMaster` are not yet fulfilled. Each run-through of the whole host list, (which is not necessarily completed at the end of the host list) counts as a single connection attempt. The driver tries as many connection attempts as specified by the value of the property `retriesAllDown`.

Seamless Reconnection

Although not recommended, you can make the driver perform failovers without invalidating the active `Statement` or `ResultSet` instances by setting either the parameter `autoReconnect` or `autoReconnectForPools` to `true`. This allows the client to continue using the same object instances after a failover event, without taking any exceptional measures. This, however, may lead to unexpected results: for example, if the driver is connected to the primary host with read/write access mode and it fails-over to a secondary host in real-only mode, further attempts to issue data-changing queries will result in errors, and the client will not be aware of that. This limitation is particularly relevant when using data streaming: after the failover, the `ResultSet` looks to be alright, but the underlying connection may have changed already, and no backing cursor is available anymore.

3.8.2 Configuring Server Failover for Connections Using X DevAPI

When using the X Protocol, Connector/J supports a client-side failover feature for establishing a Session. If multiple hosts are specified in the connection URL, when Connector/J fails to connect to a listed host, it tries to connect to another one. This is a sample X DevAPI URL for configuring client-side failover:

```
mysqlx://sandy:mypassword@[host1:33060,host2:33061]/test
```

With the client-side failover configured, when there is a failure to establish a connection, Connector/J keeps attempting to connect to a host on the host list. The order in which the hosts are attempted for connection is as follows:

- For connections with the `priority` property set for each host in the connection URL, hosts are attempted according to the set priorities for the hosts, which are specified by any numbers between 0 to 100, with a larger number indicating a higher priority for connection. For example:

```
mysqlx://sandy:mypassword@[ (address=host1:33060,priority=2) , (address=host2:33061,priority=1) ]/test
```

In this example, `host1` is always attempted before `host2` when new sessions are created.

Priorities should either be set for all or no hosts.

- For connections with the `priority` property NOT set for each host in the connection URL:
 - For release 8.0.19 and later, hosts are attempted one after another in a random order.
 - for release 8.0.18 and earlier, hosts are attempted one after another in the order they appear in the connection URL—a host appearing earlier in the list will be attempted before a host appearing later in the list.

Notice that the server failover feature for X DevAPI only allows for a failover when Connector/J is trying to establish a connection, but not during operations after a connection has already been made.

Connection Pooling Using X DevAPI. When using connection pooling with X DevAPI, Connector/J keeps track of any host it failed to connect to and, for a short waiting period after the failure, avoids connecting to it during the creation or retrieval of a `Session`. However, if all other hosts have already been tried, those excluded hosts will be retried without waiting. Once all hosts have been tried and no connections can be established, Connector/J throws a `com.mysql.cj.exceptions.CJCommunicationsException` and returns the message `Unable to connect to any of the target hosts`.

3.8.3 Configuring Load Balancing with Connector/J

Connector/J has long provided an effective means to distribute read/write load across multiple MySQL server instances for Cluster or master-master replication deployments. You can dynamically configure load-balanced connections, with no service outage. In-process transactions are not lost, and no application exceptions are generated if any application is trying to use that particular server instance.

The load balancing is configured at the initial setup stage of the server connection by the following connection URL, which has a similar format as the general JDBC URL for MySQL connection, but a specialized scheme:

```
jdbc:mysql:loadbalance://[host1][:port],[host2][:port][,[host3][:port]]...[[/database]] >
[?propertyName1=PropertyValue1[&propertyName2=PropertyValue2]...]
```

There are two configuration properties associated with this functionality:

- `loadBalanceConnectionGroup` – This provides the ability to group connections from different sources. This allows you to manage these JDBC sources within a single class loader in any combination you choose. If they use the same configuration, and you want to manage them as a logical single group, give them the same name. This is the key property for management: if you do not define a name (string) for `loadBalanceConnectionGroup`, you cannot manage the connections. All load-balanced connections sharing the same `loadBalanceConnectionGroup` value, regardless of how the application creates them, will be managed together.
- `ha.enableJMX` – The ability to manage the connections is exposed when you define a `loadBalanceConnectionGroup`; but if you want to manage this externally, enable JMX by setting this property to `true`. This enables a JMX implementation, which exposes the management and monitoring operations of a connection group. Further, start your application with the `-Dcom.sun.management.jmxremote` JVM flag. You can then perform connect and perform operations using a JMX client such as `jconsole`.

Once a connection has been made using the correct connection properties, a number of monitoring properties are available:

- Current active host count.
- Current active physical connection count.

- Current active logical connection count.
- Total logical connections created.
- Total transaction count.

The following management operations can also be performed:

- Add host.
- Remove host.

The JMX interface, `com.mysql.cj.jdbc.jmx.LoadBalanceConnectionGroupManagerMBean`, has the following methods:

- `int getActiveHostCount(String group);`
- `int getTotalHostCount(String group);`
- `long getTotalLogicalConnectionCount(String group);`
- `long getActiveLogicalConnectionCount(String group);`
- `long getActivePhysicalConnectionCount(String group);`
- `long getTotalPhysicalConnectionCount(String group);`
- `long getTotalTransactionCount(String group);`
- `void removeHost(String group, String host) throws SQLException;`
- `void stopNewConnectionsToHost(String group, String host) throws SQLException;`
- `void addHost(String group, String host, boolean forExisting);`
- `String getActiveHostsList(String group);`
- `String getRegisteredConnectionGroups();`

The `getRegisteredConnectionGroups()` method returns the names of all connection groups defined in that class loader.

You can test this setup with the following code:

```
public class Test {  
    private static String URL = "jdbc:mysql:loadbalance://" +  
        "localhost:3306,localhost:3310/test?" +  
        "loadBalanceConnectionGroup=first&ha.enableJMX=true";  
    public static void main(String[] args) throws Exception {  
        new Thread(new Repeater()).start();  
        new Thread(new Repeater()).start();  
        new Thread(new Repeater()).start();  
    }  
    static Connection getConnection() throws SQLException, ClassNotFoundException {  
        Class.forName("com.mysql.cj.jdbc.Driver");  
        return DriverManager.getConnection(URL, "root", "");  
    }  
    static void executeSimpleTransaction(Connection c, int conn, int trans){  
        try {  
            c.setAutoCommit(false);  
            Statement s = c.createStatement();  
            s.executeQuery("SELECT SLEEP(1) /* Connection: " + conn + ", transaction: " + trans + " */");  
            c.commit();  
        } catch (SQLException e) {  
            e.printStackTrace();  
        }  
    }  
}
```

```
        }
    public static class Repeater implements Runnable {
        public void run() {
            for(int i=0; i < 100; i++){
                try {
                    Connection c = getNewConnection();
                    for(int j=0; j < 10; j++){
                        executeSimpleTransaction(c, i, j);
                        Thread.sleep(Math.round(100 * Math.random()));
                    }
                    c.close();
                    Thread.sleep(100);
                } catch (Exception e) {
                    e.printStackTrace();
                }
            }
        }
    }
}
```

After compiling, the application can be started with the `-Dcom.sun.management.jmxremote` flag, to enable remote management. `jconsole` can then be started. The `Test` main class will be listed by `jconsole`. Select this and click **Connect**. You can then navigate to the `com.mysql.cj.jdbc.jmx.LoadBalanceConnectionGroupManager` bean. At this point, you can click on various operations and examine the returned result.

If you now had an additional instance of MySQL running on port 3309, you could ensure that Connector/J starts using it by using the `addHost()`, which is exposed in `jconsole`. Note that these operations can be performed dynamically without having to stop the application running.

For further information on the combination of load balancing and failover, see [Section 3.8.5, “Advanced Load-balancing and Failover Configuration”](#).

3.8.4 Configuring Master/Slave Replication with Connector/J

This section describe a number of features of Connector/J's support for replication-aware deployments.

The replication is configured at the initial setup stage of the server connection by the connection URL, which has a similar format as [the general JDBC URL for MySQL connection](#), but a specialized scheme:

```
jdbc:mysql:replication://[master host][:port],[slave host 1][:port][,[slave host 2][:port]]...[[/][database]]...[?propertyName1=propertyValue1[&propertyName2=propertyValue2]...]
```

Users may specify the property `allowMasterDownConnections=true` to allow `Connection` objects to be created even though no master hosts are reachable. Such `Connection` objects report they are read-only, and `isMasterConnection()` returns false for them. The `Connection` tests for available master hosts when `Connection.setReadOnly(false)` is called, throwing an `SQLException` if it cannot establish a connection to a master, or switching to a master connection if the host is available.

Users may specify the property `allowSlavesDownConnections=true` to allow `Connection` objects to be created even though no slave hosts are reachable. A `Connection` then, at runtime, tests for available slave hosts when `Connection.setReadOnly(true)` is called (see explanation for the method below), throwing an `SQLException` if it cannot establish a connection to a slave, unless the property `readFromMasterWhenNoSlaves` is set to be “true” (see below for a description of the property).

Scaling out Read Load by Distributing Read Traffic to Slaves

Connector/J supports replication-aware connections. It can automatically send queries to a read/write master, or a failover or round-robin loadbalanced set of slaves based on the state of `Connection.getReadOnly()`.

An application signals that it wants a transaction to be read-only by calling `Connection.setReadOnly(true)`. The replication-aware connection will use one of the

slave connections, which are load-balanced per slave host using a round-robin scheme. A given connection is sticky to a slave until a transaction boundary command (a commit or rollback) is issued, or until the slave is removed from service. After calling `Connection.setReadOnly(true)`, if you want to allow connection to a master when no slaves are available, set the property `readFromMasterWhenNoSlaves` to "true." Notice that the master host will be used in read-only state in those cases, as if it is a slave host. Also notice that setting `readFromMasterWhenNoSlaves=true` might result in an extra load for the master host in a transparent manner.

If you have a write transaction, or if you have a read that is time-sensitive (remember, replication in MySQL is asynchronous), set the connection to be not read-only, by calling `Connection.setReadOnly(false)` and the driver will ensure that further calls are sent to the master MySQL server. The driver takes care of propagating the current state of autocommit, isolation level, and catalog between all of the connections that it uses to accomplish this load balancing functionality.

To enable this functionality, use the specialized replication scheme (`jdbc:mysql:replication://`) when connecting to the server.

Here is a short example of how a replication-aware connection might be used in a standalone application:

```
import java.sql.Connection;
import java.sql.ResultSet;
import java.util.Properties;
import java.sql.DriverManager;
public class ReplicationDemo {
    public static void main(String[] args) throws Exception {

        Properties props = new Properties();
        // We want this for failover on the slaves
        props.put("autoReconnect", "true");
        // We want to load balance between the slaves
        props.put("roundRobinLoadBalance", "true");
        props.put("user", "foo");
        props.put("password", "password");
        //
        // Looks like a normal MySQL JDBC url, with a
        // comma-separated list of hosts, the first
        // being the 'master', the rest being any number
        // of slaves that the driver will load balance against
        //
        Connection conn =
            DriverManager.getConnection("jdbc:mysql:replication://master,slave1,slave2,slave3/test",
                props);
        //
        // Perform read/write work on the master
        // by setting the read-only flag to "false"
        //
        conn.setReadOnly(false);
        conn.setAutoCommit(false);
        conn.createStatement().executeUpdate("UPDATE some_table ....");
        conn.commit();
        //
        // Now, do a query from a slave, the driver automatically picks one
        // from the list
        //
        conn.setReadOnly(true);
        ResultSet rs =
            conn.createStatement().executeQuery("SELECT a,b FROM alt_table");
        ....
    }
}
```

Consider using the Load Balancing JDBC Pool ([1bpool](#)) tool, which provides a wrapper around the standard JDBC driver and enables you to use DB connection pools that includes checks for system failures and uneven load distribution. For more information, see [Load Balancing JDBC Driver for MySQL \(mysql-lbpool\)](#).

Support for Multiple-Master Replication Topographies

Connector/J supports multi-master replication topographies.

The connection URL for replication discussed earlier (i.e., in the format of `jdbc:mysql:replication://master,slave1,slave2,slave3/test`) assumes that the first (and only the first) host is the master. Supporting deployments with an arbitrary number of masters and slaves requires the "address-equals" URL syntax for multiple host connection discussed in [Section 3.5.2, “Connection URL Syntax”](#), with the property `type=[master|slave]`; for example:

```
jdbc:mysql:replication://address=(type=master)(host=master1host),address=(type=master)(host=master2host),ad
```

Connector/J uses a load-balanced connection internally for management of the master connections, which means that `ReplicationConnection`, when configured to use multiple masters, exposes the same options to balance load across master hosts as described in [Section 3.8.3, “Configuring Load Balancing with Connector/J”](#).

Live Reconfiguration of Replication Topography

Connector/J also supports live management of replication host (single or multi-master) topographies. This enables users to promote slaves for Java applications without requiring an application restart.

The replication hosts are most effectively managed in the context of a replication connection group. A `ReplicationConnectionGroup` class represents a logical grouping of connections which can be managed together. There may be one or more such replication connection groups in a given Java class loader (there can be an application with two different JDBC resources needing to be managed independently). This key class exposes host management methods for replication connections, and `ReplicationConnection` objects register themselves with the appropriate `ReplicationConnectionGroup` if a value for the new `replicationConnectionGroup` property is specified. The `ReplicationConnectionGroup` object tracks these connections until they are closed, and it is used to manipulate the hosts associated with these connections.

Some important methods related to host management include:

- `getMasterHosts()`: Returns a collection of strings representing the hosts configured as masters
- `getSlaveHosts()`: Returns a collection of strings representing the hosts configured as slaves
- `addSlaveHost(String host)`: Adds new host to pool of possible slave hosts for selection at start of new read-only workload
- `promoteSlaveToMaster(String host)`: Removes the host from the pool of potential slaves for future read-only processes (existing read-only process is allowed to continue to completion) and adds the host to the pool of potential master hosts
- `removeSlaveHost(String host, boolean closeGently)`: Removes the host (host name match must be exact) from the list of configured slaves; if `closeGently` is false, existing connections which have this host as currently active will be closed hardy (application should expect exceptions)
- `removeMasterHost(String host, boolean closeGently)`: Same as `removeSlaveHost()`, but removes the host from the list of configured masters

Some useful management metrics include:

- `getConnectionCountWithHostAsSlave(String host)`: Returns the number of `ReplicationConnection` objects that have the given host configured as a possible slave
- `getConnectionCountWithHostAsMaster(String host)`: Returns the number of `ReplicationConnection` objects that have the given host configured as a possible master
- `getNumberOfSlavesAdded()`: Returns the number of times a slave host has been dynamically added to the group pool

- `getNumberOfSlavesRemoved()`: Returns the number of times a slave host has been dynamically removed from the group pool
- `getNumberOfSlavePromotions()`: Returns the number of times a slave host has been promoted to a master
- `getTotalConnectionCount()`: Returns the number of `ReplicationConnection` objects which have been registered with this group
- `getActiveConnectionCount()`: Returns the number of `ReplicationConnection` objects currently being managed by this group

ReplicationConnectionGroupManager

`com.mysql.cj.jdbc.ha.ReplicationConnectionGroupManager` provides access to the replication connection groups, together with some utility methods.

- `getConnectionGroup(String groupName)`: Returns the `ReplicationConnectionGroup` object matching the `groupName` provided

The other methods in `ReplicationConnectionGroupManager` mirror those of `ReplicationConnectionGroup`, except that the first argument is a String group name. These methods will operate on all matching `ReplicationConnectionGroups`, which are helpful for removing a server from service and have it decommissioned across all possible `ReplicationConnectionGroups`.

These methods might be useful for in-JVM management of replication hosts if an application triggers topography changes. For managing host configurations from outside the JVM, JMX can be used.

Using JMX for Managing Replication Hosts

When Connector/J is started with `ha.enableJMX=true` and a value set for the property `replicationConnectionGroup`, a JMX MBean will be registered, allowing manipulation of replication hosts by a JMX client. The MBean interface is defined in `com.mysql.cj.jdbc.jmx.ReplicationGroupManagerMBean`, and leverages the `ReplicationConnectionGroupManager` static methods:

```
public abstract void addSlaveHost(String groupFilter, String host) throws SQLException;
public abstract void removeSlaveHost(String groupFilter, String host) throws SQLException;
public abstract void promoteSlaveToMaster(String groupFilter, String host) throws SQLException;
public abstract void removeMasterHost(String groupFilter, String host) throws SQLException;
public abstract String getMasterHostsList(String group);
public abstract String getSlaveHostsList(String group);
public abstract String getRegisteredConnectionGroups();
public abstract int getActiveMasterHostCount(String group);
public abstract int getActiveSlaveHostCount(String group);
public abstract int getSlavePromotionCount(String group);
public abstract long getTotalLogicalConnectionCount(String group);
public abstract long getActiveLogicalConnectionCount(String group);
```

3.8.5 Advanced Load-balancing and Failover Configuration

Connector/J provides a useful load-balancing implementation for MySQL Cluster or multi-master deployments, as explained in [Section 3.8.3, “Configuring Load Balancing with Connector/J”](#) and [Support for Multiple-Master Replication Topographies](#). This same implementation is used for balancing load between read-only slaves for replication-aware connections.

When trying to balance workload between multiple servers, the driver has to determine when it is safe to swap servers, doing so in the middle of a transaction, for example, could cause problems. It is important not to lose state information. For this reason, Connector/J will only try to pick a new server when one of the following happens:

1. At transaction boundaries (transactions are explicitly committed or rolled back).

2. A communication exception (SQL State starting with "08") is encountered.
3. When a `SQLException` matches conditions defined by user, using the extension points defined by the `loadBalanceSQLStateFailover`, `loadBalanceSQLExceptionSubclassFailover` or `loadBalanceExceptionChecker` properties.

The third condition revolves around three properties, which allow you to control which `SQLExceptions` trigger failover:

- `loadBalanceExceptionChecker` - The `loadBalanceExceptionChecker` property is really the key. This takes a fully-qualified class name which implements the new `com.mysql.cj.jdbc.ha.LoadBalanceExceptionChecker` interface. This interface is very simple, and you only need to implement the following method:

```
public boolean shouldExceptionTriggerFailover(SQLException ex)
```

A `SQLException` is passed in, and a boolean returned. A value of `true` triggers a failover, `false` does not.

You can use this to implement your own custom logic. An example where this might be useful is when dealing with transient errors when using MySQL Cluster, where certain buffers may become overloaded. The following code snippet illustrates this:

```
public class NdbLoadBalanceExceptionChecker
  extends StandardLoadBalanceExceptionChecker {
  public boolean shouldExceptionTriggerFailover(SQLException ex) {
    return super.shouldExceptionTriggerFailover(ex)
      || checkNdbException(ex);
  }
  private boolean checkNdbException(SQLException ex){
    // Have to parse the message since most NDB errors
    // are mapped to the same DEMC.
    return (ex.getMessage().startsWith("Lock wait timeout exceeded") ||
      (ex.getMessage().startsWith("Got temporary error")
      && ex.getMessage().endsWith("from NDB")));
  }
}
```

The code above extends

`com.mysql.cj.jdbc.ha.StandardLoadBalanceExceptionChecker`, which is the default implementation. There are a few convenient shortcuts built into this, for those who want to have some level of control using properties, without writing Java code. This default implementation uses the two remaining properties: `loadBalanceSQLStateFailover` and `loadBalanceSQLExceptionSubclassFailover`.

- `loadBalanceSQLStateFailover` - allows you to define a comma-delimited list of `SQLState` code prefixes, against which a `SQLException` is compared. If the prefix matches, failover is triggered. So, for example, the following would trigger a failover if a given `SQLException` starts with "00", or is "12345":

```
loadBalanceSQLStateFailover=00,12345
```

- `loadBalanceSQLExceptionSubclassFailover` - can be used in conjunction with `loadBalanceSQLStateFailover` or on its own. If you want certain subclasses of `SQLException` to trigger failover, simply provide a comma-delimited list of fully-qualified class or interface names to check against. For example, if you want all `SQLTransientConnectionExceptions` to trigger failover, you would specify:

```
loadBalanceSQLExceptionSubclassFailover=java.sql.SQLTransientConnectionException
```

While the three failover conditions enumerated earlier suit most situations, if `autocommit` is enabled, Connector/J never re-balances, and continues using the same physical connection. This can be problematic, particularly when load-balancing is being used to distribute read-only load across multiple

slaves. However, Connector/J can be configured to re-balance after a certain number of statements are executed, when `autocommit` is enabled. This functionality is dependent upon the following properties:

- `loadBalanceAutoCommitStatementThreshold` – defines the number of matching statements which will trigger the driver to potentially swap physical server connections. The default value, 0, retains the behavior that connections with `autocommit` enabled are never balanced.
- `loadBalanceAutoCommitStatementRegex` – the regular expression against which statements must match. The default value, blank, matches all statements. So, for example, using the following properties will cause Connector/J to re-balance after every third statement that contains the string “test”:

```
loadBalanceAutoCommitStatementThreshold=3  
loadBalanceAutoCommitStatementRegex=.*test.*
```

`loadBalanceAutoCommitStatementRegex` can prove useful in a number of situations. Your application may use temporary tables, server-side session state variables, or connection state, where letting the driver arbitrarily swap physical connections before processing is complete could cause data loss or other problems. This allows you to identify a trigger statement that is only executed when it is safe to swap physical connections.

3.9 Using the Connector/J Interceptor Classes

An interceptor is a software design pattern that provides a transparent way to extend or modify some aspect of a program, similar to a user exit. No recompiling is required. With Connector/J, the interceptors are enabled and disabled by updating the connection string to refer to different sets of interceptor classes that you instantiate.

The connection properties that control the interceptors are explained in [Section 3.5.3, “Configuration Properties”](#):

- `connectionLifecycleInterceptors`, where you specify the fully qualified names of classes that implement the `com.mysql.cj.jdbc.interceptors.ConnectionLifecycleInterceptor` interface. In these kinds of interceptor classes, you might log events such as rollbacks, measure the time between transaction start and end, or count events such as calls to `setAutoCommit()`.
- `exceptionInterceptors`, where you specify the fully qualified names of classes that implement the `com.mysql.cj.exceptions.ExceptionInterceptor` interface. In these kinds of interceptor classes, you might add extra diagnostic information to exceptions that can have multiple causes or indicate a problem with server settings. `exceptionInterceptors` classes are called when handling an `Exception` thrown from Connector/J code.
- `queryInterceptors`, where you specify the fully qualified names of classes that implement the `com.mysql.cj.interceptors.QueryInterceptor` interface. In these kinds of interceptor classes, you might change or augment the processing done by certain kinds of statements, such as automatically checking for queried data in a `memcached` server, rewriting slow queries, logging information about statement execution, or route requests to remote servers.

3.10 Using Connector/J with Tomcat

The following instructions are based on the instructions for Tomcat-5.x, available at <http://tomcat.apache.org/tomcat-5.5-doc/jndi-datasource-examples-howto.html> which is current at the time this document was written.

First, install the `.jar` file that comes with Connector/J in `$CATALINA_HOME/common/lib` so that it is available to all applications installed in the container.

Next, configure the JNDI DataSource by adding a declaration resource to `$CATALINA_HOME/conf/server.xml` in the context that defines your web application:

```

<Context ....>
...
<Resource name="jdbc/MySQLDB"
           auth="Container"
           type="javax.sql.DataSource"/>
<ResourceParams name="jdbc/MySQLDB">
    <parameter>
        <name>factory</name>
        <value>org.apache.commons.dbcp.BasicDataSourceFactory</value>
    </parameter>
    <parameter>
        <name>maxActive</name>
        <value>10</value>
    </parameter>
    <parameter>
        <name>maxIdle</name>
        <value>5</value>
    </parameter>
    <parameter>
        <name>validationQuery</name>
        <value>SELECT 1</value>
    </parameter>
    <parameter>
        <name>testOnBorrow</name>
        <value>true</value>
    </parameter>
    <parameter>
        <name>testWhileIdle</name>
        <value>true</value>
    </parameter>
    <parameter>
        <name>timeBetweenEvictionRunsMillis</name>
        <value>10000</value>
    </parameter>
    <parameter>
        <name>minEvictableIdleTimeMillis</name>
        <value>60000</value>
    </parameter>
    <parameter>
        <name>username</name>
        <value>someuser</value>
    </parameter>
    <parameter>
        <name>password</name>
        <value>somepass</value>
    </parameter>
    <parameter>
        <name>driverClassName</name>
        <value>com.mysql.cj.jdbc.Driver</value>
    </parameter>
    <parameter>
        <name>url</name>
        <value>jdbc:mysql://localhost:3306/test</value>
    </parameter>
</ResourceParams>
</Context>

```

Connector/J introduces a facility whereby, rather than use a `validationQuery` value of `SELECT 1`, it is possible to use `validationQuery` with a value set to `/* ping */`. This sends a ping to the server which then returns a fake result set. This is a lighter weight solution. It also has the advantage that if using `ReplicationConnection` or `LoadBalancedConnection` type connections, the ping will be sent across all active connections. The following XML snippet illustrates how to select this option:

```

<parameter>
    <name>validationQuery</name>
    <value>/* ping */</value>
</parameter>

```

Note that `/* ping */` has to be specified exactly.

In general, follow the installation instructions that come with your version of Tomcat, as the way you configure datasources in Tomcat changes from time to time, and if you use the wrong syntax in your XML file, you will most likely end up with an exception similar to the following:

```
Error: java.sql.SQLException: Cannot load JDBC driver class 'null' SQL state: null
```

Note that the auto-loading of drivers having the `META-INF/service/java.sql.Driver` class in JDBC 4.0 and later causes an improper undeployment of the Connector/J driver in Tomcat on Windows. Namely, the Connector/J jar remains locked. This is an initialization problem that is not related to the driver. The possible workarounds, if viable, are as follows: use `"antiResourceLocking=true"` as a Tomcat Context attribute, or remove the `META-INF/` directory.

3.11 Using Connector/J with JBoss

These instructions cover JBoss-4.x. To make the JDBC driver classes available to the application server, put the JBoss common JDBC wrapper JAR archive (available from, for example, the Maven Central Repository at <http://central.maven.org/maven2/jboss/jboss-common-jdbc-wrapper/>) into the `lib` directory for your server configuration (which is usually called `default`). Then, in the same configuration directory, in the subdirectory named `deploy`, create a datasource configuration file that ends with `-ds.xml`, which tells JBoss to deploy this file as a JDBC Datasource. The file should have the following contents:

```
<datasources>
    <local-tx-datasource>
        <jndi-name>MySQLDB</jndi-name>
        <connection-url>jdbc:mysql://localhost:3306/dbname</connection-url>
        <driver-class>com.mysql.cj.jdbc.Driver</driver-class>
        <user-name>user</user-name>
        <password>pass</password>
        <min-pool-size>5</min-pool-size>
        <max-pool-size>20</max-pool-size>
        <idle-timeout-minutes>5</idle-timeout-minutes>
        <exception-sorter-class-name>
            com.mysql.cj.jdbc.integration.jboss.ExtendedMysqlExceptionSorter
        </exception-sorter-class-name>
        <valid-connection-checker-class-name>
            com.mysql.cj.jdbc.integration.jboss.MysqlValidConnectionChecker
        </valid-connection-checker-class-name>
    </local-tx-datasource>
</datasources>
```

3.12 Using Connector/J with Spring

The Spring Framework is a Java-based application framework designed for assisting in application design by providing a way to configure components. The technique used by Spring is a well known design pattern called Dependency Injection (see [Inversion of Control Containers and the Dependency Injection pattern](#)). This article will focus on Java-oriented access to MySQL databases with Spring 2.0. For those wondering, there is a .NET port of Spring appropriately named Spring.NET.

Spring is not only a system for configuring components, but also includes support for aspect oriented programming (AOP). This is one of the main benefits and the foundation for Spring's resource and transaction management. Spring also provides utilities for integrating resource management with JDBC and Hibernate.

For the examples in this section the MySQL world sample database will be used. The first task is to set up a MySQL data source through Spring. Components within Spring use the "bean" terminology. For example, to configure a connection to a MySQL server supporting the world sample database, you might use:

```
<util:map id="dbProps">
    <entry key="db.driver" value="com.mysql.cj.jdbc.Driver"/>
    <entry key="db.jdbcurl" value="jdbc:mysql://localhost/world"/>
```

```
<entry key="db.username" value="myuser" />
<entry key="db.password" value="mypass" />
</util:map>
```

In the above example, we are assigning values to properties that will be used in the configuration. For the datasource configuration:

```
<bean id="dataSource"
      class="org.springframework.jdbc.datasource.DriverManagerDataSource">
    <property name="driverClassName" value="${db.driver}" />
    <property name="url" value="${db.jdbcurl}" />
    <property name="username" value="${db.username}" />
    <property name="password" value="${db.password}" />
</bean>
```

The placeholders are used to provide values for properties of this bean. This means that we can specify all the properties of the configuration in one place instead of entering the values for each property on each bean. We do, however, need one more bean to pull this all together. The last bean is responsible for actually replacing the placeholders with the property values.

```
<bean
  class="org.springframework.beans.factory.config.PropertyPlaceholderConfigurer">
  <property name="properties" ref="dbProps"/>
</bean>
```

Now that we have our MySQL data source configured and ready to go, we write some Java code to access it. The example below will retrieve three random cities and their corresponding country using the data source we configured with Spring.

```
// Create a new application context. this processes the Spring config
ApplicationContext ctx =
    new ClassPathXmlApplicationContext("exlappContext.xml");
// Retrieve the data source from the application context
DataSource ds = (DataSource) ctx.getBean("dataSource");
// Open a database connection using Spring's DataSourceUtils
Connection c = DataSourceUtils.getConnection(ds);
try {
    // retrieve a list of three random cities
    PreparedStatement ps = c.prepareStatement(
        "select City.Name as 'City', Country.Name as 'Country' " +
        "from City inner join Country on City.CountryCode = Country.Code " +
        "order by rand() limit 3");
    ResultSet rs = ps.executeQuery();
    while(rs.next()) {
        String city = rs.getString("City");
        String country = rs.getString("Country");
        System.out.printf("The city %s is in %s%n", city, country);
    }
} catch (SQLException ex) {
    // something has failed and we print a stack trace to analyse the error
    ex.printStackTrace();
    // ignore failure closing connection
    try { c.close(); } catch (SQLException e) { }
} finally {
    // properly release our connection
    DataSourceUtils.releaseConnection(c, ds);
}
```

This is very similar to normal JDBC access to MySQL with the main difference being that we are using `DataSourceUtils` instead of the `DriverManager` to create the connection.

While it may seem like a small difference, the implications are somewhat far reaching. Spring manages this resource in a way similar to a container managed data source in a J2EE application server. When a connection is opened, it can be subsequently accessed in other parts of the code if it is synchronized with a transaction. This makes it possible to treat different parts of your application as transactional instead of passing around a database connection.

3.12.1 Using [JdbcTemplate](#)

Spring makes extensive use of the Template method design pattern (see [Template Method Pattern](#)). Our immediate focus will be on the [JdbcTemplate](#) and related classes, specifically [NamedParameterJdbcTemplate](#). The template classes handle obtaining and releasing a connection for data access when one is needed.

The next example shows how to use [NamedParameterJdbcTemplate](#) inside of a DAO (Data Access Object) class to retrieve a random city given a country code.

```
public class Ex2JdbcDao {
    /**
     * Data source reference which will be provided by Spring.
     */
    private DataSource dataSource;
    /**
     * Our query to find a random city given a country code. Notice
     * the ":country" parameter toward the end. This is called a
     * named parameter.
     */
    private String queryString = "select Name from City " +
        "where CountryCode = :country order by rand() limit 1";
    /**
     * Retrieve a random city using Spring JDBC access classes.
     */
    public String getRandomCityByCountryCode(String cntryCode) {
        // A template that permits using queries with named parameters
        NamedParameterJdbcTemplate template =
            new NamedParameterJdbcTemplate(dataSource);
        // A java.util.Map is used to provide values for the parameters
        Map params = new HashMap();
        params.put("country", cntryCode);
        // We query for an Object and specify what class we are expecting
        return (String)template.queryForObject(queryString, params, String.class);
    }
    /**
     * A JavaBean setter-style method to allow Spring to inject the data source.
     * @param dataSource
     */
    public void setDataSource(DataSource dataSource) {
        this.dataSource = dataSource;
    }
}
```

The focus in the above code is on the `getRandomCityByCountryCode()` method. We pass a country code and use the [NamedParameterJdbcTemplate](#) to query for a city. The country code is placed in a Map with the key "country", which is the parameter is named in the SQL query.

To access this code, you need to configure it with Spring by providing a reference to the data source.

```
<bean id="dao" class="code.Ex2JdbcDao">
    <property name="dataSource" ref="dataSource"/>
</bean>
```

At this point, we can just grab a reference to the DAO from Spring and call `getRandomCityByCountryCode()`.

```
// Create the application context
ApplicationContext ctx =
new ClassPathXmlApplicationContext("ex2appContext.xml");
// Obtain a reference to our DAO
Ex2JdbcDao dao = (Ex2JdbcDao) ctx.getBean("dao");
String countryCode = "USA";
// Find a few random cities in the US
for(int i = 0; i < 4; ++i)
    System.out.printf("A random city in %s is %s%n", countryCode,
        dao.getRandomCityByCountryCode(countryCode));
```

This example shows how to use Spring's JDBC classes to completely abstract away the use of traditional JDBC classes including `Connection` and `PreparedStatement`.

3.12.2 Transactional JDBC Access

Spring allows us to add transactions into our code without having to deal directly with the JDBC classes. For that purpose, Spring provides a transaction management package that not only replaces JDBC transaction management, but also enables declarative transaction management (configuration instead of code).

To use transactional database access, we will need to change the storage engine of the tables in the world database. The downloaded script explicitly creates MyISAM tables, which do not support transactional semantics. The InnoDB storage engine does support transactions and this is what we will be using. We can change the storage engine with the following statements.

```
ALTER TABLE City ENGINE=InnoDB;
ALTER TABLE Country ENGINE=InnoDB;
ALTER TABLE CountryLanguage ENGINE=InnoDB;
```

A good programming practice emphasized by Spring is separating interfaces and implementations. What this means is that we can create a Java interface and only use the operations on this interface without any internal knowledge of what the actual implementation is. We will let Spring manage the implementation and with this it will manage the transactions for our implementation.

First you create a simple interface:

```
public interface Ex3Dao {
    Integer createCity(String name, String countryCode,
                      String district, Integer population);
}
```

This interface contains one method that will create a new city record in the database and return the id of the new record. Next you need to create an implementation of this interface.

```
public class Ex3DaoImpl implements Ex3Dao {
    protected DataSource dataSource;
    protected SqlUpdate updateQuery;
    protected SqlFunction idQuery;
    public Integer createCity(String name, String countryCode,
                             String district, Integer population) {
        updateQuery.update(new Object[] { name, countryCode,
                                         district, population });
        return getLastId();
    }
    protected Integer getLastId() {
        return idQuery.run();
    }
}
```

You can see that we only operate on abstract query objects here and do not deal directly with the JDBC API. Also, this is the complete implementation. All of our transaction management will be dealt with in the configuration. To get the configuration started, we need to create the DAO.

```
<bean id="dao" class="code.Ex3DaoImpl">
    <property name="dataSource" ref="dataSource"/>
    <property name="updateQuery">...</property>
    <property name="idQuery">...</property>
</bean>
```

Now we need to set up the transaction configuration. The first thing we must do is create transaction manager to manage the data source and a specification of what transaction properties are required for the `dao` methods.

```

<bean id="transactionManager"
      class="org.springframework.jdbc.datasource.DataSourceTransactionManager">
    <property name="dataSource" ref="dataSource"/>
</bean>
<tx:advice id="txAdvice" transaction-manager="transactionManager">
    <tx:attributes>
        <tx:method name="*" />
    </tx:attributes>
</tx:advice>

```

The preceding code creates a transaction manager that handles transactions for the data source provided to it. The `txAdvice` uses this transaction manager and the attributes specify to create a transaction for all methods. Finally we need to apply this advice with an AOP pointcut.

```

<aop:config>
    <aop:pointcut id="daoMethods"
        expression="execution(* code.Ex3Dao.*(..))" />
    <aop:advisor advice-ref="txAdvice" pointcut-ref="daoMethods" />
</aop:config>

```

This basically says that all methods called on the `Ex3Dao` interface will be wrapped in a transaction. To make use of this, we only have to retrieve the `dao` from the application context and call a method on the `dao` instance.

```

Ex3Dao dao = (Ex3Dao) ctx.getBean("dao");
Integer id = dao.createCity(name, countryCode, district, pop);

```

We can verify from this that there is no transaction management happening in our Java code and it is all configured with Spring. This is a very powerful notion and regarded as one of the most beneficial features of Spring.

3.12.3 Connection Pooling with Spring

In many situations, such as web applications, there will be a large number of small database transactions. When this is the case, it usually makes sense to create a pool of database connections available for web requests as needed. Although MySQL does not spawn an extra process when a connection is made, there is still a small amount of overhead to create and set up the connection. Pooling of connections also alleviates problems such as collecting large amounts of sockets in the `TIME_WAIT` state.

Setting up pooling of MySQL connections with Spring is as simple as changing the data source configuration in the application context. There are a number of configurations that we can use. The first example is based on the [Jakarta Commons DBCP library](#). The example below replaces the source configuration that was based on `DriverManagerDataSource` with DBCP's `BasicDataSource`.

```

<bean id="dataSource" destroy-method="close"
      class="org.apache.commons.dbcp.BasicDataSource">
    <property name="driverClassName" value="${db.driver}" />
    <property name="url" value="${db.jdbcurl}" />
    <property name="username" value="${db.username}" />
    <property name="password" value="${db.password}" />
    <property name="initialSize" value="3" />
</bean>

```

The configuration of the two solutions is very similar. The difference is that DBCP will pool connections to the database instead of creating a new connection every time one is requested. We have also set a parameter here called `initialSize`. This tells DBCP that we want three connections in the pool when it is created.

Another way to configure connection pooling is to configure a data source in our J2EE application server. Using JBoss as an example, you can set up the MySQL connection pool by creating a file called `mysql-local-ds.xml` and placing it in the `server/default/deploy` directory in JBoss.

Once we have this set up, we can use JNDI to look it up. With Spring, this lookup is very simple. The data source configuration looks like this.

```
<jee:jndi-lookup id="dataSource" jndi-name="java:MySQL_DS"/>
```

3.13 Troubleshooting Connector/J Applications

This section explains the symptoms and resolutions for the most commonly encountered issues with applications using MySQL Connector/J.

Questions

- [3.13.1:](#) When I try to connect to the database with MySQL Connector/J, I get the following exception:

```
SQLException: Server configuration denies access to data source  
SQLState: 08001  
VendorError: 0
```

What is going on? I can connect just fine with the MySQL command-line client.

- [3.13.2:](#) My application throws an SQLException 'No Suitable Driver'. Why is this happening?
- [3.13.3:](#) I'm trying to use MySQL Connector/J in an applet or application and I get an exception similar to:

```
SQLException: Cannot connect to MySQL server on host:3306.  
Is there a MySQL server running on the machine/port you  
are trying to connect to?  
(java.security.AccessControlException)  
SQLState: 08S01  
VendorError: 0
```

- [3.13.4:](#) I have a servlet/application that works fine for a day, and then stops working overnight
- [3.13.5:](#) I cannot connect to the MySQL server using Connector/J, and I'm sure the connection parameters are correct.
- [3.13.6:](#) My application is deployed through JBoss and I am using transactions to handle the statements on the MySQL database. Under heavy loads, I am getting an error and stack trace, but these only occur after a fixed period of heavy activity.
- [3.13.7:](#) Updating a table that contains a [primary key](#) that is either [FLOAT](#) or compound primary key that uses [FLOAT](#) fails to update the table and raises an exception.
- [3.13.8:](#) I get an [ER_NET_PACKET_TOO_LARGE](#) exception, even though the binary blob size I want to insert using JDBC is safely below the [max_allowed_packet](#) size.
- [3.13.9:](#) What should I do if I receive error messages similar to the following: "Communications link failure – Last packet sent to the server was X ms ago"?
- [3.13.10:](#) Why does Connector/J not reconnect to MySQL and re-issue the statement after a communication failure instead of throwing an Exception, even though I use the [autoReconnect](#) connection string option?
- [3.13.11:](#) How can I use 3-byte UTF8 with Connector/J?
- [3.13.12:](#) How can I use 4-byte UTF8 ([utf8mb4](#)) with Connector/J?
- [3.13.13:](#) Using [useServerPrepStmts=false](#) and certain character encodings can lead to corruption when inserting BLOBs. How can this be avoided?

Questions and Answers

3.13.1: When I try to connect to the database with MySQL Connector/J, I get the following exception:

```
SQLException: Server configuration denies access to data source
SQLstate: 08001
VendorError: 0
```

What is going on? I can connect just fine with the MySQL command-line client.

Connector/J normally uses TCP/IP sockets to connect to MySQL (see [Section 3.5.8, “Connecting Using Unix Domain Sockets”](#) and [Section 3.5.9, “Connecting Using Named Pipes”](#) for exceptions). The security manager on the MySQL server uses its grant tables to determine whether a TCP/IP connection is permitted. You must therefore add the necessary security credentials to the MySQL server for the connection by issuing a `GRANT` statement to your MySQL Server. See [GRANT Statement](#), for more information.

Warning

Changing privileges and permissions improperly on MySQL can potentially cause your server installation to have non-optimal security properties.

Note

Testing your connectivity with the `mysql` command-line client will not work unless you add the `--host` flag, and use something other than `localhost` for the host. The `mysql` command-line client will try to use Unix domain sockets if you use the special host name `localhost`. If you are testing TCP/IP connectivity to `localhost`, use `127.0.0.1` as the host name instead.

3.13.2: My application throws an SQLException 'No Suitable Driver'. Why is this happening?

There are three possible causes for this error:

- The Connector/J driver is not in your `CLASSPATH`, see [Section 3.3, “Connector/J Installation”](#).
- The format of your connection URL is incorrect, or you are referencing the wrong JDBC driver.
- When using `DriverManager`, the `jdbc.drivers` system property has not been populated with the location of the Connector/J driver.

3.13.3: I'm trying to use MySQL Connector/J in an applet or application and I get an exception similar to:

```
SQLException: Cannot connect to MySQL server on host:3306.
Is there a MySQL server running on the machine/port you
are trying to connect to?
(java.security.AccessControlException)
SQLState: 08S01
VendorError: 0
```

Either you're running an Applet, your MySQL server has been installed with the `skip_networking` system variable enabled, or your MySQL server has a firewall sitting in front of it.

Applets can only make network connections back to the machine that runs the web server that served the .class files for the applet. This means that MySQL must run on the same machine (or you must have some sort of port re-direction) for this to work. This also means that you will not be able to test applets from your local file system, but must always deploy them to a web server.

Connector/J normally uses TCP/IP sockets to connect to MySQL (see [Section 3.5.8, “Connecting Using Unix Domain Sockets”](#) and [Section 3.5.9, “Connecting Using Named Pipes”](#) for exceptions). TCP/IP communication with MySQL can be affected by the `skip_networking` system variable or the server firewall. If MySQL has been started with `skip_networking` enabled, you need to comment it out in the file `/etc/mysql/my.cnf` or `/etc/my.cnf` for TCP/IP connections to work. (Note that your server configuration file might also exist in the `data` directory of your MySQL server,

or somewhere else, depending on how MySQL was compiled; binaries created by Oracle always look for `/etc/my.cnf` and `datadir/my.cnf`; see [Using Option Files](#) for details.) If your MySQL server has been firewalled, you will need to have the firewall configured to allow TCP/IP connections from the host where your Java code is running to the MySQL server on the port that MySQL is listening to (by default, 3306).

3.13.4: I have a servlet/application that works fine for a day, and then stops working overnight

MySQL closes connections after 8 hours of inactivity. You either need to use a connection pool that handles stale connections or use the `autoReconnect` parameter (see [Section 3.5.3, “Configuration Properties”](#)).

Also, catch `SQLExceptions` in your application and deal with them, rather than propagating them all the way until your application exits. This is just good programming practice. MySQL Connector/J will set the `SQLState` (see `java.sql.SQLException.getSQLState()` in your API docs) to `08S01` when it encounters network-connectivity issues during the processing of a query. Attempt to reconnect to MySQL at this point.

The following (simplistic) example shows what code that can handle these exceptions might look like:

Example 3.12 Connector/J: Example of transaction with retry logic

```
public void doBusinessOp() throws SQLException {
    Connection conn = null;
    Statement stmt = null;
    ResultSet rs = null;
    //
    // How many times do you want to retry the transaction
    // (or at least _getting_ a connection)?
    //
    int retryCount = 5;
    boolean transactionCompleted = false;
    do {
        try {
            conn = getConnection(); // assume getting this from a
                                   // javax.sql.DataSource, or the
                                   // java.sql.DriverManager
            conn.setAutoCommit(false);
            //
            // Okay, at this point, the 'retry-ability' of the
            // transaction really depends on your application logic,
            // whether or not you're using autocommit (in this case
            // not), and whether you're using transactional storage
            // engines
            //
            // For this example, we'll assume that it's _not_ safe
            // to retry the entire transaction, so we set retry
            // count to 0 at this point
            //
            // If you were using exclusively transaction-safe tables,
            // or your application could recover from a connection going
            // bad in the middle of an operation, then you would not
            // touch 'retryCount' here, and just let the loop repeat
            // until retryCount == 0.
            //
            retryCount = 0;
            stmt = conn.createStatement();
            String query = "SELECT foo FROM bar ORDER BY baz";
            rs = stmt.executeQuery(query);
            while (rs.next()) {
            }
            rs.close();
            rs = null;
            stmt.close();
            stmt = null;
            conn.commit();
            conn.close();
            conn = null;
            transactionCompleted = true;
        } catch (SQLException e) {
            if (retryCount > 0) {
                retryCount--;
                continue;
            } else {
                throw e;
            }
        }
    }
}
```

```

        } catch (SQLException sqlEx) {
            //
            // The two SQL states that are 'retry-able' are 08S01
            // for a communications error, and 40001 for deadlock.
            //
            // Only retry if the error was due to a stale connection,
            // communications problem or deadlock
            //
            String sqlState = sqlEx.getSQLState();
            if ("08S01".equals(sqlState) || "40001".equals(sqlState)) {
                retryCount -= 1;
            } else {
                retryCount = 0;
            }
        } finally {
            if (rs != null) {
                try {
                    rs.close();
                } catch (SQLException sqlEx) {
                    // You'd probably want to log this...
                }
            }
            if (stmt != null) {
                try {
                    stmt.close();
                } catch (SQLException sqlEx) {
                    // You'd probably want to log this as well...
                }
            }
            if (conn != null) {
                try {
                    //
                    // If we got here, and conn is not null, the
                    // transaction should be rolled back, as not
                    // all work has been done
                    try {
                        conn.rollback();
                    } finally {
                        conn.close();
                    }
                } catch (SQLException sqlEx) {
                    //
                    // If we got an exception here, something
                    // pretty serious is going on, so we better
                    // pass it up the stack, rather than just
                    // logging it...
                    throw sqlEx;
                }
            }
        }
    } while (!transactionCompleted && (retryCount > 0));
}

```

Note

Use of the `autoReconnect` option is not recommended because there is no safe method of reconnecting to the MySQL server without risking some corruption of the connection state or database state information. Instead, use a connection pool, which will enable your application to connect to the MySQL server using an available connection from the pool. The `autoReconnect` facility is deprecated, and may be removed in a future release.

3.13.5: I cannot connect to the MySQL server using Connector/J, and I'm sure the connection parameters are correct.

Make sure that the `skip_networking` system variable has not been enabled on your server. Connector/J must be able to communicate with your server over TCP/IP; named sockets are not supported. Also ensure that you are not filtering connections through a firewall or other network security system. For more information, see [Can't connect to \[local\] MySQL server](#).

3.13.6: My application is deployed through JBoss and I am using transactions to handle the statements on the MySQL database. Under heavy loads, I am getting an error and stack trace, but these only occur after a fixed period of heavy activity.

This is a JBoss, not Connector/J, issue and is connected to the use of transactions. Under heavy loads the time taken for transactions to complete can increase, and the error is caused because you have exceeded the predefined timeout.

You can increase the timeout value by setting the `TransactionTimeout` attribute to the `TransactionManagerService` within the `/conf/jboss-service.xml` file (pre-4.0.3) or `/deploy/jta-service.xml` for JBoss 4.0.3 or later. See `TransactionTimeout` within the JBoss wiki for more information.

3.13.7: Updating a table that contains a primary key that is either FLOAT or compound primary key that uses FLOAT fails to update the table and raises an exception.

Connector/J adds conditions to the `WHERE` clause during an `UPDATE` to check the old values of the primary key. If there is no match, then Connector/J considers this a failure condition and raises an exception.

The problem is that rounding differences between supplied values and the values stored in the database may mean that the values never match, and hence the update fails. The issue will affect all queries, not just those from Connector/J.

To prevent this issue, use a primary key that does not use `FLOAT`. If you have to use a floating point column in your primary key, use `DOUBLE` or `DECIMAL` types in place of `FLOAT`.

3.13.8: I get an ER_NET_PACKET_TOO_LARGE exception, even though the binary blob size I want to insert using JDBC is safely below the max_allowed_packet size.

This is because the `hexEscapeBlock()` method in `com.mysql.cj.AbstractPreparedStatement.streamToBytes()` may almost double the size of your data.

3.13.9: What should I do if I receive error messages similar to the following: “Communications link failure – Last packet sent to the server was X ms ago”?

Generally speaking, this error suggests that the network connection has been closed. There can be several root causes:

- Firewalls or routers may clamp down on idle connections (the MySQL client/server protocol does not ping).
- The MySQL Server may be closing idle connections that exceed the `wait_timeout` or `interactive_timeout` threshold.

Although network connections can be volatile, the following can be helpful in avoiding problems:

- Ensure connections are valid when used from the connection pool. Use a query that starts with `/* ping */` to execute a lightweight ping instead of full query. Note, the syntax of the ping needs to be exactly as specified here.
- Minimize the duration a connection object is left idle while other application logic is executed.
- Explicitly validate the connection before using it if the connection has been left idle for an extended period of time.
- Ensure that `wait_timeout` and `interactive_timeout` are set sufficiently high.
- Ensure that `tcpKeepalive` is enabled.
- Ensure that any configurable firewall or router timeout settings allow for the maximum expected connection idle time.

Note

Do not expect to be able to reuse a connection without problems if it has been lying idle for a period. If a connection is to be reused after being idle for any length of time, ensure that you explicitly test it before reusing it.

3.13.10: Why does Connector/J not reconnect to MySQL and re-issue the statement after a communication failure instead of throwing an Exception, even though I use the `autoReconnect` connection string option?

There are several reasons for this. The first is transactional integrity. The MySQL Reference Manual states that “there is no safe method of reconnecting to the MySQL server without risking some corruption of the connection state or database state information”. Consider the following series of statements for example:

```
conn.createStatement().execute(
    "UPDATE checking_account SET balance = balance - 1000.00 WHERE customer='Smith'");
conn.createStatement().execute(
    "UPDATE savings_account SET balance = balance + 1000.00 WHERE customer='Smith'");
conn.commit();
```

Consider the case where the connection to the server fails after the `UPDATE` to `checking_account`. If no exception is thrown, and the application never learns about the problem, it will continue executing. However, the server did not commit the first transaction in this case, so that will get rolled back. But execution continues with the next transaction, and increases the `savings_account` balance by 1000. The application did not receive an exception, so it continued regardless, eventually committing the second transaction, as the commit only applies to the changes made in the new connection. Rather than a transfer taking place, a deposit was made in this example.

Note that running with `autocommit` enabled does not solve this problem. When Connector/J encounters a communication problem, there is no means to determine whether the server processed the currently executing statement or not. The following theoretical states are equally possible:

- The server never received the statement, and therefore no related processing occurred on the server.
- The server received the statement, executed it in full, but the response was not received by the client.

If you are running with `autocommit` enabled, it is not possible to guarantee the state of data on the server when a communication exception is encountered. The statement may have reached the server, or it may not. All you know is that communication failed at some point, before the client received confirmation (or data) from the server. This does not only affect `autocommit` statements though. If the communication problem occurred during `Connection.commit()`, the question arises of whether the transaction was committed on the server before the communication failed, or whether the server received the commit request at all.

The second reason for the generation of exceptions is that transaction-scoped contextual data may be vulnerable, for example:

- Temporary tables.
- User-defined variables.
- Server-side prepared statements.

These items are lost when a connection fails, and if the connection silently reconnects without generating an exception, this could be detrimental to the correct execution of your application.

In summary, communication errors generate conditions that may well be unsafe for Connector/J to simply ignore by silently reconnecting. It is necessary for the application to be notified. It is then for the application developer to decide how to proceed in the event of connection errors and failures.

3.13.11: How can I use 3-byte UTF8 with Connector/J?

For 8.0.12 and earlier: To use 3-byte UTF8 with Connector/J set `characterEncoding=utf8` and set `useUnicode=true` in the connection string.

For 8.0.13 and later: Because there is no Java-style character set name for `utf8mb3` that you can use with the connection option `charaterEncoding`, the only way to use `utf8mb3` as your connection character set is to use a `utf8mb3` collation (for example, `utf8_general_ci`) for the connection option `connectionCollation`, which forces a `utf8mb3` character set to be used. See [Section 3.5.6, “Using Character Sets and Unicode”](#) for details.

3.13.12: How can I use 4-byte UTF8 (`utf8mb4`) with Connector/J?

To use 4-byte UTF8 with Connector/J configure the MySQL server with `character_set_server=utf8mb4`. Connector/J will then use that setting, if `characterEncoding` and `connectionCollation` have not been set in the connection string. This is equivalent to autodetection of the character set. See [Section 3.5.6, “Using Character Sets and Unicode”](#) for details. *For 8.0.13 and later:* You can use `characterEncoding=UTF-8` to use `utf8mb4`, even if `character_set_server` on the server has been set to something else.

3.13.13: Using `useServerPrepStmts=false` and certain character encodings can lead to corruption when inserting BLOBs. How can this be avoided?

When using certain character encodings, such as SJIS, CP932, and BIG5, it is possible that BLOB data contains characters that can be interpreted as control characters, for example, backslash, '\'. This can lead to corrupted data when inserting BLOBs into the database. There are two things that need to be done to avoid this:

1. Set the connection string option `useServerPrepStmts` to `true`.
2. Set `SQL_MODE` to `NO_BACKSLASH_ESCAPES`.

3.14 Known Issues and Limitations

The following are some known issues and limitations for MySQL Connector/J:

- When Connector/J retrieves timestamps for a daylight saving time (DST) switch day using the `getTimestamp()` method on the result set, some of the returned values might be wrong. The errors can be avoided by using the following connection options when connecting to a database:

```
serverTimezone=UTC
```

- The functionality of the property `elideSetAutoCommits` has been disabled due to Bug# 66884. Any value given for the property is ignored by Connector/J.
- MySQL Server uses a proleptic Gregorian calendar internally. However, Connector/J uses `java.sql.Date`, which is non-proleptic. Therefore, when setting and retrieving dates that were before the Julian-Gregorian cutover (October 15, 1582) using the `PreparedStatement` methods, always supply explicitly a proleptic Gregorian calendar to the `setDate()` and `getDate()` methods, in order to avoid possible errors with dates stored to and calculated by the server.
- *For MySQL 8.0.14 and later, 5.7.25 and later, and 5.6.43 and later:* To use Windows named pipes for connections, the MySQL Server that Connector/J wants to connect to must be started with the system variable `named_pipe_full_access_group`; see [Section 3.5.9, “Connecting Using Named Pipes”](#) for details.
- Because Connector/J does not enable connections with TLSv1.2 and higher by default due to compatibility issues, when connecting to servers that restrict connections to use those higher TLS versions, you might encounter `com.mysql.cj.exceptions.CJCommunicationsException: javax.net.ssl.SSLHandshakeException: No appropriate protocol (protocol`

is disabled or cipher suites are inappropriate). You need to enable connections with TLSv1.2 and higher versions using the `enabledTLSProtocols` connection property. See [Section 3.5.7, “Connecting Securely Using SSL”](#) for details.

3.15 Connector/J Support

3.15.1 Connector/J Community Support

You can join the [#connectors channel in the MySQL Community Slack workspace](#), where you can get help directly from MySQL developers and other users.

3.15.2 How to Report Connector/J Bugs or Problems

The normal place to report bugs is <http://bugs.mysql.com/>, which is the address for our bugs database. This database is public, and can be browsed and searched by anyone. If you log in to the system, you will also be able to enter new reports.

If you find a sensitive security bug in MySQL Server, please let us know immediately by sending an email message to <secalert_us@oracle.com>. Exception: Support customers should report all problems, including security bugs, to Oracle Support at <http://support.oracle.com/>.

Writing a good bug report takes patience, but doing it right the first time saves time both for us and for yourself. A good bug report, containing a full test case for the bug, makes it very likely that we will fix sooner rather than later.

This section will help you write your report correctly so that you do not waste your time doing things that may not help us much or at all.

If you have a repeatable bug report, please report it to the bugs database at <http://bugs.mysql.com/>. Any bug that we are able to repeat has a high chance of being fixed sooner rather than later.

To report other problems, you can use one of the MySQL mailing lists.

Remember that it is possible for us to respond to a message containing too much information, but not to one containing too little. People often omit facts because they think they know the cause of a problem and assume that some details do not matter.

A good principle is this: If you are in doubt about stating something, state it. It is faster and less troublesome to write a couple more lines in your report than to wait longer for the answer if we must ask you to provide information that was missing from the initial report.

The most common errors made in bug reports are (a) not including the version number of Connector/J or MySQL used, and (b) not fully describing the platform on which Connector/J is installed (including the JVM version, and the platform type and version number that MySQL itself is installed on).

This is highly relevant information, and in 99 cases out of 100, the bug report is useless without it. Very often we get questions like, “Why doesn’t this work for me?” Then we find that the feature requested was not implemented in that MySQL version, or that a bug described in a report has already been fixed in newer MySQL versions.

Sometimes the error is platform-dependent; in such cases, it is next to impossible for us to fix anything without knowing the operating system and the version number of the platform.

If at all possible, create a repeatable, standalone testcase that doesn’t involve any third-party classes.

To streamline this process, we ship a base class for testcases with Connector/J, named `'com.mysql.cj.jdbc.util.BaseBugReport'`. To create a testcase for Connector/J using this class, create your own class that inherits from `com.mysql.cj.jdbc.util.BaseBugReport` and override the methods `setUp()`, `tearDown()` and `runTest()`.

In the `setUp()` method, create code that creates your tables, and populates them with any data needed to demonstrate the bug.

In the `runTest()` method, create code that demonstrates the bug using the tables and data you created in the `setUp` method.

In the `tearDown()` method, drop any tables you created in the `setUp()` method.

In any of the above three methods, use one of the variants of the `getConnection()` method to create a JDBC connection to MySQL:

- `getConnection()` - Provides a connection to the JDBC URL specified in `getUrl()`. If a connection already exists, that connection is returned, otherwise a new connection is created.
- `getNewConnection()` - Use this if you need to get a new connection for your bug report (that is, there is more than one connection involved).
- `getConnection(String url)` - Returns a connection using the given URL.
- `getConnection(String url, Properties props)` - Returns a connection using the given URL and properties.

If you need to use a JDBC URL that is different from 'jdbc:mysql:///test', override the method `getUrl()` as well.

Use the `assertTrue(boolean expression)` and `assertTrue(String failureMessage, boolean expression)` methods to create conditions that must be met in your testcase demonstrating the behavior you are expecting (vs. the behavior you are observing, which is why you are most likely filing a bug report).

Finally, create a `main()` method that creates a new instance of your testcase, and calls the `run` method:

```
public static void main(String[] args) throws Exception {
    new MyBugReport().run();
}
```

Once you have finished your testcase, and have verified that it demonstrates the bug you are reporting, upload it with your bug report to <http://bugs.mysql.com/>.

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MySQL Connector/.NET is the connector that enables .NET applications to communicate with MySQL servers.

For notes detailing the changes in each release of Connector/.NET, see [MySQL Connector/.NET Release Notes](#).

For legal information, see the [Legal Notices](#).

For help with using MySQL, please visit the [MySQL Forums](#), where you can discuss your issues with other MySQL users.

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4.1 Introduction to MySQL Connector/.NET

MySQL Connector/.NET enables you to develop .NET applications that require secure, high-performance data connectivity with MySQL. It implements the required ADO.NET interfaces and integrates into ADO.NET-aware tools. You can build applications using your choice of .NET languages. Connector/.NET is a fully managed ADO.NET data provider written in 100% pure C#. It does not use the MySQL C client library.

For notes detailing the changes in each release of Connector/.NET, see [MySQL Connector/.NET Release Notes](#).

Connector/.NET includes full support for:

- Encrypted connections using the TLSv1.2 protocol over TCP/IP. Requires Connector/.NET 8.0.11 or higher.
- MySQL as a Document Store over X Protocol.
- Features provided by MySQL Server up to and including the MySQL 8.0 release series.
- .NET Core and Entity Framework Core to enable cross-platform development.
- Large-packet support for sending and receiving rows and `BLOB` values up to 2 gigabytes in size.
- Protocol compression, which enables compressing the data stream between the client and server.
- Connections using TCP/IP sockets, named pipes, or shared memory on Windows.
- Connections using TCP/IP sockets or Unix sockets on Unix.
- The Open Source Mono framework developed by Novell.
- Entity Framework.
- .NET for Windows 8.x Store apps (Windows RT Store apps).

Connector/NET supports full versions of Visual Studio 2013, 2015, and 2017, although the extent of support may be limited depending on your versions of Connector/NET and Visual Studio. For details, see [MySQL for Visual Studio](#).

Key Topics

- For connection string properties when using the `MySqlConnection` class, see [Section 4.4.5, "Connector/NET 8.0 Connection Options Reference"](#).

4.2 Connector/NET Versions

There are several versions of MySQL Connector/NET currently available:

- MySQL Connector/NET 8.0 is a continuation of Connector/NET 7.0, but now named to synchronize the first digit of the version number with the (highest) MySQL server version it supports. This version also includes support for X Protocol.

MySQL Connector/NET 8.0 is highly recommended for use with MySQL Server 8.0, 5.7, and 5.6. Please upgrade to MySQL Connector/NET 8.0.

- MySQL Connector/NET 6.10 includes Entity Framework Core support and enables compression in the .NET Core driver implementation. Provides expanded cross-platform support to Linux and macOS when using .NET Core.

The minimum connector versions that support the TLSv1.2 protocol are Connector/NET 6.10.4 and Connector/NET 8.0.11 (Commercial and Community Editions). In addition, the Microsoft Windows or Microsoft Windows Server host must support TLSv1.2 (enabled manually or by default). Connections made using Windows named pipes or shared memory do not support the TLSv1.2 protocol. For general guidance about configuring the server and clients for encrypted connections, see [Configuring MySQL to Use Encrypted Connections](#).

Note

Both .NET Core 3.0 (cross platform) and .NET Framework 4.8 (windows only) added support for TLSv1.3. Be sure to confirm that the platform operating system running your application also supports TLSv1.3 before using it exclusively for connections.

The following table shows the versions of ADO.NET, .NET (Core and Framework), and MySQL Server that are supported or required by MySQL Connector/NET.

Table 4.1 Connector/NET Requirements for Related Products

Connector/NET Version	ADO.NET Version	.NET Version Required	MySQL Server	Supported?
8.0	2.x+	<ul style="list-style-type: none"> C/.NET 8.0.18+: .NET Core 3.0 for VS 2019 (version 16.3 or higher) C/.NET 8.0.17+: .NET Core 2.2 for VS 2017 (version 15.0.9 or higher), .NET Core 2.1 for VS 2017 (version 15.0.7 or higher) C/.NET 8.0.10+: .NET Core 2.0 for VS 2017 (version 15.0.3 or higher) C/.NET 8.0.8+: .NET Framework 4.5.x for VS 2013 / 2015 / 2017 	8.0, 5.7, 5.6	Yes
6.10	2.x+	<ul style="list-style-type: none"> C/.NET 6.10.9+: .NET Core 2.2 for VS 2017 (version 15.0.9 or higher), .NET 	8.0, 5.7, 5.6	Upgrade to 8.0

Connector/NET Version	ADO.NET Version	.NET Version Required	MySQL Server	Supported?
		Core 2.1 for VS 2017 (version 15.0.7 or higher) • C/.NET 6.10.5+: .NET Core 2.0 for VS 2017 (version 15.0.3 or higher)		

The following versions of Connector/NET are no longer supported:

- MySQL Connector/NET 7.0 includes support for the X Protocol (development milestone releases only).
- MySQL Connector/NET 6.9 includes new features such as a MySQL web personalization, sitemap, and simple membership providers. It also includes support for MySQL for Visual Studio 1.2 (or higher).
- Connector/NET 6.8 includes new features such as Entity Framework 6 support, added idempotent script for Entity Framework 6 migrations, changed EF migration history table to use a single column as primary key, removed installer validation when MySQL for Visual Studio is installed, and support for MySQL for Visual Studio 1.1.

This version of Connector/NET is no longer supported.

- Connector/NET 6.7 includes new features such as Entity Framework 5 support, built-in Load Balancing (to be used with a back end implementing either MySQL Replication or MySQL Clustering), a Memcached client (compatible with InnoDB Memcached plugin) and support for Windows Runtime (WinRT) to write store apps. This version also removes all features related to Visual Studio Integration, which are provided in a separate product, [MySQL for Visual Studio](#).

This version of Connector/NET is no longer supported.

- Connector/NET 6.6 includes new features such as stored procedure debugging in Microsoft Visual Studio, support for pluggable authentication including the ability to write your own authentication plugins, Entity Framework 4.3 Code First support, and enhancements to partial trust support to allow hosting services to deploy applications without installing the Connector/NET library in the GAC.

This version of Connector/NET is no longer supported.

- Connector/NET 6.5 includes new features such as interceptor classes for exceptions and commands, support for the MySQL 5.6+ fractional seconds feature, better partial-trust support, and better IntelliSense, including auto-completion when editing stored procedures or `.mysql` files.

This version of Connector/NET is no longer supported.

- Connector/NET 6.4 includes new features such as support for Windows authentication (when connecting to MySQL Server 5.5+), table caching on the client side, simple connection fail-over support, and improved SQL generation from the Entity Framework provider.

This version of Connector/NET is no longer supported.

- Connector/NET 6.3 includes new features such as integration with Visual Studio 2010, such as the availability of DDL T4 template for Entity Framework, and a custom MySQL SQL Editor. Other features include refactored transaction scope: Connector/NET now supports nested transactions in a scope where they use the same connection string.

This version of Connector/NET is no longer supported.

- Connector/NET 6.2 includes new features such as a new logging system and client SSL certificates.

This version of Connector/NET is no longer supported.

- Connector/NET 6.1 includes new features such as the MySQL Website Configuration Tool, and a Session State Provider.
This version of Connector/NET is no longer supported.
- Connector/NET 6.0 includes support for UDF schema collection, Initial Entity Framework, and use of the traditional SQL Server buttons in Visual Studio for keys, indexes, and so on.
This version of Connector/NET is no longer supported.
- Connector/NET 5.2 includes support for a new membership and role providers, Compact Framework 2.0, a new stored procedure parser and improvements to [GetSchema](#). Connector/NET 5.2 also includes the Visual Studio Plugin as a standard installable component.
This version of Connector/NET is no longer supported.
- Connector/NET 5.1 includes support for a new membership and role providers, Compact Framework 2.0, a new stored procedure parser and improvements to [GetSchema](#). Connector/NET 5.1 also includes the Visual Studio Plugin as a standard installable component.
This version of Connector/NET is no longer supported.
- Connector/NET 5.0 includes full support for the ADO.NET 2.0 interfaces and subclasses, includes support for the usage advisor and performance monitor (PerfMon) hooks.
This version of Connector/NET is no longer supported.
- Connector/NET 1.0 includes full compatibility with the ADO.NET driver interface.
This version of Connector/NET is no longer supported.

The following table shows the .NET Framework version required and the MySQL server version supported by Connector/NET:

Table 4.2 Connector/NET Requirements for Related Products

Connector/NET Version	ADO.NET Version Supported	.NET Framework Version Required	MySQL Server Version Supported	Currently Supported
7.0	2.x+	.NET Core 1.1 for VS 2015 / 2017; .NET Framework 4.5.x for VS 2013 / 2015 / 2017	5.7, 5.6	No
6.9	2.x+	3.5+ for VS 2008, 4.x+ for VS 2010 / 2012 / 2013, WinRT for VS 2012 / 2013	5.7, 5.6, 5.5	No
6.8	2.x+	3.5+ for VS 2008, 4.x+ for VS 2010 / 2012 / 2013, WinRT for VS 2012 / 2013	5.7, 5.6, 5.5, 5.1, 5.0	No
6.7	2.x+	2.x+ for VS 2008, 4.x+ for VS 2010 / 2012 / 2013, WinRT for VS 2012 / 2013	5.7, 5.6, 5.5, 5.1, 5.0	No

Connector/NET Version	ADO.NET Version Supported	.NET Framework Version Required	MySQL Server Version Supported	Currently Supported
6.6	2.x+	2.x+ for VS 2008, 4.x+ for VS 2010 / 2012 / 2013	5.7, 5.6, 5.5, 5.1, 5.0	No
6.5	2.x+	2.x+ for VS 2008, 4.x+ for VS 2010	5.7, 5.6, 5.5, 5.1, 5.0	No
6.4	2.x+	2.x+, 4.x+ for VS 2010	5.6, 5.5, 5.1, 5.0	No
6.3	2.x+	2.x+, 4.x+ for VS 2010	5.6, 5.5, 5.1, 5.0	No
6.2	2.x+	2.x+	5.6, 5.5, 5.1, 5.0, 4.1	No
6.1	2.x+	2.x+	5.6, 5.5, 5.1, 5.0, 4.1	No
6.0	2.x+	2.x+	5.5, 5.1, 5.0, 4.1	No
5.2	2.x+	2.x+	5.5, 5.1, 5.0, 4.1	No
5.1	2.x+	2.x+	5.5, 5.1, 5.0, 4.1, 4.0	No
5.0	2.x+	2.x+	5.0, 4.1, 4.0	No
1.0	1.x	1.x	5.0, 4.1, 4.0	No

4.3 Connector/NET Installation

MySQL Connector/NET runs on any platform that supports the .NET Standard (.NET Framework, .NET Core, and Mono). The .NET Framework is primarily supported on recent versions of Microsoft Windows and Microsoft Windows Server.

Cross-platform options:

- .NET Core provides support on Windows, macOS, and Linux.
- [Open Source Mono platform](#) provides support on Linux.

Connector/NET is available for download from the [MySQL Installer](#), as a [standalone MSI Installer](#), or from the [NuGet gallery](#). The source code is available for download from MySQL [Download MySQL Connector/NET](#) or at GitHub from the [MySQL Connector/NET repository](#).

4.3.1 Installing Connector/NET on Windows

On Microsoft Windows, you can install either through a binary installation process using a Connector/NET MSI, choose the MySQL Connector/NET product from the MySQL Installer, using NuGet, or by downloading and using the source code.

Before installing, ensure that your system is up to date, including installing the latest version of the .NET Framework or .NET Core. For additional information, see [Section 4.2, “Connector/NET Versions”](#).

4.3.1.1 Installing Connector/NET Using MySQL Installer

MySQL Installer provides an easy to use, wizard-based installation experience for all MySQL software on Windows. It can be used to install and upgrade your MySQL Connector/NET installation.

To use, download and install [MySQL Installer](#).

After executing MySQL Installer, choose and install the Connector/NET product.

4.3.1.2 Installing Connector/NET Using the Standalone Installer

You can install MySQL Connector/NET through a Windows Installer (`.msi`) installation package, which can install Connector/NET on supported Windows operating systems. The MSI package is a file named `mysql-connector-net-version.msi`, where `version` indicates the Connector/NET version.

Note

Using the central MySQL Installer is recommended, instead of the standalone package that is documented in this section. The MySQL Installer is available for download at [MySQL Installer](#).

To install Connector/NET:

1. Double-click the MSI installer file, and click **Next** to start the installation.
2. Choose the type of installation to perform (Typical, Custom, or Complete) and then click **Next**.
 - The typical installation is suitable in most cases. Click **Typical** and proceed to Step 5.
 - A Complete installation installs all the available files. To conduct a Complete installation, click the **Complete** button and proceed to step 5.
 - To customize your installation, including choosing the components to install and some installation options, click the **Custom** button and proceed to Step 3.

The Connector/NET installer will register the connector within the Global Assembly Cache (GAC) - this will make the Connector/NET component available to all applications, not just those where you explicitly reference the Connector/NET component. The installer will also create the necessary links in the Start menu to the documentation and release notes.

3. If you have chosen a custom installation, you can select the individual components to install, including the core interface component, supporting documentation options, examples, and the source code. Click **Disk Usage** to determine the disk-space requirements of your component choices.

Select the items and their installation level and then click **Next** to continue the installation.

4. You will be given a final opportunity to confirm the installation. Click **Install** to copy and install the files onto your computer. Use **Back** to return to the modify your component options.
5. When prompted, click **Finish** to exit the MSI installer.

Unless you choose a different folder, Connector/NET is installed in `C:\Program Files (x86)\MySQL\MySQL Connector Net version` (the version installed). New installations do not overwrite existing versions of Connector/NET.

You may also use the `/quiet` or `/q` command-line option with the `msiexec` tool to install the Connector/NET package automatically (using the default options) with no notification to the user. Using this method the user cannot select options. Additionally, no prompts, messages or dialog boxes will be displayed.

```
C:\> msiexec /package connector-net.msi /quiet
```

To provide a progress bar to the user during automatic installation, use the `/passive` option.

4.3.1.3 Installing Connector/NET Using NuGet

MySQL Connector/NET functionality is available as packages from NuGet, an open-source package manager for the Microsoft development platform (including .NET Core). The NuGet Gallery is the

central software package repository populated with the most recent NuGet packages for Connector/NET.

You can install or upgrade one or more individual Connector/NET packages with NuGet, making it a convenient way to introduce existing technology, such as Entity Framework, to your project. NuGet manages dependencies across the related packages and all of the prerequisites are listed in the NuGet Gallery. For a description of each Connector/NET package, see [Connector/NET Packages \(NuGet\)](#).

Important

For projects that require Connector/NET assemblies to be stored in the GAC, integration with Entity Framework Designer (Visual Studio), or access to MySQL for Visual Studio, use [MySQL Installer](#) or the [standalone MSI](#) to install Connector/NET, rather than installing the NuGet packages.

Consuming Connector/NET Packages with NuGet

The NuGet Gallery (<https://www.nuget.org/>) provides several client tools that can help you install or upgrade Connector/NET packages. If you are not familiar with the tool options or processes, see [Package consumption workflow](#) to get started. After locating a package description in NuGet, confirm the following information:

- The identity and version number of the package are correct. Use the **Version History** list to select the current version.
- All of the prerequisites are installed. See the **Dependencies** list for details.
- The license terms are met. See the **License Info** link to view this information.

Connector/NET Packages (NuGet)

Connector/NET provides the following five NuGet packages:

[MySql.Data](#)

This package contains the core functionality of Connector/NET, including using MySQL as a document store (with Connector/NET 8.0 only). It implements the required ADO.NET interfaces and integrates with ADO.NET-aware tools. In addition, the package provides access to multiple versions of MySQL server and encapsulates database-specific protocols.

[MySql.Web](#)

The [MySql.Web](#) package includes support for the ASP.NET 2.0 provider model (see [Section 4.5.17, “ASP.NET Provider Model”](#)). This model enables you to focus on the business logic of your application, rather than having to recreate boilerplate items such as membership and roles support. The package supports the membership, role, profile, and session-state providers.

Package dependency: [MySql.Data](#).

[MySql.Data.EntityFramework](#) This package provides object-relational mapper (ORM) capabilities, which enables you to work with MySQL databases using domain-specific objects, thereby eliminating the need for most of the data access code. Select this package for your Entity Framework 6 applications (see [Section 4.8.1, “Entity Framework 6 Support”](#)).

Package dependency: [MySql.Data](#).

[MySql.Data.EntityFrameworkCore](#) This package is similar to the [MySql.Data.EntityFramework](#) package; however, it provides multi-platform support for Entity Framework tasks. Select this package for your Entity Framework Core applications (see [Section 4.8.2, “Entity Framework Core Support”](#)).

`MySql.Data.EntityFramework` The `MySql.Data.EntityFrameworkCore.Design` package includes shared design-time components for Entity Framework Core tools, which enable you to scaffold and migrate MySQL databases.

4.3.2 Installing Connector/NET on Unix with Mono

There is no installer available for installing the MySQL Connector/NET component on your Unix installation. Before installing, ensure that you have a working Mono project installation. To test whether your system has Mono installed, enter:

```
shell> mono --version
```

The version of the Mono JIT compiler is displayed.

To compile C# source code, make sure a Mono C# compiler is installed.

Note

There are three Mono C# compilers available: `mcs`, which accesses the 1.0-profile libraries, `gmcs`, which accesses the 2.0-profile libraries, and `dmcs`, which accesses the 4.0-profile libraries.

To install Connector/NET on Unix/Mono:

1. Download the `mysql-connector-net-version-noinstall.zip` and extract the contents to a directory of your choice, for example: `~/connector-net/`.
2. In the directory where you unzipped the connector to, change into the `bin` subdirectory. Ensure the file `MySql.Data.dll` is present. This filename is case-sensitive.
3. You must register the Connector/NET component, `MySql.Data`, in the Global Assembly Cache (GAC). In the current directory enter the `gacutil` command:

```
root-shell> gacutil /i MySql.Data.dll
```

This will register `MySql.Data` into the GAC. You can check this by listing the contents of `/usr/lib/mono/gac`, where you will find `MySql.Data` if the registration has been successful.

You are now ready to compile your application. You must ensure that when you compile your application you include the Connector/NET component using the `-r:` command-line option. For example:

```
shell> gmcs -r:System.dll -r:System.Data.dll -r:MySql.Data.dll HelloWorld.cs
```

The referenced assemblies depend on the requirements of the application, but applications using Connector/NET must provide `-r:MySql.Data` at a minimum.

You can further check your installation by running the compiled program, for example:

```
shell> mono HelloWorld.exe
```

4.3.3 Installing Connector/NET from Source

Building MySQL Connector/NET from the source code enables you to customize build parameters and target platforms such as Linux and macOS. The procedures in this section describe how to build source with Microsoft Visual Studio (Windows or macOS) and .NET Core CLI (Windows, macOS, or Linux).

MySQL Connector/NET source code is available for download from <https://dev.mysql.com/downloads/connector/net/>. Select `Source Code` from the **Select Operating System** list. Use the **Archive** tab to download a previous version of Connector/NET source code.

Source code is packaged as a ZIP archive file with a name similar to `mysql-connector-net-8.0.19-src.zip`. Unzip the file to local directory.

The file includes the following directories with source files:

- `EFCore`: Source and test files for Entity Framework Core features.
- `EntityFramework`: Source and test files for Entity Framework 6 features.
- `MySQL.Data`: Source and test files for features using the MySQL library.
- `MySQL.Web`: Source and test files for the web providers, including the membership, role, profile providers that are used in ASP.NET or ASP.NET Core websites.

Building Source Code with Visual Studio

The following procedure can be used to build the connector on Microsoft Windows or macOS. Connector/.NET supports various versions of Microsoft Visual Studio and .NET libraries. For guidance about the Connector/.NET version you intend to build, see [Section 4.2, “Connector/.NET Versions”](#) before you begin.

1. Navigate to the root of the source code directory and then to the directory with the source files to build, such as `MySQL.Data`. Each source directory contains a Microsoft Visual Studio solution file with the `.sln` (for example, `MySQLData.sln`).
2. Double-click the solutions file to start Visual Studio and open the solution.

Visual Studio opens the solution files in the Solution Explorer. All of the projects related to the solution also appear in the navigation tree. These related projects can include test files and the projects that your solutions requires.

3. Locate the project with the same name as the solution (`MySQL.Data` in this example). Right-click the node and select **Build** from the context menu to build the solution.

Building Source Code with .NET Core CLI

The following procedure can be used to build the connector on Microsoft Windows, Linux, or macOS. A current version of the .NET Core SDK must be installed locally to execute `dotnet` commands. For additional usage information, visit <https://docs.microsoft.com/en-us/dotnet/core/tools/>.

1. Open a terminal such as `Powershell`, `Command Prompt`, or `bash`.

Navigate to the root of the source code directory and then to the directory with the source files to build, such as `MySQL.Data`.

2. Clean the output of the previous build.

```
dotnet clean
```

3. Type the following command to build the solution file (`MySQL.Data.sln` in this example) using the default command arguments:

```
dotnet build
```

Solution and project default. When no directory and file name is provided on the command line, the default value depends on the current directory. If the command is executed from the top directory, such as `MySQL.Data`, the solution file is selected (new with the .NET Core 3.0 SDK). Otherwise, if executed from the `src` subdirectory, the project file is used.

Configuration default, `-c` | `--configuration`. Defaults to the `Debug` build configuration. Alternatively, `-c Release` is the other supported build configuration argument value.

Framework default, `-f` | `--framework`. When no framework is specified on the command line, the solution or project is built for all possible frameworks that apply. To determine which frameworks

are supported, use a text editor to open the related project file (for example, `MySql.Data.csproj` in the `src` subdirectory) and search for the `<TargetFrameworks>` element.

To build source code on Linux and macOS, you must target .NET Standard (`-f netstandard2.0` or `-f netstandard2.1`). To build source code on Microsoft Windows, you can target .NET Standard and .NET Framework (`-f net452` or `-f net48`).

4.4 Connector/.NET Connections

All interaction between a .NET application and the MySQL server is routed through a `MySqlConnection` object when using the classic MySQL protocol. Before your application can interact with the server, it must instantiate, configure, and open a `MySqlConnection` object.

Even when using the `MySqlHelper` class, a `MySqlConnection` object is created by the helper class. Likewise, when using the `MySqlConnectionStringBuilder` class to expose the connection options as properties, your application must open a `MySqlConnection` object.

This sections in this chapter describe how to connect to MySQL using the `MySqlConnection` object.

4.4.1 Creating a Connector/.NET Connection String

The `MySqlConnection` object is configured using a connection string. A connection string contains several key-value pairs, separated by semicolons. In each key-value pair, the option name and its corresponding value are joined by an equal sign. For the list of option names to use in the connection string, see [Section 4.4.5, “Connector/.NET 8.0 Connection Options Reference”](#).

The following is a sample connection string:

```
"server=127.0.0.1;uid=root;pwd=12345;database=test"
```

In this example, the `MySqlConnection` object is configured to connect to a MySQL server at `127.0.0.1`, with a user name of `root` and a password of `12345`. The default database for all statements will be the `test` database.

Note

Using the '@' symbol for parameters is now the preferred approach, although the old pattern of using '?' is still supported. To avoid conflicts when using the '@' symbol in combination with user variables, see the `Allow User Variables` connection string option in [Section 4.4.5, “Connector/.NET 8.0 Connection Options Reference”](#). The `Old Syntax` connection string option has now been deprecated.

Connector/.NET supports several connection models:

- [Opening a Connection to a Single Server](#)
- [Opening a Connection for Multiple Hosts with Failover](#)
- [Opening a Connection Using a Single DNS Domain](#)

Opening a Connection to a Single Server

After you have created a connection string it can be used to open a connection to the MySQL server.

The following code is used to create a `MySqlConnection` object, assign the connection string, and open the connection.

MySQL Connector/.NET can also connect using the native Windows authentication plugin. See [Section 4.5.3, “Using the Windows Native Authentication Plugin”](#) for details.

You can further extend the authentication mechanism by writing your own authentication plugin. See [Section 4.5.4, “Writing a Custom Authentication Plugin”](#) for details.

Visual Basic Example

```
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
```

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);
}
```

You can also pass the connection string to the constructor of the `MySqlConnection` class:

Visual Basic Example

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

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(myConnectionString);
    conn.Open();
}
catch (MySql.Data.MySqlClient.MySqlException ex)
{
    MessageBox.Show(ex.Message);
}
```

After the connection is open, it can be used by the other Connector/.NET classes to communicate with the MySQL server.

Opening a Connection for Multiple Hosts with Failover

Data used by applications can be stored on multiple MySQL servers to provide high availability. Connector/NET provides a simple way to specify multiple hosts in a connection string for cases in which multiple MySQL servers are configured for replication and you are not concerned about the precise server your application connects to in the set. For an example of how to configure multiple hosts with replication, see [Using Replication & Load balancing](#).

Starting in Connector/NET 8.0.19, both classic MySQL protocol and X Protocol connections permit the use of multiple host names and multiple endpoints (a `host:port` pair) in a connection string or URI scheme. For example:

```
// classic protocol example
"server=10.10.10.10:3306,192.10.10.2:3305,localhost:3306;uid=test;password=xxxx"
// X Protocol example
mysqlx://test:test@[192.1.10.10:3305,127.0.0.1:3306]
```

An updated failover approach selects the target for connection first by priority order, if provided, or random order when no priority is specified. If the attempted connection to a selected target is unsuccessful, Connector/NET selects a new target from the list until no more hosts are available. If enabled, Connector/NET uses connection pooling to manage unsuccessful connections (see [Section 4.4.3, “Managing a Connection Pool in Connector/NET”](#)).

Opening a Connection Using a Single DNS Domain

Important

To enable DNS-SRV in your .NET Framework project, avoid downloading the `MySQL.Data.dll` package from the NuGet gallery. The package omits some libraries required by .NET Framework for this feature. Instead, download the no-install version of MySQL Connector/NET (`mysql-connector-net-8.0.19.msi`) from <https://dev.mysql.com/downloads/connector/net/> and then add `v4.5.2\MySQL.Data.dll` as a reference to your project. No other references are required if all items remain in the same location.

.NET Core projects can use the NuGet package directly to enable the DNS-SRV feature.

When multiple MySQL instances can provide the same service in your installation, such as with a cluster of servers, you can apply DNS Service (SRV) records to provide failover, load balancing, and replication services. DNS SRV records remove the need for clients to identify each possible host in the connection string, or for connections to be handled by an additional software component. They can also be updated centrally by administrators when servers are added or removed from the configuration or when their host names are changed. DNS SRV records can be used in combination with connection pooling, in which case connections to hosts that are no longer in the current list of SRV records are removed from the pool when they become idle.

A service record is a specification of data managed by your domain name system that defines the location (host name and port number) of servers for specified services. The record format defines the priority, weight, port, and target for the service as defined in the RFC 2782 specification (see <https://tools.ietf.org/html/rfc2782>). In the following SRV record example with four server targets (for `_mysql._tcp.foo.abc.com.`), Connector/NET uses the server selection order of `foo2`, `foo1`, `foo3`, and `foo4`.

Record	TTL	Class	Priority	Weight	Port	Target
<code>_mysql._tcp.foo.abc.com.</code>	86400	IN SRV	0	5	3306	<code>foo1.abc.com</code>
<code>_mysql._tcp.foo.abc.com.</code>	86400	IN SRV	0	10	3306	<code>foo2.abc.com</code>
<code>_mysql._tcp.foo.abc.com.</code>	86400	IN SRV	10	5	3306	<code>foo3.abc.com</code>
<code>_mysql._tcp.foo.abc.com.</code>	86400	IN SRV	20	5	3306	<code>foo4.abc.com</code>

To open a connection using DNS SRV records, add the `dns-srv` connection option to your connection string. For example:

C# Example

```
var conn = new MySqlConnection("server=_mysql._tcp.foo.abc.com.;dns-srv=true;" +  
    "user id=user;password=****;database=test");
```

For additional usage examples and restrictions for both classic MySQL protocol and X Protocol, see [Options for Both Classic MySQL Protocol and X Protocol](#).

4.4.2 Connecting With TCP/IP Over SSH

SSH tunneling (or port forwarding) enables you to create a secure connection between your computer and a remote computer through which you can access MySQL data. SSH tunnels permit you to connect to a MySQL database from behind a firewall when the MySQL server port is blocked.

There are several considerations for connecting with standard TCP/IP over SSH:

- Your application (client to make the connection) requires authorization on the SSH server.
- The SSH server communicates with a MySQL server instance in an unencrypted or encrypted mode, based on the value selected for the `SslMode` connection option (or property). The default value of the option can vary, depending on the version of Connector/.NET you use (see [Options for Both Classic MySQL Protocol and X Protocol](#)). The MySQL server instance does not require additional configuration for this type of connection.
- The `ConnectionProtocol` connection option (or property) must use the default value (`socket` or `tcp`) to establish a connection with standard TCP/IP over SSH.
- The SSH server name and port are configured using the `SshHostName` and `SshPort` connection options (or properties). To authenticate the client requesting a connection (specified by the `SshUserName` connection option or property), you can use one of the following strategies:
 - `SshUserName` and `SshPassword` only
 - `SshUserName` and `SshKeyFile` only

Your SSH server may require that you also provide the `SshPassPhrase` connection option (or property) when using a key file. An invalid pass phrase generates an exception.

- `SshUserName` and `SshKeyFile` (`SshPassPhrase`) and `SshPassword`

The combination of user name + key file (pass phrase) + password can perform fallback authentication when the key file and pass phrase are valid, but an error occurs on the server. Specifically, the first attempt to connect uses the key file, and if it fails, the next attempt to connect uses the password instead. If the SSH key file is null or empty, but the SSH password is provided, Connector/.NET attempts to connect using the SSH password only.

You can configure SSH tunneling by using either Connector/.NET 8.0.17 (or higher) connection-string options or class properties: the `MySqlConnectionStringBuilder` class for use with classic MySQL protocol or the `MySqlXConnectionStringBuilder` class for X Protocol. SSH tunnels to MySQL are supported with .NET Framework 4.5.2, .NET Standard 1.3 (.NET Core 1.1), and .NET Standard 2.2 (.NET Core 2.0).

The examples in the next sections show connections made using standard TCP/IP over SSH:

- [Basic SSH Connection with Defaults \(Classic Protocol\)](#)
- [SSH Connection With Ports \(Classic Protocol\)](#)
- [SSH Connection With Key File \(Classic Protocol\)](#)
- [SSH Connection with Fallback \(Classic Protocol\)](#)
- [Basic SSH Connection with Defaults \(X Protocol\)](#)

- [SSH Connection With SSL Mode \(X Protocol\)](#)

Basic SSH Connection with Defaults (Classic Protocol)

This example shows the most basic form of the SSH tunnel connection. The MySQL port defaults to 3306 and the SSH port defaults to 22, because the values are not configured. Also, only a password is provided to authenticate to the SSH server. In this example, the connection is made using a [MySqlConnectionStringBuilder](#) object.

```
var builder = new MySqlConnectionStringBuilder();
builder.UserID = "myUser";
builder.Password = "test";
builder.Server = "localhost";
builder.SshHostName = "10.0.0.2";
builder.SshUserName = "mySshUser";
builder.SshPassword = "sshtest";
using (var connection = new MySqlConnection(builder.ConnectionString))
{
    connection.Open();
    connection.Close();
}
```

SSH Connection With Ports (Classic Protocol)

In this SSH tunneling example, the MySQL and SSH ports are configured to override the default values. Only a password is provided to authenticate to the SSH server. Note that the connection is made using a connection string.

```
using (var connection = new MySqlConnection("uid=myUser;password=test;server=localhost;port=3307;
                                         sshHostName=10.0.0.2;sshUserName=mySshUser;sshPassword=sshtest;sshPort=23"))
{
    connection.Open();
    connection.Close();
}
```

SSH Connection With Key File (Classic Protocol)

In addition to making the connection with a password, this example also includes a key file and pass phrase. Like the previous example, both the MySQL and SSH ports are configured.

```
using (var connection = new MySqlConnection("uid=myUser;password=test;server=localhost;port=3307;
                                         sshHostName=10.0.0.2;sshUserName=mySshUser;sshKeyFile=C:\\keys\\myOpenSshKeyFile.ppk;sshPassP
                                         {
    connection.Open();
    connection.Close();
}
```

SSH Connection with Fallback (Classic Protocol)

This example includes the SSH key file (without a pass phrase) and the SSH password. Because the key file is valid and the pass phrase is not required, the connection can fall back to the SSH password value if authentication with the SSH key file encounters an error on the server.

```
var builder = new MySqlConnectionStringBuilder();
builder.UserID = "myUser";
builder.Password = "test";
builder.Server = "localhost";
builder.Port = 3307;
builder.SshHostName = "10.0.0.2";
builder.SshUserName = "mySshUser";
builder.SshKeyFile = @"C:\\keys\\noPassPhraseOpenSshKeyFile.ppk";
builder.SshPassword = "sshtest";
using (var connection = new MySqlConnection(builder.ConnectionString))
{
    connection.Open();
    connection.Close();
}
```

Basic SSH Connection with Defaults (X Protocol)

This example configures the SSH connection with a default value for the SSH port (22). However, because the connection uses X Protocol to establish the SSH tunnel, the default MySQL port (33060) is provided in the URI-like connection string.

```
using (var session = MySQLX.GetSession("mysqlx://myUser:test@localhost:33060?sshHostName=10.0.0.2;
                                         sshUserName=mySshUser;sshPassword=sshTest"))
{
    session.Close();
}
```

SSH Connection With SSL Mode (X Protocol)

This example creates the SSH tunnel for an anonymous object and it ensures that the use of SSL by denying the connection explicitly if the server does not support SSL.

```
var sessionOptions = {
    UserID = "myUser",
    Password = "test",
    Server = "127.0.0.1",
    Port = 3307,
    SshHostName = "10.0.0.2",
    SshUserName = "mySshUser",
    SshKeyFile = @"C:\keys\myOpenSshKeyFile.ppk",
    SshPassPhrase = "sshtest",
    SslMode = MySqlSslMode.Required
};
using (var session = MySQLX.GetSession(sessionOptions))
{
    session.Close();
}
```

4.4.3 Managing a Connection Pool in Connector/NET

The MySQL Connector/.NET supports connection pooling for better performance and scalability with database-intensive applications. This is enabled by default. You can turn it off or adjust its performance characteristics using the connection string options [Pooling](#), [Connection Reset](#), [Connection Lifetime](#), [Cache Server Properties](#), [Max Pool Size](#) and [Min Pool Size](#). See [Section 4.4.1, “Creating a Connector/.NET Connection String”](#) for further information.

Connection pooling works by keeping the native connection to the server live when the client disposes of a [MySqlConnection](#). Subsequently, if a new [MySqlConnection](#) object is opened, it is created from the connection pool, rather than creating a new native connection. This improves performance.

Guidelines

To work as designed, it is best to let the connection pooling system manage all connections. Do not create a globally accessible instance of [MySqlConnection](#) and then manually open and close it. This interferes with the way the pooling works and can lead to unpredictable results or even exceptions.

One approach that simplifies things is to avoid creating a [MySqlConnection](#) object manually. Instead, use the overloaded methods that take a connection string as an argument. With this approach, Connector/.NET automatically creates, opens, closes and destructs connections, using the connection pooling system for best performance.

Typed Datasets and the [MembershipProvider](#) and [RoleProvider](#) classes use this approach. Most classes that have methods that take a [MySqlConnection](#) as an argument, also have methods that take a connection string as an argument. This includes [MySqlDataAdapter](#).

Instead of creating [MySqlCommand](#) objects manually, you can use the static methods of the [MySqlHelper](#) class. These methods take a connection string as an argument and they fully support connection pooling.

Resource Usage

Connector/.NET runs a background job every three minutes and removes connections from pool that have been idle (unused) for more than three minutes. The pool cleanup frees resources on both client and server side. This is because on the client side every connection uses a socket, and on the server side every connection uses a socket and a thread.

Multiple endpoints. Starting with Connector/.NET 8.0.19, a connection string can include multiple endpoints (`server:port`) with connection pooling enabled. At runtime, Connector/.NET selects one of the addresses from the pool randomly (or by priority when provided) and attempts to connect to it. If the connection attempt is unsuccessful, Connector/.NET selects another address until the set of addresses is exhausted. Unsuccessful endpoints are retried every two minutes. Successful connections are managed by the connection pooling mechanism.

4.4.4 Handling 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 will return a `MySQLException` object. This object has two properties that are of interest when handling errors:

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

When handling errors, you can adapt the response of your application based on the error number. The two most common error numbers when connecting are as follows:

- `0`: Cannot connect to server.
- `1045`: Invalid user name, user password, or both.

The following code example shows how to manage the response of an application based on the actual error:

Visual Basic Example

```
Dim myConnectionString As String
myConnectionString = "server=127.0.0.1;" _
    & "uid=root;" _
    & "pwd=12345;" _
    & "database=test"

Try
    Dim conn As New MySql.Data.MySqlClient.MySqlConnection(myConnectionString)
    conn.Open()
Catch ex As MySql.Data.MySqlClient.MySqlException
    Select Case ex.Number
        Case 0
            MessageBox.Show("Cannot connect to server. Contact administrator")
        Case 1045
            MessageBox.Show("Invalid username/password, please try again")
    End Select
End Try
```

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(myConnectionString);
    conn.Open();
}
catch (MySql.Data.MySqlClient.MySqlException ex)
{
    switch (ex.Number)
```

```
{  
    case 0:  
        MessageBox.Show("Cannot connect to server. Contact administrator");  
        break;  
    case 1045:  
        MessageBox.Show("Invalid username/password, please try again");  
        break;  
}
```

Important

If you are using multilanguage databases then you must specify the character set in the connection string. If you do not specify the character set, the connection defaults to the `latin1` character set. You can specify the character set as part of the connection string, for example:

```
MySqlConnection myConnection = new MySqlConnection("server=127.0.0.1;uid=root;" +  
    "pwd=12345;database=test;Charset=latin1");
```

4.4.5 Connector/NET 8.0 Connection Options Reference

This chapter describes the full set of MySQL Connector/NET 8.0 connection options. The protocol you use to make a connection to the server (classic MySQL protocol or X Protocol) determines which options you should use. Connection options have a default value that you can override by defining the new value in the connection string (classic MySQL protocol and X Protocol) or in the URI-like connection string (X Protocol). Connector/NET option names and synonyms are not case sensitive.

For instructions about how to use connection strings, see [Section 4.4.1, “Creating a Connector/NET Connection String”](#). For alternative connection styles, see [Connecting to the Server Using URI-Like Strings or Key-Value Pairs](#).

The following sections list the connection options that apply to both protocols, classic MySQL protocol only, and X Protocol only:

- [Options for Both Classic MySQL Protocol and X Protocol](#)
- [Options for Classic MySQL Protocol Only](#)
- [Options for X Protocol Only](#)

Options for Both Classic MySQL Protocol and X Protocol

The following Connector/NET connection options can be used with either protocol. Connector/NET 8.0 exposes the options in this section as properties in both the `MySql.Data.MySqlClient.MySqlConnectionStringBuilder` and `MySqlX.XDevAPI.MySqlXConnectionStringBuilder` classes.

<code>CertificateFile</code> , <code>Certificate File</code>	Default: <code>null</code> This option specifies the path to a certificate file in PKCS #12 format (<code>.pfx</code>). For an example of usage, see Section 4.6.10.2, “Using PFX Certificates in Connector/NET” .
<code>CertificatePassword</code> , <code>Certificate Password</code>	Default: <code>null</code> Specifies a password that is used in conjunction with a certificate specified using the option <code>CertificateFile</code> . For an example of usage, see Section 4.6.10.2, “Using PFX Certificates in Connector/NET” .
<code>CertificateStoreLocation</code> , <code>Certificate Store Location</code>	Default: <code>null</code>

	<p>Enables you to access a certificate held in a personal store, rather than use a certificate file and password combination. For an example of usage, see Section 4.6.10.2, “Using PFX Certificates in Connector/NET”.</p>
<code>CertificateThumbprint</code> , <code>Certificate Thumbprint</code>	<p>Default: <code>null</code></p> <p>Specifies a certificate thumbprint to ensure correct identification of a certificate contained within a personal store. For an example of usage, see Section 4.6.10.2, “Using PFX Certificates in Connector/NET”.</p>
<code>CharacterSet</code> , <code>Character Set</code> , <code>CharSet</code>	<p>Specifies the character set that should be used to encode all queries sent to the server. Results are still returned in the character set of the result data.</p>
<code>ConnectionProtocol</code> , <code>Protocol</code> , <code>Connection Protocol</code>	<p>Default: <code>socket</code> (or <code>tcp</code>)</p> <p>Specifies the type of connection to make to the server. Values can be:</p> <ul style="list-style-type: none">• <code>socket</code> or <code>tcp</code> for a socket connection using TCP/IP.• <code>pipe</code> for a named pipe connection.• <code>unix</code> for a UNIX socket connection.• <code>memory</code> to use MySQL shared memory.
<code>Database</code> , <code>Initial Catalog</code>	<p>Default: <code>mysql</code></p> <p>The case-sensitive name of the database to use initially.</p>
<code>dns-srv</code> , <code>dnssrv</code>	<p>Default: <code>false</code></p> <p>Enables the connection to resolve service (SRV) addresses in a DNS SRV record, which defines the location (host name and port number) of servers for specified the services. A single DNS domain can map to multiple targets (servers) using SRV address records. Each SRV record includes the host name, port, priority, and weight. DNS SRV support was introduced in Connector/NET 8.0.19 to remove the need for clients to identify each possible host in the connection string, with or without connection pooling.</p> <p>Specifying multiple host names, a port number, or a Unix socket connection (see the <code>ConnectionProtocol</code> option) in the connection string is not permitted when DNS SRV is enabled.</p> <p>Using classic MySQL protocol. The <code>dns-srv</code> option applies to connection strings; the <code>DnsSrv</code> property is declared in the <code>MySqlConnectionStringBuilder</code> class.</p> <pre>// Connection string example var conn = new MySqlConnection("server=_mysql._tcp.foo.abc.com.;dns-srv=false"); // MySqlConnectionStringBuilder class example var sb = new MySqlConnectionStringBuilder(); { Server = "_mysql._tcp.foo.abc.com.", UserID = "user", DnsSrv = false,</pre>

```
        Password = "*****",
        DnsSrv = true,
        Database = "test"
    };

var conn = new MySqlConnection(sb.ConnectionString);
```

Using X Protocol. The `dns-srv` option applies to connection strings and anonymous objects; the `DnsSrv` property is declared in the `MySqlXConnectionStringBuilder` class. An error is raised if both `dns-srv=false` and the URI scheme of `mysqlx+srv://` are combined to create a conflicting connection configuration. For details about using the`mysqlx+srv://` scheme element in URI-like connection strings, see [Connections Using DNS SRV Records](#).

```
// Connection string example

var session = MySQLX.GetSession("server=_mysqlx._tcp.foo.abc.com.;dns-srv=true");

// Anonymous object example

var connstring = new
{
    server = "_mysqlx._tcp.foo.abc.com.",
    user = "user",
    password = "*****",
    dnssrv = true
};

var session = MySQLX.GetSession(connString);

// MySqlXConnectionStringBuilder class example

var sb = new MySqlXConnectionStringBuilder();
{
    Server = "_mysqlx._tcp.foo.abc.com.",
    UserID = "user",
    Password = "*****",
    DnsSrv = true,
    Database = "test"
};

var session = MySQLX.GetSession(sb.ConnectionString);
```

`Keepalive`, `Keep Alive`

Default: `0`

For TCP connections, idle connection time measured in seconds, before the first keepalive packet is sent. A value of 0 indicates that `keepalive` is not used. Before Connector/NET 6.6.7/6.7.5/6.8.4, this value was measured in milliseconds.

`Password`, `pwd`

The password for the MySQL account being used.

`Port`

Default: `3306`

The port MySQL is using to listen for connections. This value is ignored if Unix socket is used.

`Server`, `Host`, `Data Source`, `DataSource`, `Address`, `Addr`, `Network Address`

Default: `localhost`

The name or network address of one or more host computers. Multiple hosts are separated by commas and a priority (0 to 100), if provided, determines the host selection order. As of Connector/NET 8.0.19, host selection is random when priorities are omitted or are the same for each host.

```
// Selects the host with the highest priority (100) first  
server=(address=192.10.1.52:3305,priority=60),(address=localhost:3306,pri
```

No attempt is made by the provider to synchronize writes to the database, so take care when using this option. In UNIX environments with Mono, this can be a fully qualified path to a MySQL socket file. With this configuration, the UNIX socket is used instead of the TCP/IP socket. Currently, only a single socket name can be given, so accessing MySQL in a replicated environment using UNIX sockets is not currently supported.

`SshHostName`, `Ssh Host Name`, `Ssh-Host-Name`

Default: `null`

The name or IP address of the computer that hosts the SSH server.

`SshKeyFile`, `Ssh Key File`, `Ssh-Key-File`

Default: `null`

The path and name of the SSH key file. The key file supports RSA and DSA private keys in both OpenSSH and ssh.com format. If you provide this file, the related pass phrase may be required for authentication. When both the key file and password are provided, the key file is authenticated first and then, if that fails, the password is used as the fallback configuration. Fallback conditions require that the SSH key file and SSH pass phrase are valid, but the connection attempt failed due to errors on the server.

`SshPassPhrase`, `Ssh Pass Phrase`, `Ssh-Pass-Phrase`

Default: `null`

The pass phrase of the SSH key file.

`SshPassword`, `Ssh Password`, `Ssh-Password`

Default: `null`

The SSH password. When both the key file and password are provided, the key file is authenticated first and then, if that fails, the password is used as the fallback configuration. Fallback conditions require that the SSH key file and SSH pass phrase are valid, but the connection attempt failed due to errors on the server.

`SshPort`, `Ssh Port`, `Ssh-Port`

Default: 22

The port number of the SSH server.

`SshUserName`, `Ssh User Name`, `Ssh-User-Name`

Default: `null`

The name of the SSH user that is authenticated by the SSH server using a key file (and pass phrase, if required), a password, or both. With valid credentials, a connection is established between the client application and the SSH server. The SSH server then communicates with an MySQL server instance in an unencrypted or encrypted connection, based on the value of the `SslMode` connection-string option.

The `ConnectionProtocol` connection-string option must be set to `socket` or `tcp` (default) to enable SSH tunneling.

`SslCa`, `Ssl-Ca`

Default: `null`

Based on the type of certificates being used, this option either specifies the path to a certificate file in PKCS #12 format (`.pfx`) or the path to a file in PEM format (`.pem`) that contains a list of trusted SSL certificate authorities (CA).

With PFX certificates in use, this option engages when the `SslMode` connection option is set to a value of `Required`, `VerifyCA`, or `VerifyFull`; otherwise, it is ignored.

With PEM certificates in use, this option engages when the `SslMode` connection option is set to a value of `VerifyCA` or `VerifyFull`; otherwise, it is ignored.

For examples of usage, see [Section 4.6.10.1, “Using PEM Certificates in Connector/NET”](#).

`SslCert`, `Ssl-Cert`

Default: `null`

The name of the SSL certificate file in PEM format to use for establishing an encrypted connection. This option engages only when `VerifyFull` is set for the `SslMode` connection option and the `SslCa` connection option uses a PEM certificate; otherwise, it is ignored. For an example of usage, see [Section 4.6.10.1, “Using PEM Certificates in Connector/NET”](#).

`SslKey`, `Ssl-Key`

Default: `null`

The name of the SSL key file in PEM format to use for establishing an encrypted connection. This option engages only when `VerifyFull` is set for the `SslMode` connection option and the `SslCa` connection option uses a PEM certificate; otherwise, it is ignored. For an example of usage, see [Section 4.6.10.1, “Using PEM Certificates in Connector/NET”](#).

`SslMode`, `Ssl Mode`, `Ssl-`
`Mode`

Default: Depends on the version of Connector/NET and the protocol in use.

- `Required` for 8.0.8 to 8.0.12 (both protocols); 8.0.13 and higher (X Protocol only).
- `Preferred` for 8.0.13 and higher (classic MySQL protocol only).

This option has the following values:

- `None` - Do not use SSL. Non-SSL enabled servers require this option be set to `None` explicitly for Connector/NET 8.0.8 or higher.
- `Preferred` - Use SSL if the server supports it, but allow connection in all cases. This option was removed in Connector/NET 8.0.8 and reimplemented in 8.0.13 for classic MySQL protocol only.

Note

Do not use this option for X Protocol operations.

- `Required` - Always use SSL. Deny connection if server does not support SSL.
- `VerifyCA` - Always use SSL. Validate the certificate authorities (CA), but tolerate a name mismatch.
- `VerifyFull` - Always use SSL. Fail if the host name is not correct.

<code>tlsversion</code> , <code>tls-version</code> , <code>tls version</code>	Default: <code>TlsV1.1,TlsV1.2,TlsV1.3</code> (A fallback solution decides which TLS version to use.)
	Restricts the set of TLS protocol versions to use during the TLS handshake when both the client and server support the TLS versions indicated and the value of the <code>SslMode</code> connection-string option is not set to <code>None</code> . This option accepts a single version or a list of versions separated by a comma, for example, <code>tls-version=TLSv1.1, TLSv1.2, TLSv1.3</code> .
	Connector/NET supports the following values:
	<ul style="list-style-type: none">• <code>TLsv1.3</code>• <code>TLsv1.2</code>• <code>TLsv1.1</code>• <code>TLsv1</code> or <code>TLsv1.0</code>
	An error is reported when a value other than those listed is assigned. Likewise, an error is reported when an empty list is provided as the value, or if all of the versions in the list are unsupported and no connection attempt is made.
<code>UserID</code> , <code>User Id</code> , <code>Username</code> , <code>Uid</code> , <code>User name</code> , <code>User</code>	Default: <code>null</code>
	The MySQL login account being used.

Options for Classic MySQL Protocol Only

Options related to systems using a connection pool appear together at the end of the list of general options (see [Connection-Pooling Options](#)). Connector/NET 8.0 exposes the options in this section as properties in the `MySql.Data.MySqlClient.MySqlConnectionStringBuilder` class.

General Options. The Connector/NET options that follow are for general use with connection strings and the options apply to all MySQL server configurations:

<code>AllowBatch</code> , <code>Allow Batch</code>	Default: <code>true</code>
	When <code>true</code> , multiple SQL statements can be sent with one command execution. Batch statements should be separated by the server-defined separator character.
<code>AllowLoadLocalInfile</code> , <code>Allow Load Local Infile</code>	Default: <code>false</code>
	Disables (by default) or enables the server functionality to load the data local infile.
<code>AllowPublicKeyRetrieval</code>	Default: <code>false</code>
	Setting this option to <code>true</code> informs Connector/NET that RSA public keys should be retrieved from the server and that connections using the classic MySQL protocol, when SSL is disabled, will fail by default. Exceptions to the default behavior can occur when previous successful connection attempts were made or when pooling is enabled and a pooled connection can be reused. This option was introduced with the 8.0.10 connector.

Caution

This option is prone to man-in-the-middle attacks, so it should be used only in

situations where you can ensure by other means that your connections are made to trusted servers.

`AllowUserVariables`,
`Allow User Variables`

Default: `false`

Setting this to `true` indicates that the provider expects user variables in the SQL.

`AllowZeroDateTime`, `Allow Zero Datetime`

Default: `false`

If set to `True`, `MySqlDataReader.GetValue()` returns a `MySqlDateTime` object for date or datetime columns that have disallowed values, such as zero datetime values, and a `System.DateTime` object for valid values. If set to `False` (the default setting) it causes a `System.DateTime` object to be returned for all valid values and an exception to be thrown for disallowed values, such as zero datetime values.

`AutoEnlist`, `Auto Enlist`

Default: `true`

If `AutoEnlist` is set to `true`, which is the default, a connection opened using `TransactionScope` participates in this scope, it commits when the scope commits and rolls back if `TransactionScope` does not commit. However, this feature is considered security sensitive and therefore cannot be used in a medium trust environment.

As of 8.0.10, this option is supported in .NET Core 2.0 implementations.

`BlobAsUTF8ExcludePattern`

Default: `null`

A POSIX-style regular expression that matches the names of BLOB columns that do not contain UTF-8 character data. See [Section 4.5.15, “Character Set Considerations for Connector/NET”](#) for usage details.

`BlobAsUTF8IncludePattern`

Default: `null`

A POSIX-style regular expression that matches the names of BLOB columns containing UTF-8 character data. See [Section 4.5.15, “Character Set Considerations for Connector/NET”](#) for usage details.

`CheckParameters`, `Check Parameters`

Default: `true`

Indicates if stored routine parameters should be checked against the server.

`CommandInterceptors`,
`Command Interceptors`

The list of interceptors that can intercept SQL command operations.

`ConnectionTimeout`,
`Connect Timeout`,
`Connection Timeout`

Default: `15`

The length of time (in seconds) to wait for a connection to the server before terminating the attempt and generating an error.

`ConvertZeroDateTime`,
`Convert Zero Datetime`

Default: `false`

Use `true` to have `MySqlDataReader.GetValue()` and `MySqlDataReader.GetDateTime()` return

	<code>DateTime.MinValue</code> for date or datetime columns that have disallowed values.
<code>DefaultCommandTimeout</code> , <code>Default Command Timeout</code>	Default: <code>30</code> Sets the default value of the command timeout to be used. This does not supersede the individual command timeout property on an individual command object. If you set the command timeout property, that will be used.
<code>DefaultTableCacheAge</code> , <code>Default Table Cache Age</code>	Default: <code>60</code> Specifies how long a <code>TableDirect</code> result should be cached, in seconds. For usage information about table caching, see Section 4.5.5, “Using Connector/NET with Table Caching” .
<code>ExceptionInterceptors</code> , <code>Exception Interceptors</code>	The list of interceptors that can triage thrown <code>MySqlException</code> exceptions.
<code>FunctionsReturnString</code> , <code>Functions Return String</code>	Default: <code>false</code> Causes the connector to return <code>binary</code> or <code>varbinary</code> values as strings, if they do not have a table name in the metadata.
<code>IgnorePrepare</code> , <code>Ignore Prepare</code>	Default: <code>true</code> When <code>true</code> , instructs the provider to ignore any calls to <code>MySqlCommand.Prepare()</code> . This option is provided to prevent issues with corruption of the statements when used with server-side prepared statements. If you use server-side prepare statements, set this option to <code>false</code> .
<code>Includesecurityasserts</code> , <code>Include security asserts</code>	Default: <code>false</code> Must be set to <code>true</code> when using the <code>MySQLClientPermissions</code> class in a partial trust environment, with the library installed in the GAC of the hosting environment. See Section 4.5.18, “Working with Partial Trust / Medium Trust” for details.
	As of 8.0.10, this option is supported in .NET Core 2.0 implementations.
<code>InteractiveSession</code> , <code>Interactive</code> , <code>Interactive Session</code>	Default: <code>false</code> If set to <code>true</code> , the client is interactive. An interactive client is one where the server variable <code>CLIENT_INTERACTIVE</code> is set. If an interactive client is set, the <code>wait_timeout</code> variable is set to the value of <code>interactive_timeout</code> . The client will then time out after this period of inactivity. For more details, see Server System Variables in the MySQL Reference Manual.
	As of 8.0.10, this option is supported in .NET Core 2.0 implementations.
<code>IntegratedSecurity</code> , <code>Integrated Security</code>	Default: <code>no</code> Use Windows authentication when connecting to server. By default, it is turned off. To enable, specify a value of <code>yes</code> . (You can also use the value <code>sspi</code> as an alternative to <code>yes</code> .) For details, see Section 4.5.3, “Using the Windows Native Authentication Plugin” .
	<i>Currently not supported for .NET Core implementations.</i>

Logging	Default: <code>false</code>
	When true, various pieces of information is output to any configured TraceListeners. See Section 4.5.13, “Using the Connector/NET Trace Source Object” for further details.
	As of 8.0.10, this option is supported in .NET Core 2.0 implementations.
<code>OldGuids</code> , <code>Old Guids</code>	Default: <code>false</code>
	The back-end representation of a GUID type was changed from <code>BINARY(16)</code> to <code>CHAR(36)</code> . This was done to allow developers to use the server function <code>UUID()</code> to populate a GUID table - <code>UUID()</code> generates a 36-character string. Developers of older applications can add ' <code>Old Guids=true</code> ' to the connection string to use a GUID of data type <code>BINARY(16)</code> .
<code>PersistSecurityInfo</code> , <code>Persist Security Info</code>	Default: <code>false</code>
	When set to <code>false</code> or <code>no</code> (strongly recommended), security-sensitive information, such as the password, is not returned as part of the connection if the connection is open or has ever been in an open state. Resetting the connection string resets all connection string values, including the password. Recognized values are <code>true</code> , <code>false</code> , <code>yes</code> , and <code>no</code> .
<code>PipeName</code> , <code>Pipe Name</code> , <code>Pipe</code>	Default: <code>mysql</code>
	When set to the name of a named pipe, the <code>MySqlConnection</code> attempts to connect to MySQL on that named pipe. This setting only applies to the Windows platform.
	<i>Currently not supported for .NET Core implementations.</i>
<code>ProcedureCacheSize</code> , <code>Procedure Cache Size</code> , <code>procedure cache</code> , <code>procedurecache</code>	Default: <code>25</code>
	Sets the size of the stored procedure cache. By default, Connector/NET stores the metadata (input/output data types) about the last 25 stored procedures used. To disable the stored procedure cache, set the value to zero (0).
Replication	Default: <code>false</code>
	Indicates if this connection is to use replicated servers.
	As of 8.0.10, this option is supported in .NET Core 2.0 implementations.
<code>RespectBinaryFlags</code> , <code>Respect Binary Flags</code>	Default: <code>true</code>
	Setting this option to <code>false</code> means that Connector/NET ignores a column's binary flags as set by the server.
<code>SharedMemoryName</code> , <code>Shared Memory Name</code>	Default: <code>mysql</code>
	The name of the shared memory object to use for communication if the connection protocol is set to <code>memory</code> . This setting only applies to the Windows platform.
	<i>Currently not supported for .NET Core implementations.</i>

<code>SqlServerMode</code> , <code>Sql Server Mode</code>	Default: <code>false</code> Allow SQL Server syntax. When set to <code>true</code> , enables Connector/NET to support square brackets around symbols instead of backticks. This enables Visual Studio wizards that bracket symbols between the [and] characters to work with Connector/NET. This option incurs a performance hit, so should only be used if necessary.
<code>TableCaching</code> , <code>Table Cache</code> , <code>TableCache</code>	Default: <code>false</code> Enables or disables caching of <code>TableDirect</code> commands. A value of <code>true</code> enables the cache while <code>false</code> disables it. For usage information about table caching, see Section 4.5.5, “Using Connector/NET with Table Caching” .
<code>TreatBlobsAsUTF8</code> , <code>Treat BLOBS as UTF8</code>	Default: <code>false</code> Setting this value to <code>true</code> causes <code>BLOB</code> columns to have a character set of <code>utf8</code> with the default collation for that character set. To convert only some of your BLOB columns, you can make use of the ' <code>'BlobAsUTF8IncludePattern'</code> and ' <code>'BlobAsUTF8ExcludePattern'</code> keywords. Set these to a regular expression pattern that matches the column names to include or exclude respectively.
<code>TreatTinyAsBoolean</code> , <code>Treat Tiny As Boolean</code>	Default: <code>true</code> Setting this value to <code>false</code> causes <code>TINYINT(1)</code> to be treated as an <code>INT</code> . See Numeric Data Type Syntax for a further explanation of the <code>TINYINT</code> and <code>BOOL</code> data types.
<code>UseAffectedRows</code> , <code>Use Affected Rows</code>	Default: <code>false</code> When <code>true</code> , the connection reports changed rows instead of found rows.
<code>UseCompression</code> , <code>Compress</code> , <code>Use Compression</code>	Default: <code>false</code> Setting this option to <code>true</code> enables compression of packets exchanged between the client and the server. This exchange is defined by the MySQL client/server protocol. Compression is used if both client and server support ZLIB compression, and the client has requested compression using this option. A compressed packet header is: packet length (3 bytes), packet number (1 byte), and Uncompressed Packet Length (3 bytes). The Uncompressed Packet Length is the number of bytes in the original, uncompressed packet. If this is zero, the data in this packet has not been compressed. When the compression protocol is in use, either the client or the server may compress packets. However, compression will not occur if the compressed length is greater than the original length. Thus, some packets will contain compressed data while other packets will not.
<code>UseDefaultCommandTimeoutForEf</code> , <code>Use Default Command Timeout For EF</code>	Default: <code>false</code> Enforces the command timeout of <code>EF MySqlCommand</code> , which is set to the value provided by the <code>DefaultCommandTimeout</code> property.

`UseOldSyntax`, `Old Syntax` Default: `false`
`, OldSyntax`, `Use Old Syntax`

This option was removed in Connector/NET 8.0.8. All code should now be written using the '@' symbol as the parameter marker.

`UsePerformanceMonitor`,
`Use Performance Monitor`,
`UserPerfMon`, `PerfMon`

Default: `false`

Indicates that performance counters should be updated during execution.

Currently not supported for .NET Core implementations.

`UseUsageAdvisor`, `Use Usage Advisor`, `Usage Advisor`

Default: `false`

Logs inefficient database operations.

As of 8.0.10, this option is supported in .NET Core 2.0 implementations.

Connection-Pooling Options. The following options are related to connection pooling within connection strings. For more information about connection pooling, see [Opening a Connection to a Single Server](#).

`CacheServerProperties`,
`Cache Server Properties`

Default: `false`

Specifies whether server variable settings are updated by a `SHOW VARIABLES` command each time a pooled connection is returned. Enabling this setting speeds up connections in a connection pool environment. Your application is not informed of any changes to configuration variables made by other connections.

`ConnectionLifetime`,
`Connection Lifetime`

Default: 0

When a connection is returned to the pool, its creation time is compared with the current time and the connection is destroyed if that time span (in seconds) exceeds the value specified by `Connection Lifetime`. This option is useful in clustered configurations to force load balancing between a running server and a server just brought online. A value of zero (0) sets pooled connections to the maximum connection timeout.

`ConnectionReset`,
`Connection Reset`

Default: `false`

If `true`, the connection state is reset when it is retrieved from the pool. The default value of `false` avoids making an additional server round trip when obtaining a connection, but the connection state is not reset.

`MaximumPoolsize`, `Max Pool Size`, `Maximum Pool Size`, `MaxPoolSize`

Default: 100

The maximum number of connections allowed in the pool.

`MinimumPoolSize`, `Min Pool Size`, `Minimum Pool Size`, `MinPoolSize`

Default: 0

The minimum number of connections allowed in the pool.

`Pooling`

Default: `true`

When `true`, the `MySqlConnection` object is drawn from the appropriate pool, or if necessary, is created and added to the appropriate pool. Recognized values are `true`, `false`, `yes`, and `no`.

Options for X Protocol Only

The connection options that follow are valid for connections made with X Protocol.

Connector/NET 8.0 exposes the options in this section as properties in the

`MySqlX.XDevAPI.MySqlXConnectionStringBuilder` class.

`Auth`, `Authentication`,
`Authentication Mode`

Authentication mechanism to use with the X Protocol. This option was introduced with the 8.0.9 connector and has the following values, which are case-insensitive: `MYSQL41`, `PLAIN`, and `EXTERNAL`. If the `auth` option is not set, the mechanism is chosen depending on the connection type. `PLAIN` is used for secure connections (TLS or Unix sockets) and `MYSQL41` is used for unencrypted connections. `EXTERNAL` is used for external authentication methods such as PAM, Windows login IDs, LDAP, or Kerberos. (`EXTERNAL` is not currently supported.)

The `auth` option is not supported for classic MySQL protocol connections and returns `NotSupportedException` if used.

`Connection-attributes`,
`ConnectionAttributes`

This option was introduced in the 8.0.16 connector to enable applications to specify attributes to be passed together with the default attributes. The aggregate size of connection attribute data sent by a client is limited by the value of the `performance_schema_session_connect_attrs_size` server variable. The total size of the data package should be less than the value of the server variable. For general information about connection attributes, see [Performance Schema Connection Attribute Tables](#).

The `connection-attributes` parameter value must be empty (the same as specifying true), a Boolean value (true or false to enable or disable the default attribute set), or a list or zero or more `key=value` specifiers separated by commas (to be sent in addition to the default attribute set). Within a list, a missing key value evaluates as the `NULL` value. Examples:

```
// Sessions
MySQLX.GetSession($"mysqlx://user@host/schema")
MySQLX.GetSession($"mysqlx://user@host/schema?connection-attributes")
MySQLX.GetSession($"mysqlx://user@host/schema?connection-attributes=true")
MySQLX.GetSession($"mysqlx://user@host/schema?connection-attributes=false")
MySQLX.GetSession($"mysqlx://user@host/schema?connection-attributes=[attr1, attr2]")
MySQLX.GetSession($"mysqlx://user@host/schema?connection-attributes=[]")

// Pooling
MySQLX.Client($"mysqlx://user@host/schema")
MySQLX.Client($"mysqlx://user@host/schema?connection-attributes")
MySQLX.Client($"mysqlx://user@host/schema?connection-attributes=true")
MySQLX.Client($"mysqlx://user@host/schema?connection-attributes=false")
MySQLX.Client($"mysqlx://user@host/schema?connection-attributes=[attr1, attr2]")
MySQLX.Client($"mysqlx://user@host/schema?connection-attributes=[]")
```

Application-defined attribute names cannot begin with `_` because such names are reserved for internal attributes.

If connection attributes are not specified in a valid way, an error occurs and the connection attempt fails.

`Connect-Timeout`,
`ConnectTimeout`

Default: `10000`

The length of time (in milliseconds) to wait for an X Protocol connection to the server before terminating the attempt and

generating an error. You can disable the connection timeout by setting the value to zero. This option can be specified as follows:

- URI-like connection string example

```
MySQLX.GetSession("mysqlx://test:test@localhost:33060?connect-timeout=2000")
```

- Connection string example

```
MySQLX.GetSession("server=localhost;user=test;port=33060;connect-timeout=2000")
```

- Anonymous object example

```
MySQLX.GetSession(new { server="localhost", user="test", port=33060, connectTimeout=2000 })
```

- `MySqlXConnectionStringBuilder` class example

```
var builder = new MySqlXConnectionStringBuilder("server=localhost;user=test");
builder.ConnectTimeout = 2000;
MySQLX.GetSession(builder.ConnectionString);
```

`SslCrl`, `Ssl-Crl`

Default: `null`

Path to a local file containing certificate revocation lists.

Important

Although the `SslCrl` connection-string option is valid for use, applying it raises a `NotSupportedException` message.

`SslEnable`, `Ssl-Enable`

Default: `false`

Enables or disables the use of SSL for connections made using the X Protocol. A value of `true` sets the `SslMode` to `Required` while `false` sets it to `None`.

This option was introduced in Connector/NET 7.0.5 and removed in Connector/NET 8.0.8 because SSL is enabled by default when appropriate. Starting with Connector/NET 8.0.8, to disable SSL when the server does not support it, you must set the value of `SslMode` to `None` explicitly.

4.4.6 Connector/NET 6.10 Connection-String Options Reference

This chapter describes both the general MySQL Connector/NET 6.10 connection-string options that apply to all server configurations and the options related to systems using a connection pool (see [Connection Pooling Options](#)). Connection options have a default value that you can override by defining the new value in the connection string. Connector/NET option names and synonyms are not case sensitive.

For instructions about how to use connection strings with Connector/NET, see [Section 4.4.1, “Creating a Connector/NET Connection String”](#).

General Options

The Connector/NET 6.10 options that follow are for general use with connection strings and apply to all MySQL server configurations:

`AllowBatch`, `Allow Batch` Default: `true`

When `true`, multiple SQL statements can be sent with one command execution. Note: starting with MySQL 4.1.1, batch

	statements should be separated by the server-defined separator character. Statements sent to earlier versions of MySQL should be separated by the semicolon character (;).
<code>AllowLoadLocalInfile</code> , <code>Allow Load Local Infile</code>	Default: <code>false</code> Disables (by default) or enables the server functionality to load the data local infile.
<code>AllowUserVariables</code> , <code>Allow User Variables</code>	Default: <code>false</code> Setting this to <code>true</code> indicates that the provider expects user variables in the SQL. This option was introduced with the 5.2.2 connector.
<code>AllowZeroDateTime</code> , <code>Allow Zero Datetime</code>	Default: <code>false</code> If set to <code>True</code> , <code>MySqlDataReader.GetValue()</code> returns a <code>MySqlDateTime</code> object for date or datetime columns that have disallowed values, such as zero datetime values, and a <code>System.DateTime</code> object for valid values. If set to <code>False</code> (the default setting) it causes a <code>System.DateTime</code> object to be returned for all valid values and an exception to be thrown for disallowed values, such as zero datetime values.
<code>AutoEnlist</code> , <code>Auto Enlist</code>	Default: <code>true</code> If <code>AutoEnlist</code> is set to <code>true</code> , which is the default, a connection opened using <code>TransactionScope</code> participates in this scope, it commits when the scope commits and rolls back if <code>TransactionScope</code> does not commit. However, this feature is considered security sensitive and therefore cannot be used in a medium trust environment. As of 6.10.6, this option is supported in .NET Core 2.0 implementations.
<code>BlobAsUTF8ExcludePattern</code>	Default: <code>null</code> A POSIX-style regular expression that matches the names of BLOB columns that do not contain UTF-8 character data. See Section 4.5.15, “Character Set Considerations for Connector/NET” for usage details.
<code>BlobAsUTF8IncludePattern</code>	Default: <code>null</code> A POSIX-style regular expression that matches the names of BLOB columns containing UTF-8 character data. See Section 4.5.15, “Character Set Considerations for Connector/NET” for usage details.
<code>CertificateFile</code> , <code>Certificate File</code>	Default: <code>null</code> This option specifies the path to a certificate file in PKCS #12 format (<code>.pfx</code>). For an example of usage, see Section 4.6.10, “Tutorial: Configuring SSL with Connector/NET” . This option was introduced with the 6.2.1 connector.
<code>CertificatePassword</code> , <code>Certificate Password</code>	Default: <code>null</code> Specifies a password that is used in conjunction with a certificate specified using the option <code>CertificateFile</code> . For an example of usage, see Section 4.6.10, “Tutorial: Configuring SSL with

	<p>Connector/NET". This option was introduced with the 6.2.1 connector.</p>
<code>CertificateStoreLocation</code> , Certificate Store Location	<p>Default: <code>null</code></p> <p>Enables you to access a certificate held in a personal store, rather than use a certificate file and password combination. For an example of usage, see Section 4.6.10, "Tutorial: Configuring SSL with Connector/NET". This option was introduced with the 6.2.1 connector.</p>
<code>CertificateThumbprint</code> , Certificate Thumbprint	<p>Default: <code>null</code></p> <p>Specifies a certificate thumbprint to ensure correct identification of a certificate contained within a personal store. For an example of usage, see Section 4.6.10, "Tutorial: Configuring SSL with Connector/NET". This option was introduced with the 6.2.1 connector.</p>
<code>CharacterSet</code> , CharSet, Character Set	<p>Specifies the character set that should be used to encode all queries sent to the server. Results are still returned in the character set of the result data.</p>
<code>CheckParameters</code> , Check Parameters	<p>Default: <code>true</code></p> <p>Indicates if stored routine parameters should be checked against the server.</p>
<code>CommandInterceptors</code> , Command Interceptors	<p>The list of interceptors that can intercept SQL command operations.</p>
<code>ConnectionProtocol</code> , Protocol, Connection Protocol	<p>Default: <code>socket</code> or <code>tcp</code></p> <p>Specifies the type of connection to make to the server. Values can be:</p> <ul style="list-style-type: none">• <code>socket</code> or <code>tcp</code> for a socket connection.• <code>pipe</code> for a named pipe connection.• <code>unix</code> for a UNIX socket connection.• <code>memory</code> to use MySQL shared memory.
<code>ConnectionTimeout</code> , Connect Timeout, Connection Timeout	<p>Default: 15</p> <p>The length of time (in seconds) to wait for a connection to the server before terminating the attempt and generating an error.</p>
<code>ConvertZeroDateTime</code> , Convert Zero Datetime	<p>Default: <code>false</code></p> <p>Use <code>true</code> to have <code>MySqlDataReader.GetValue()</code> and <code>MySqlDataReader.GetDateTime()</code> return <code>DateTime.MinValue</code> for date or datetime columns that have disallowed values.</p>
<code>Database</code> , Initial Catalog	<p>Default: <code>mysql</code></p> <p>The case-sensitive name of the database to use initially.</p>
<code>DefaultCommandTimeout</code> , Default Command Timeout	<p>Default: 30</p>

	Sets the default value of the command timeout to be used. This does not supersede the individual command timeout property on an individual command object. If you set the command timeout property, that will be used. This option was introduced with the 5.1.4 connector.
<code>DefaultTableCacheAge</code> , <code>Default Table Cache Age</code>	Default: 60 Specifies how long a <code>TableDirect</code> result should be cached, in seconds. For usage information about table caching, see Section 4.5.5, “Using Connector/NET with Table Caching” . This option was introduced with the 6.4 connector.
<code>ExceptionInterceptors</code> , <code>Exception Interceptors</code>	The list of interceptors that can triage thrown <code>MySqlException</code> exceptions.
<code>FunctionsReturnString</code> , <code>Functions Return String</code>	Default: <code>false</code> Causes the connector to return <code>binary</code> or <code>varbinary</code> values as strings, if they do not have a table name in the metadata.
<code>IgnorePrepare</code> , <code>Ignore Prepare</code>	Default: <code>true</code> When <code>true</code> , instructs the provider to ignore any calls to <code>MySqlCommand.Prepare()</code> . This option is provided to prevent issues with corruption of the statements when used with server-side prepared statements. If you use server-side prepare statements, set this option to <code>false</code> . This option was introduced with the 5.0.3 and 1.0.9 connectors.
<code>IncludeSecurityAsserts</code> , <code>Include Security Asserts</code>	Default: <code>false</code> Must be set to <code>true</code> when using the <code>MySQLClientPermissions</code> class in a partial trust environment, with the library installed in the GAC of the hosting environment. This requirement is new for partial-trust applications in Connector/NET 6.6.4 and higher. See Section 4.5.18, “Working with Partial Trust / Medium Trust” for details.
	As of 6.10.6, this option is supported in .NET Core 2.0 implementations.
<code>IntegratedSecurity</code> , <code>Integrated Security</code>	Default: no Use Windows authentication when connecting to server. By default, it is turned off. To enable, specify a value of <code>yes</code> . (You can also use the value <code>sspi</code> as an alternative to <code>yes</code> .) For details, see Section 4.5.3, “Using the Windows Native Authentication Plugin” . This setting only applies to the Windows platform and was introduced with the 6.4.4 connector.
	<i>Currently not supported for .NET Core implementations.</i>
<code>InteractiveSession</code> , <code>Interactive</code> , <code>Interactive Session</code>	Default: <code>false</code> If set to <code>true</code> , the client is interactive. An interactive client is one where the server variable <code>CLIENT_INTERACTIVE</code> is set. If an interactive client is set, the <code>wait_timeout</code> variable is set to the value of <code>interactive_timeout</code> . The client will then time out

	after this period of inactivity. For more details, see Server System Variables in the MySQL Reference Manual.
<code>Keepalive , Keep Alive</code>	As of 6.10.6, this option is supported in .NET Core 2.0 implementations.
<code>Logging</code>	Default: 0 For TCP connections, idle connection time measured in seconds, before the first keepalive packet is sent. A value of 0 indicates that <code>keepalive</code> is not used. Before Connector/NET 6.6.7/6.7.5/6.8.4, this value was measured in milliseconds.
<code>OldGuids , Old Guids</code>	Default: <code>false</code> When true, various pieces of information is output to any configured TraceListeners. See Section 4.5.13, “Using the Connector/NET Trace Source Object” for further details.
<code>Password , pwd</code>	As of 6.10.6, this option is supported in .NET Core 2.0 implementations.
<code>PersistSecurityInfo , Persist Security Info</code>	Default: <code>false</code> This option was introduced in Connector/NET 6.1.1. The back-end representation of a GUID type was changed from <code>BINARY(16)</code> to <code>CHAR(36)</code> . This was done to allow developers to use the server function <code>UUID()</code> to populate a GUID table - <code>UUID()</code> generates a 36-character string. Developers of older applications can add ' <code>Old Guids=true</code> ' to the connection string to use a GUID of data type <code>BINARY(16)</code> .
<code>PipeName , Pipe Name , Pipe</code>	The password for the MySQL account being used. Default: <code>false</code> When set to <code>false</code> or <code>no</code> (strongly recommended), security-sensitive information, such as the password, is not returned as part of the connection if the connection is open or has ever been in an open state. Resetting the connection string resets all connection string values, including the password. Recognized values are <code>true</code> , <code>false</code> , <code>yes</code> , and <code>no</code> .
<code>Port</code>	Default: mysql When set to the name of a named pipe, the <code>MySqlConnection</code> attempts to connect to MySQL on that named pipe. This setting only applies to the Windows platform. <i>Currently not supported for .NET Core implementations.</i>
<code>ProcedureCacheSize , Procedure Cache Size , Procedure Cache , ProcedureCache</code>	Default: 3306 The port MySQL is using to listen for connections. This value is ignored if Unix socket is used. Default: 25 Sets the size of the stored procedure cache. By default, Connector/.NET stores the metadata (input/output data types) about the last 25 stored procedures used. To disable the stored procedure cache, set

	<p>the value to zero (0). This option was introduced with the 5.0.2 and 1.0.9 connectors.</p>
Replication	<p>Default: <code>false</code></p> <p>Indicates if this connection is to use replicated servers.</p> <p>As of 6.10.6, this option is supported in .NET Core 2.0 implementations.</p>
RespectBinaryFlags , Respect Binary Flags	<p>Default: <code>true</code></p> <p>Setting this option to <code>false</code> means that Connector/NET ignores a column's binary flags as set by the server. This option was introduced with the 5.1.3 connector.</p>
Server , Host , Data Source , DataSource , Address , Addr , Network Address	<p>Default: <code>localhost</code></p> <p>The name or network address of the instance of MySQL to which to connect. Multiple hosts can be specified separated by commas. This can be useful where multiple MySQL servers are configured for replication and you are not concerned about the precise server you are connecting to. No attempt is made by the provider to synchronize writes to the database, so take care when using this option. In Unix environment with Mono, this can be a fully qualified path to a MySQL socket file. With this configuration, the Unix socket is used instead of the TCP/IP socket. Currently, only a single socket name can be given, so accessing MySQL in a replicated environment using Unix sockets is not currently supported.</p>
SharedMemoryName , Shared Memory Name	<p>Default: <code>MYSQL</code></p> <p>The name of the shared memory object to use for communication if the connection protocol is set to <code>memory</code>. This setting only applies to the Windows platform.</p> <p><i>Currently not supported for .NET Core implementations.</i></p>
SqlServerMode , Sql Server Mode	<p>Default: <code>false</code></p> <p>Allow SQL Server syntax. When set to <code>true</code>, enables Connector/NET to support square brackets around symbols instead of backticks. This enables Visual Studio wizards that bracket symbols with [] to work with Connector/NET. This option incurs a performance hit, so should only be used if necessary. This option was introduced with the 6.3.1 connector.</p>
SslMode , Ssl Mode , Ssl- Mode	<p>Default: <code>Preferred</code></p> <p>This option was introduced in Connector/NET 6.2.1 and has the following values:</p> <ul style="list-style-type: none">• <code>None</code> - Do not use SSL.• <code>Preferred</code> - Use SSL if the server supports it, but allow connection in all cases.• <code>Required</code> - Always use SSL. Deny connection if server does not support SSL.• <code>VerifyCA</code> - Always use SSL. Validate the CA but tolerate name mismatch.

	<ul style="list-style-type: none">• <code>VerifyFull</code> - Always use SSL. Fail if the host name is not correct.
<code>TableCaching</code> , <code>Table Cache</code> , <code>tablecache</code>	Default: <code>false</code> Enables or disables caching of <code>TableDirect</code> commands. A value of <code>true</code> enables the cache while <code>false</code> disables it. For usage information about table caching, see Section 4.5.5, “Using Connector/NET with Table Caching” . This option was introduced with the 6.4 connector.
<code>TreatBlobsAsUTF8</code> , <code>Treat BLOBs as UTF8</code>	Default: <code>false</code> Setting this value to <code>true</code> causes <code>BLOB</code> columns to have a character set of <code>utf8</code> with the default collation for that character set.
<code>TreatTinyAsBoolean</code> , <code>Treat Tiny As Boolean</code>	Default: <code>true</code> Setting this value to <code>false</code> causes <code>TINYINT(1)</code> to be treated as an <code>INT</code> . See Numeric Data Type Syntax for a further explanation of the <code>TINYINT</code> and <code>BOOL</code> data types.
<code>UseAffectedRows</code> , <code>Use Affected Rows</code>	Default: <code>false</code> When <code>true</code> , the connection reports changed rows instead of found rows. This option was introduced with the 5.2.6 connector.
<code>UseCompression</code> , <code>Compress</code> , <code>Use Compression</code>	Default: <code>false</code> Setting this option to <code>true</code> enables compression of packets exchanged between the client and the server. This exchange is defined by the MySQL client/server protocol. Compression is used if both client and server support ZLIB compression, and the client has requested compression using this option. A compressed packet header is: packet length (3 bytes), packet number (1 byte), and Uncompressed Packet Length (3 bytes). The Uncompressed Packet Length is the number of bytes in the original, uncompressed packet. If this is zero, the data in this packet has not been compressed. When the compression protocol is in use, either the client or the server may compress packets. However, compression will not occur if the compressed length is greater than the original length. Thus, some packets will contain compressed data while other packets will not.
<code>UseDefaultCommandTimeoutForEF</code> , <code>, Use Default Command Timeout For EF</code>	Default: <code>false</code> Enforces the command timeout of <code>EF MySqlCommand</code> , which is set to the value provided by the <code>DefaultCommandTimeout</code> property.
<code>UseOldSyntax</code> , <code>Old Syntax</code> , <code>, OldSyntax</code> , <code>Use Old Syntax</code>	Default: <code>false</code> This option was deprecated in Connector/NET 5.2.2 and removed in Connector/NET 6.10.2. All code should now be written using the '@' symbol as the parameter marker.
<code>UsePerformanceMonitor</code> , <code>Use Performance Monitor</code> , <code>UserPerfmon</code> , <code>Perfmon</code>	Default: <code>false</code>

	Indicates that performance counters should be updated during execution.
	<i>Currently not supported for .NET Core implementations.</i>
<code>UseProcedureBodies</code> , <code>Use Procedure Bodies</code> , <code>Procedure Bodies</code>	Default: <code>true</code> When set to <code>true</code> , the default value, Connector/NET expects the body of the procedure to be viewable. This enables it to determine the parameter types and order. Set the option to <code>false</code> when the user connecting to the database does not have the <code>SELECT</code> privileges for the <code>mysql.proc</code> (stored procedures) table or cannot view <code>INFORMATION_SCHEMA.ROUTINES</code> , and then explicitly set the types of all the parameters before the call and add the parameters to the command in the same order as they appear in the procedure definition.
	This option was deprecated in Connector/NET 6.3.7 and removed in Connector/NET 6.10.4; use the <code>Check Parameters</code> option instead.
<code>UserID</code> , <code>User Id</code> , <code>Username</code> , <code>Uid</code> , <code>User name</code> , <code>User</code>	The MySQL login account being used.
<code>UseUsageAdvisor</code> , <code>Use Usage Advisor</code> , <code>Usage Advisor</code>	Default: <code>false</code> Logs inefficient database operations. As of 6.10.6, this option is supported in .NET Core 2.0 implementations.

Connection Pooling Options

The following options are related to connection pooling within connection strings. For more information about connection pooling, see [Opening a Connection to a Single Server](#).

<code>CacheServerProperties</code> , <code>Cache Server Properties</code>	Default: <code>false</code> Specifies whether server variable settings are updated by a <code>SHOW VARIABLES</code> command each time a pooled connection is returned. Enabling this setting speeds up connections in a connection pool environment. Your application is not informed of any changes to configuration variables made by other connections. This option was introduced with the 6.3 connector.
<code>ConnectionLifetime</code> , <code>Connection Lifetime</code>	Default: 0 When a connection is returned to the pool, its creation time is compared with the current time, and the connection is destroyed if that time span (in seconds) exceeds the value specified by <code>Connection Lifetime</code> . This is useful in clustered configurations to force load balancing between a running server and a server just brought online. A value of zero (0) causes pooled connections to have the maximum connection timeout.
<code>ConnectionReset</code> , <code>Connection Reset</code>	Default: <code>false</code> If <code>true</code> , the connection state is reset when it is retrieved from the pool. The default value of <code>false</code> avoids making an additional server

	round trip when obtaining a connection, but the connection state is not reset.
MaximumPoolsize , Maximum Pool Size , Max Pool Size , MaxPoolSize	Default: 100 The maximum number of connections allowed in the pool. This option applies to Connector/.NET 6.7 and higher.
MinimumPoolSize , Minimum Pool Size , Min Pool Size , MinPoolSize	Default: 0 The minimum number of connections allowed in the pool. This option applies to Connector/.NET 6.7 and higher.
Pooling	Default: <code>true</code> When <code>true</code> , the <code>MySqlConnection</code> object is drawn from the appropriate pool, or if necessary, is created and added to the appropriate pool. Recognized values are <code>true</code> , <code>false</code> , <code>yes</code> , and <code>no</code> .

4.5 Connector/.NET Programming

MySQL Connector/.NET comprises several classes that are used to connect to the database, execute queries and statements, and manage query results.

The following are the major classes of Connector/.NET:

- `MySqlConnection`: Represents an open connection to a MySQL database.
- `MySqlConnectionStringBuilder`: Aids in the creation of a connection string by exposing the connection options as properties.
- `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.
- `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.

In the following sections, you will learn about some common use cases for Connector/.NET, including BLOB handling, date handling, and using Connector/.NET with common tools such as Crystal Reports.

4.5.1 Using `GetSchema` on a Connection

The `GetSchema()` method of the connection object can be used to retrieve schema information about the database currently connected to. The schema information is returned in the form of a `DataTable`. The schema information is organized into a number of collections. Different forms of the `GetSchema()` method can be used depending on the information required. There are three forms of the `GetSchema()` method:

- `GetSchema()` - This call will return a list of available collections.

- `GetSchema(String)` - This call returns information about the collection named in the string parameter. If the string “`MetaDataCollections`” is used then a list of all available collections is returned. This is the same as calling `GetSchema()` without any parameters.
- `GetSchema(String, String[])` - In this call the first string parameter represents the collection name, and the second parameter represents a string array of restriction values. Restriction values limit the amount of data that will be returned. Restriction values are explained in more detail in the [Microsoft .NET documentation](#).

Collections

The collections can be broadly grouped into two types: collections that are common to all data providers, and collections specific to a particular provider.

Common Collections. The following collections are common to all data providers:

- `MetaDataCollections`
- `DataSourceInformation`
- `DataTypes`
- `Restrictions`
- `ReservedWords`

Provider-Specific Collections. The following are the collections currently provided by Connector/.NET, in addition to the common collections shown previously:

- `Databases`
- `Tables`
- `Columns`
- `Users`
- `Foreign Keys`
- `IndexColumns`
- `Indexes`
- `Foreign Key Columns`
- `UDF`
- `Views`
- `ViewColumns`
- `Procedure Parameters`
- `Procedures`
- `Triggers`

Example Code. A list of available collections can be obtained using the following code:

```
using System;
using System.Data;
using System.Text;
using MySql.Data;
using MySql.Data.MySqlClient;
namespace ConsoleApplication2
```

```

{
    class Program
    {
        private static void DisplayData(System.Data.DataTable table)
        {
            foreach (System.Data DataRow row in table.Rows)
            {
                foreach (System.Data DataColumn col in table.Columns)
                {
                    Console.WriteLine("{0} = {1}", col.ColumnName, row[col]);
                }
                Console.WriteLine("=====");
            }
        }
        static void Main(string[] args)
        {
            string connStr = "server=localhost;user=root;database=world;port=3306;password=*****";
            MySqlConnection conn = new MySqlConnection(connStr);
            try
            {
                Console.WriteLine("Connecting to MySQL...");
                conn.Open();
                DataTable table = conn.GetSchema("MetaDataCollections");
                //DataTable table = conn.GetSchema("UDF");
                DisplayData(table);
                conn.Close();
            }
            catch (Exception ex)
            {
                Console.WriteLine(ex.ToString());
            }
            Console.WriteLine("Done.");
        }
    }
}

```

Further information on the [GetSchema\(\)](#) method and schema collections can be found in the [Microsoft .NET documentation](#).

4.5.2 Using MySqlCommand

A `MySqlCommand` has the `CommandText` and `CommandType` properties associated with it. The `CommandType` will be handled differently depending on the setting of `CommandType`. `CommandType` can be one of:

- Text - An SQL text command (default)
- StoredProcedure - The name of a Stored Procedure
- TableDirect - The name of a table

The default `CommandType`, `Text`, is used for executing queries and other SQL commands. Some example of this can be found in the following section [Section 4.6.1.2, “The MySqlCommand Object”](#).

If `CommandType` is set to `StoredProcedure`, set `CommandText` to the name of the Stored Procedure to access.

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 to query. This is illustrated by the following code snippet:

```

...
MySqlCommand cmd = new MySqlCommand();
cmd.CommandText = "mytable";
cmd.Connection = someConnection;
cmd.CommandType = CommandType.TableDirect;
MySqlDataReader reader = cmd.ExecuteReader();

```

```
while (reader.Read())
{
    Console.WriteLine(reader[0], reader[1]...);
}
...
```

Examples of using the CommandType of StoredProcedure can be found in the section [Section 4.5.7, "Accessing Stored Procedures with Connector/NET"](#).

Commands can have a timeout associated with them. This is useful as you may not want a situation where a command takes up an excessive amount of time. A timeout can be set using the `CommandTimeout` property. The following code snippet sets a timeout of one minute:

```
MySqlCommand cmd = new MySqlCommand();
cmd.CommandTimeout = 60;
```

The default value is 30 seconds. Avoid a value of 0, which indicates an indefinite wait. To change the default command timeout, use the connection string option `Default Command Timeout`.

Connector/NET supports timeouts that are aligned with how Microsoft handles `SqlCommand.CommandTimeout`. This property is the cumulative timeout for all network reads and writes during command execution or processing of the results. A timeout can still occur in the `MySqlReader.Read` method after the first row is returned, and does not include user processing time, only IO operations.

Further details on this can be found in the relevant [Microsoft documentation](#).

4.5.3 Using the Windows Native Authentication Plugin

MySQL Connector/NET applications can authenticate to a MySQL server using the Windows Native Authentication Plugin. Users who have logged in to Windows can connect from MySQL client programs to the server based on the information in their environment without specifying an additional password. For background and usage information about the authentication plugin, see [Windows Pluggable Authentication](#).

The interface matches the `MySql.Data.MySqlClient` object. To enable, pass in `Integrated Security` to the connection string with a value of `yes` or `sspi`.

Passing in a user ID is optional. When Windows authentication is set up, a MySQL user is created and configured to be used by Windows authentication. By default, this user ID is named `auth_windows`, but can be defined using a different name. If the default name is used, then passing the user ID to the connection string from Connector/NET is optional, because it will use the `auth_windows` user. Otherwise, the name must be passed to the `connection string` using the standard user ID element.

4.5.4 Writing a Custom Authentication Plugin

Advanced users with special security requirements can create their own authentication plugins for MySQL Connector/NET applications. You can extend the handshake protocol, adding custom logic. For background and usage information about MySQL authentication plugins, see [Authentication Plugins](#) and [Writing Authentication Plugins](#).

To write a custom authentication plugin, you will need a reference to the assembly `MySql.Data.dll`. The classes relevant for writing authentication plugins are available at the namespace `MySql.Data.MySqlClient.Authentication`.

How the Custom Authentication Plugin Works

At some point during handshake, the internal method

```
void Authenticate(bool reset)
```

of `MySqlAuthenticationPlugin` is called. This method in turns calls several overridable methods of the current plugin.

Creating the Authentication Plugin Class

You put the authentication plugin logic inside a new class derived from `MySql.Data.MySqlClient.Authentication.MySqlAuthenticationPlugin`. The following methods are available to be overridden:

```
protected virtual void CheckConstraints()
protected virtual void AuthenticationFailed(Exception ex)
protected virtual void AuthenticationSuccessful()
protected virtual byte[] MoreData(byte[] data)
protected virtual void AuthenticationChange()
public abstract string PluginName { get; }
public virtual string GetUsername()
public virtual object GetPassword()
protected byte[] AuthData;
```

The following is a brief explanation of each one:

```
/// <summary>
/// This method must check authentication method specific constraints in the
environment and throw an Exception
/// if the conditions are not met. The default implementation does nothing.
/// </summary>
protected virtual void CheckConstraints()
/// <summary>
/// This method, called when the authentication failed, provides a chance to
plugins to manage the error
/// the way they consider decide (either showing a message, logging it, etc.).
/// The default implementation wraps the original exception in a MySqlException
with an standard message and rethrows it.
/// </summary>
/// <param name="ex">The exception with extra information on the error.</param>
protected virtual void AuthenticationFailed(Exception ex)
/// <summary>
/// This method is invoked when the authentication phase was successful accepted
by the server.
/// Derived classes must override this if they want to be notified of such
condition.
/// </summary>
/// <remarks>The default implementation does nothing.</remarks>
protected virtual void AuthenticationSuccessful()
/// <summary>
/// This method provides a chance for the plugin to send more data when the
server requests so during the
/// authentication phase. This method will be called at least once, and more
than one depending upon whether the
/// server response packets have the 0x01 prefix.
/// </summary>
/// <param name="data">The response data from the server, during the
authentication phase the first time is called is null, in
subsequent calls contains the server response.</param>
/// <returns>The data generated by the plugin for server consumption.</returns>
/// <remarks>The default implementation always returns null.</remarks>
protected virtual byte[] MoreData(byte[] data)
/// <summary>
/// The plugin name.
/// </summary>
public abstract string PluginName { get; }
/// <summary>
/// Gets the user name to send to the server in the authentication phase.
/// </summary>
/// <returns>An string with the user name</returns>
/// <remarks>Default implementation returns the UserId passed from the
connection string.</remarks>
public virtual string GetUsername()
/// <summary>
/// Gets the password to send to the server in the authentication phase. This
can be a string or a
/// </summary>
/// <returns>An object, can be byte[], string or null, with the password.
</returns>
```

```
/// <remarks>Default implementation returns null.</remarks>
public virtual object GetPassword()
{
    /// <summary>
    /// The authentication data passed when creating the plugin.
    /// For example in mysql_native_password this is the seed to encrypt the
    /// password.
    /// </summary>
    protected byte[] AuthData;
```

Sample Authentication Plugin

Here is an example showing how to create the authentication plugin, then enable it by means of a configuration file. Follow these steps:

1. Create a console app, adding a reference to [MySql.Data.dll](#).
2. Design the main program as follows:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using MySql.Data.MySqlClient;
namespace AuthPluginTest
{
    class Program
    {
        static void Main(string[] args)
        {
            // Customize the connection string as necessary.
            MySqlConnection con = new MySqlConnection("server=localhost;
            database=test; user id=myuser; password=mypass");
            con.Open();
            con.Close();
        }
    }
}
```

3. Create your plugin class. In this example, we add an “alternative” implementation of the Native password plugin by just using the same code from the original plugin. We name our class [MySqlNativePasswordPlugin2](#):

```
using System.IO;
using System;
using System.Text;
using System.Security.Cryptography;
using MySql.Data.MySqlClient.Authentication;
using System.Diagnostics;
namespace AuthPluginTest
{
    public class MySqlNativePasswordPlugin2 : MySqlAuthenticationPlugin
    {
        public override string PluginName
        {
            get { return "mysql_native_password"; }
        }
        public override object GetPassword()
        {
            Debug.WriteLine("Calling MySqlNativePasswordPlugin2.GetPassword");
            return Get411Password(Settings.Password, AuthData);
        }
        /// <summary>
        /// Returns a byte array containing the proper encryption of the
        /// given password/seed according to the new 4.1.1 authentication scheme.
        /// </summary>
        /// <param name="password"></param>
        /// <param name="seed"></param>
        /// <returns></returns>
        private byte[] Get411Password(string password, byte[] seedBytes)
        {
```

```
// if we have no password, then we just return 1 zero byte
if (password.Length == 0) return new byte[1];
SHA1 sha = new SHA1CryptoServiceProvider();
byte[] firstHash = sha.ComputeHash(Encoding.Default.GetBytes(password));
byte[] secondHash = sha.ComputeHash(firstHash);
byte[] input = new byte[seedBytes.Length + secondHash.Length];
Array.Copy(seedBytes, 0, input, 0, seedBytes.Length);
Array.Copy(secondHash, 0, input, seedBytes.Length, secondHash.Length);
byte[] thirdHash = sha.ComputeHash(input);
byte[] finalHash = new byte[thirdHash.Length + 1];
finalHash[0] = 0x14;
Array.Copy(thirdHash, 0, finalHash, 1, thirdHash.Length);
for (int i = 1; i < finalHash.Length; i++)
    finalHash[i] = (byte)(finalHash[i] ^ firstHash[i - 1]);
return finalHash;
}
```

4. Notice that the plugin implementation just overrides `GetPassword`, and provides an implementation to encrypt the password using the 4.1 protocol. We also put the following line in the `GetPassword` body:

```
Debug.WriteLine("Calling MySqlNativePasswordPlugin2.GetPassword");
```

to provide confirmation that the plugin was effectively used. (You could also put a breakpoint on that method.)

5. Enable the new plugin in the configuration file:

```
<?xml version="1.0"?>
<configuration>
    <configSections>
        <section name="MySQL" type="MySql.Data.MySqlClient.MySqlConfiguration,
MySql.Data"/>
    </configSections>
    <MySQL>
        <AuthenticationPlugins>
            <add name="mysql_native_password"
type="AuthPluginTest.MySqlNativePasswordPlugin2, AuthPluginTest"></add>
        </AuthenticationPlugins>
    </MySQL>
    <startup><supportedRuntime version="v4.0" sku=".NETFramework,Version=v4.0"/>
</startup></configuration>
```

6. Run the application. In Visual Studio, you will see the message `Calling MySqlNativePasswordPlugin2.GetPassword` in the debug window.
7. Continue enhancing the authentication logic, overriding more methods if you required.

4.5.5 Using Connector/NET with Table Caching

Table caching is a feature that can be used to cache slow-changing datasets on the client side. This is useful for applications that are designed to use readers, but still want to minimize trips to the server for slow-changing tables.

This feature is transparent to the application, and is disabled by default.

Configuration

- To enable table caching, add '`table cache = true`' to the connection string.
- Optionally, specify the '`Default Table Cache Age`' connection string option, which represents the number of seconds a table is cached before the cached data is discarded. The default value is `60`.
- You can turn caching on and off and set caching options at runtime, on a per-command basis.

4.5.6 Using the Connector/NET with Prepared Statements

Use of prepared statements can provide significant performance improvements on queries that are executed more than once.

Note

Prepared statement support is available with MySQL 4.1 and higher.

Prepared execution is faster than direct execution for statements executed more than once, primarily because the query is parsed only once. In the case of direct execution, the query is parsed every time it is executed. Prepared execution also can provide a reduction of network traffic because for each execution of the prepared statement, it is necessary only to send the data for the parameters.

Another advantage of prepared statements is that, with server-side prepared statements enabled, it uses a binary protocol that makes data transfer between client and server more efficient.

Note

Enable server-side prepared statements (they are disabled by default) by passing in "IgnorePrepare=false" to your connection string.

4.5.6.1 Preparing Statements in Connector/NET

To prepare a statement, create a command object and set the `CommandText` property to your query.

After entering your statement, call the `Prepare` method of the `MySqlCommand` object. After the statement is prepared, add parameters for each of the dynamic elements in the query.

After you enter your query and enter parameters, execute the statement using the `ExecuteNonQuery()`, `ExecuteScalar()`, or `ExecuteReader` methods.

For subsequent executions, you need only modify the values of the parameters and call the execute method again, there is no need to set the `CommandText` property or redefine the parameters.

Visual Basic Example

```
Dim conn As New MySqlConnection
Dim cmd As New MySqlCommand
conn.ConnectionString = strConnection
Try
    conn.Open()
    cmd.Connection = conn
    cmd.CommandText = "INSERT INTO myTable VALUES(NULL, @number, @text)"
    cmd.Prepare()
    cmd.Parameters.AddWithValue("@number", 1)
    cmd.Parameters.AddWithValue("@text", "One")
    For i = 1 To 1000
        cmd.Parameters("@number").Value = i
        cmd.Parameters("@text").Value = "A string value"
        cmd.ExecuteNonQuery()
    Next
Catch ex As MySqlException
    MessageBox.Show("Error " & ex.Number & " has occurred: " & ex.Message, "Error", MessageBoxButtons.OK)
End Try
```

C# Example

```
MySql.Data.MySqlClient.MySqlConnection conn;
MySql.Data.MySqlClient.MySqlCommand cmd;
conn = new MySql.Data.MySqlClient.MySqlConnection();
cmd = new MySql.Data.MySqlClient.MySqlCommand();
conn.ConnectionString = strConnection;
try
{
    conn.Open();
```

```
cmd.Connection = conn;
cmd.CommandText = "INSERT INTO myTable VALUES(NULL, @number, @text)";
cmd.Prepare();
cmd.Parameters.AddWithValue("@number", 1);
cmd.Parameters.AddWithValue("@text", "One");
for (int i=1; i <= 1000; i++)
{
    cmd.Parameters["@number"].Value = i;
    cmd.Parameters["@text"].Value = "A string value";
    cmd.ExecuteNonQuery();
}
catch ( MySql.Data.MySqlClient.MySqlException ex )
{
    MessageBox.Show("Error " + ex.Number + " has occurred: " + ex.Message,
                    "Error", MessageBoxButtons.OK, MessageBoxIcon.Error);
}
```

4.5.7 Accessing Stored Procedures with Connector/NET

MySQL 5.0 and higher supports stored procedures with the SQL 2003 stored procedure syntax.

A stored procedure is a set of SQL statements that is stored in the server. Clients make a single call to the stored procedure, passing parameters that can influence the procedure logic and query conditions, rather than issuing individual hardcoded SQL statements.

Stored procedures can be particularly useful in situations such as the following:

- Stored procedures can act as an API or abstraction layer, allowing multiple client applications to perform the same database operations. The applications can be written in different languages and run on different platforms. The applications do not need to hardcode table and column names, complicated queries, and so on. When you extend and optimize the queries in a stored procedure, all the applications that call the procedure automatically receive the benefits.
- When security is paramount, stored procedures keep applications from directly manipulating tables, or even knowing details such as table and column names. Banks, for example, use stored procedures for all common operations. This provides a consistent and secure environment, and procedures can ensure that each operation is properly logged. In such a setup, applications and users would not get any access to the database tables directly, but can only execute specific stored procedures.

Connector/NET supports the calling of stored procedures through the `MySqlCommand` object. Data can be passed in and out of a MySQL stored procedure through use of the `MySqlCommand.Parameters` collection.

Note

When you call a stored procedure (in versions before the MySQL 8.0 release series), the command object makes an additional `SELECT` call to determine the parameters of the stored procedure. You must ensure that the user calling the procedure has the `SELECT` privilege on the `mysql.proc` table to enable them to verify the parameters. Failure to do this will result in an error when calling the procedure.

This section will not provide in-depth information on creating Stored Procedures. For such information, please refer to <https://dev.mysql.com/doc/mysql/en/stored-routines.html>.

A sample application demonstrating how to use stored procedures with Connector/NET can be found in the `Samples` directory of your Connector/NET installation.

4.5.7.1 Using Stored Routines from Connector/NET

Stored procedures in MySQL can be created using a variety of tools. First, stored procedures can be created using the `mysql` command-line client. Second, stored procedures can be created using

MySQL Workbench. Finally, stored procedures can be created using the `ExecuteNonQuery` method of the `MySqlCommand` object.

Unlike the command-line and GUI clients, you are not required to specify a special delimiter when creating stored procedures in Connector/NET.

To call a stored procedure using Connector/NET, you create a `MySqlCommand` object and pass the stored procedure name as the `CommandText` property. You then set the `CommandType` property to `CommandType.StoredProcedure`.

After the stored procedure is named, you create one `MySqlCommand` parameter for every parameter in the stored procedure. `IN` parameters are defined with the parameter name and the object containing the value, `OUT` parameters are defined with the parameter name and the data type that is expected to be returned. All parameters need the parameter direction defined.

After defining the parameters, you call the stored procedure by using the `MySqlCommand.ExecuteNonQuery()` method.

Once the stored procedure is called, the values of the output parameters can be retrieved by using the `.Value` property of the `MySqlConnector.Parameters` collection.

Note

When a stored procedure is called using `MySqlCommand.ExecuteReader`, and the stored procedure has output parameters, the output parameters are only set after the `MySqlDataReader` returned by `ExecuteReader` is closed.

The following C# example code demonstrates the use of stored procedures. It assumes the database 'employees' has already been created:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Data;
using MySql.Data;
using MySql.Data.MySqlClient;
namespace UsingStoredRoutines
{
    class Program
    {
        static void Main(string[] args)
        {
            MySqlConnection conn = new MySqlConnection();
            conn.ConnectionString = "server=localhost;user=root;database=employees;port=3306;password=*";
            MySqlCommand cmd = new MySqlCommand();
            try
            {
                Console.WriteLine("Connecting to MySQL...");
                conn.Open();
                cmd.Connection = conn;
                cmd.CommandText = "DROP PROCEDURE IF EXISTS add_emp";
                cmd.ExecuteNonQuery();
                cmd.CommandText = "DROP TABLE IF EXISTS emp";
                cmd.ExecuteNonQuery();
                cmd.CommandText = "CREATE TABLE emp (empno INT UNSIGNED NOT NULL AUTO_INCREMENT PRIMARY KEY";
                cmd.ExecuteNonQuery();
                cmd.CommandText = "CREATE PROCEDURE add_emp( " +
                    "IN fname VARCHAR(20), IN lname VARCHAR(20), IN bday DATETIME, OUT emplid INT )";
                cmd.ExecuteNonQuery();
                cmd.CommandText = "BEGIN INSERT INTO emp(first_name, last_name, birthdate) " +
                    "VALUES(fname, lname, DATE(bday)); SET empno = LAST_INSERT_ID(); END";
                cmd.ExecuteNonQuery();
            }
            catch (MySqlException ex)
            {
                Console.WriteLine("Error " + ex.Number + " has occurred: " + ex.Message);
            }
        }
    }
}
```

```
conn.Close();
Console.WriteLine("Connection closed.");
try
{
    Console.WriteLine("Connecting to MySQL...");
    conn.Open();
    cmd.Connection = conn;
    cmd.CommandText = "add_emp";
    cmd.CommandType = CommandType.StoredProcedure;
    cmd.Parameters.AddWithValue("@lname", "Jones");
    cmd.Parameters["@lname"].Direction = ParameterDirection.Input;
    cmd.Parameters.AddWithValue("@fname", "Tom");
    cmd.Parameters["@fname"].Direction = ParameterDirection.Input;
    cmd.Parameters.AddWithValue("@bday", "1940-06-07");
    cmd.Parameters["@bday"].Direction = ParameterDirection.Input;
    cmd.Parameters.AddWithValue("@empno", MySqlDbType.Int32);
    cmd.Parameters["@empno"].Direction = ParameterDirection.Output;
    cmd.ExecuteNonQuery();
    Console.WriteLine("Employee number: " + cmd.Parameters["@empno"].Value);
    Console.WriteLine("Birthday: " + cmd.Parameters["@bday"].Value);
}
catch (MySql.Data.MySqlClient.MySqlException ex)
{
    Console.WriteLine("Error " + ex.Number + " has occurred: " + ex.Message);
}
conn.Close();
Console.WriteLine("Done.");
}
}
```

The following code shows the same application in Visual Basic:

```
Imports System
Imports System.Collections.Generic
Imports System.Linq
Imports System.Text
Imports System.Data
Imports MySql.Data
Imports MySql.Data.MySqlClient
Module Module1
    Sub Main()
        Dim conn As New MySqlConnection()
        conn.ConnectionString = "server=localhost;user=root;database=world;port=3306;password=*****"
        Dim cmd As New MySqlCommand()
        Try
            Console.WriteLine("Connecting to MySQL...")
            conn.Open()
            cmd.Connection = conn
            cmd.CommandText = "DROP PROCEDURE IF EXISTS add_emp"
            cmd.ExecuteNonQuery()
            cmd.CommandText = "DROP TABLE IF EXISTS emp"
            cmd.ExecuteNonQuery()
            cmd.CommandText = "CREATE TABLE emp (empno INT UNSIGNED NOT NULL AUTO_INCREMENT PRIMARY KEY, f"
            cmd.ExecuteNonQuery()
            cmd.CommandText = "CREATE PROCEDURE add_emp(" & "IN fname VARCHAR(20), IN lname VARCHAR(20), IN"
            cmd.ExecuteNonQuery()
        Catch ex As MySqlException
            Console.WriteLine(("Error " & ex.Number & " has occurred: ") + ex.Message)
        End Try
        conn.Close()
        Console.WriteLine("Connection closed.")
        Try
            Console.WriteLine("Connecting to MySQL...")
            conn.Open()
            cmd.Connection = conn
            cmd.CommandText = "add_emp"
            cmd.CommandType = CommandType.StoredProcedure
            cmd.Parameters.AddWithValue("@lname", "Jones")
            cmd.Parameters("@lname").Direction = ParameterDirection.Input
            cmd.Parameters.AddWithValue("@fname", "Tom")
            cmd.Parameters("@fname").Direction = ParameterDirection.Input

```

```

cmd.Parameters.AddWithValue("@bday", "1940-06-07")
cmd.Parameters("@bday").Direction = ParameterDirection.Input
cmd.Parameters.AddWithValue("@empno", MySqlDbType.Int32)
cmd.Parameters("@empno").Direction = ParameterDirection.Output
cmd.ExecuteNonQuery()
Console.WriteLine("Employee number: " & cmd.Parameters("@empno").Value)
Console.WriteLine("Birthday: " & cmd.Parameters("@bday").Value)
Catch ex As MySql.Data.MySqlClient.MySqlException
    Console.WriteLine(("Error " & ex.Number & " has occurred: ") + ex.Message)
End Try
conn.Close()
Console.WriteLine("Done.")
End Sub
End Module

```

4.5.8 Handling BLOB Data With Connector/NET

One common use for MySQL is the storage of binary data in [BLOB](#) columns. MySQL supports four different BLOB data types: [TINYBLOB](#), [BLOB](#), [MEDIUMBLOB](#), and [LONGBLOB](#), all described in [The BLOB and TEXT Types](#) and [Data Type Storage Requirements](#).

Data stored in a [BLOB](#) column can be accessed using MySQL Connector/NET and manipulated using client-side code. There are no special requirements for using Connector/NET with [BLOB](#) data.

Simple code examples will be presented within this section, and a full sample application can be found in the [Samples](#) directory of the Connector/NET installation.

4.5.8.1 Preparing the MySQL Server

The first step is using MySQL with [BLOB](#) data is to configure the server. Let's start by creating a table to be accessed. In my file tables, I usually have four columns: an [AUTO_INCREMENT](#) column of appropriate size ([UNSIGNED SMALLINT](#)) to serve as a primary key to identify the file, a [VARCHAR](#) column that stores the file name, an [UNSIGNED MEDIUMINT](#) column that stores the size of the file, and a [MEDIUMBLOB](#) column that stores the file itself. For this example, I will use the following table definition:

```

CREATE TABLE file(
file_id SMALLINT UNSIGNED AUTO_INCREMENT NOT NULL PRIMARY KEY,
file_name VARCHAR(64) NOT NULL,
file_size MEDIUMINT UNSIGNED NOT NULL,
file MEDIUMBLOB NOT NULL);

```

After creating a table, you might need to modify the [max_allowed_packet](#) system variable. This variable determines how large of a packet (that is, a single row) can be sent to the MySQL server. By default, the server only accepts a maximum size of 1MB from the client application. If you intend to exceed 1MB in your file transfers, increase this number.

The [max_allowed_packet](#) option can be modified using the MySQL Workbench [Server Administration](#) screen. Adjust the Maximum permitted option in the [Data / Memory size](#) section of the Networking tab to an appropriate setting. After adjusting the value, click the [Apply](#) button and restart the server using the [Startup / Shutdown](#) screen of MySQL Workbench. You can also adjust this value directly in the [my.cnf](#) file (add a line that reads `max_allowed_packet=xxM`), or use the `SET max_allowed_packet=xxM;` syntax from within MySQL.

Try to be conservative when setting [max_allowed_packet](#), as transfers of BLOB data can take some time to complete. Try to set a value that will be adequate for your intended use and increase the value if necessary.

4.5.8.2 Writing a File to the Database

To write a file to a database, we need to convert the file to a byte array, then use the byte array as a parameter to an [INSERT](#) query.

The following code opens a file using a `FileStream` object, reads it into a byte array, and inserts it into the `file` table:

Visual Basic Example

```
Dim conn As New MySqlConnection
Dim cmd As New MySqlCommand
Dim SQL As String
Dim FileSize As UInt32
Dim rawData() As Byte
Dim fs As FileStream
conn.ConnectionString = "server=127.0.0.1;" _
    & "uid=root;" _
    & "pwd=12345;" _
    & "database=test"
Try
    fs = New FileStream("c:\image.png", FileMode.Open, FileAccess.Read)
    FileSize = fs.Length
    rawData = New Byte[FileSize] {}
    fs.Read(rawData, 0, FileSize)
    fs.Close()
    conn.Open()
    SQL = "INSERT INTO file VALUES(NULL, @FileName, @FileSize, @File)"
    cmd.Connection = conn
    cmd.CommandText = SQL
    cmd.Parameters.AddWithValue("@FileName", strFileName)
    cmd.Parameters.AddWithValue("@FileSize", FileSize)
    cmd.Parameters.AddWithValue("@File", rawData)
    cmd.ExecuteNonQuery()
    MessageBox.Show("File Inserted into database successfully!", _
        "Success!", MessageBoxButtons.OK, MessageBoxIcon.Asterisk)
    conn.Close()
Catch ex As Exception
    MessageBox.Show("There was an error: " & ex.Message, "Error", _
        MessageBoxButtons.OK, MessageBoxIcon.Error)
End Try
```

C# Example

```
MySql.Data.MySqlClient.MySqlConnection conn;
MySql.Data.MySqlClient.MySqlCommand cmd;
conn = new MySql.Data.MySqlClient.MySqlConnection();
cmd = new MySql.Data.MySqlClient.MySqlCommand();
string SQL;
UInt32 FileSize;
byte[] rawData;
FileStream fs;
conn.ConnectionString = "server=127.0.0.1;uid=root;" +
    "pwd=12345;database=test";
try
{
    fs = new FileStream(@"c:\image.png", FileMode.Open, FileAccess.Read);
    FileSize = fs.Length;
    rawData = new byte[FileSize];
    fs.Read(rawData, 0, FileSize);
    fs.Close();
    conn.Open();
    SQL = "INSERT INTO file VALUES(NULL, @FileName, @FileSize, @File)";
    cmd.Connection = conn;
    cmd.CommandText = SQL;
    cmd.Parameters.AddWithValue("@FileName", strFileName);
    cmd.Parameters.AddWithValue("@FileSize", FileSize);
    cmd.Parameters.AddWithValue("@File", rawData);
    cmd.ExecuteNonQuery();
    MessageBox.Show("File Inserted into database successfully!", 
        "Success!", MessageBoxButtons.OK, MessageBoxIcon.Asterisk);
    conn.Close();
}
catch (MySql.Data.MySqlClient.MySqlException ex)
{
    MessageBox.Show("Error " + ex.Number + " has occurred: " + ex.Message,
        "Error", MessageBoxButtons.OK, MessageBoxIcon.Error);
```

```
}
```

The `Read` method of the `FileStream` object is used to load the file into a byte array which is sized according to the `Length` property of the `FileStream` object.

After assigning the byte array as a parameter of the `MySqlCommand` object, the `ExecuteNonQuery` method is called and the `BLOB` is inserted into the `file` table.

4.5.8.3 Reading a BLOB from the Database to a File on Disk

After a file is loaded into the `file` table, we can use the `MySqlDataReader` class to retrieve it.

The following code retrieves a row from the `file` table, then loads the data into a `FileStream` object to be written to disk:

Visual Basic Example

```
Dim conn As New MySqlConnection
Dim cmd As New MySqlCommand
Dim myData As MySqlDataReader
Dim SQL As String
Dim rawData() As Byte
Dim FileSize As UInt32
Dim fs As FileStream
conn.ConnectionString = "server=127.0.0.1;" _
    & "uid=root;" _
    & "pwd=12345;" _
    & "database=test"
SQL = "SELECT file_name, file_size, file FROM file"
Try
    conn.Open()
    cmd.Connection = conn
    cmd.CommandText = SQL
    myData = cmd.ExecuteReader
    If Not myData.HasRows Then Throw New Exception("There are no BLOBs to save")
    myData.Read()
    FileSize = myData.GetUInt32(myData.GetOrdinal("file_size"))
    rawData = New Byte[FileSize] {}
    myData.GetBytes(myData.GetOrdinal("file"), 0, rawData, 0, FileSize)
    fs = New FileStream("C:\newfile.png", FileMode.OpenOrCreate, FileAccess.Write)
    fs.Write(rawData, 0, FileSize)
    fs.Close()
    MessageBox.Show("File successfully written to disk!", "Success!", MessageBoxButtons.OK, MessageBoxIcon.Information)
    myData.Close()
    conn.Close()
Catch ex As Exception
    MessageBox.Show("There was an error: " & ex.Message, "Error", MessageBoxButtons.OK, MessageBoxIcon.Error)
End Try
```

C# Example

```
MySql.Data.MySqlClient.MySqlConnection conn;
MySql.Data.MySqlClient.MySqlCommand cmd;
MySql.Data.MySqlClient.MySqlDataReader myData;
conn = new MySql.Data.MySqlClient.MySqlConnection();
cmd = new MySql.Data.MySqlClient.MySqlCommand();
string SQL;
UInt32 FileSize;
byte[] rawData;
FileStream fs;
conn.ConnectionString = "server=127.0.0.1;uid=root;" +
    "pwd=12345;database=test";
SQL = "SELECT file_name, file_size, file FROM file";
try
{
    conn.Open();
    cmd.Connection = conn;
    cmd.CommandText = SQL;
    myData = cmd.ExecuteReader();
    if (! myData.HasRows)
        throw new Exception("There are no BLOBs to save");
```

```
myData.Read();
FileSize = myData.GetUInt32(myData.GetOrdinal("file_size"));
rawData = new byte[FileSize];
myData.GetBytes(myData.GetOrdinal("file"), 0, rawData, 0, (int)FileSize);
fs = new FileStream(@"C:\newfile.png", FileMode.OpenOrCreate, FileAccess.Write);
fs.Write(rawData, 0, (int)FileSize);
fs.Close();
MessageBox.Show("File successfully written to disk!",
    "Success!", MessageBoxButtons.OK, MessageBoxIcon.Asterisk);
myData.Close();
conn.Close();
}
catch ( MySql.Data.MySqlClient.MySqlException ex )
{
    MessageBox.Show( "Error " + ex.Number + " has occurred: " + ex.Message,
        "Error", MessageBoxButtons.OK, MessageBoxIcon.Error);
}
```

After connecting, the contents of the `file` table are loaded into a `MySqlDataReader` object. The `GetBytes` method of the `MySqlDataReader` is used to load the `BLOB` into a byte array, which is then written to disk using a `FileStream` object.

The `GetOrdinal` method of the `MySqlDataReader` can be used to determine the integer index of a named column. Use of the `GetOrdinal` method prevents errors if the column order of the `SELECT` query is changed.

4.5.9 Asynchronous Methods

The Task-based Asynchronous Pattern (TAP) is a pattern for asynchrony in the .NET Framework. It is based on the `Task` and `Task<TResult>` types in the `System.Threading.Tasks` namespace, which are used to represent arbitrary asynchronous operations.

Async-Await are new keywords introduced to work with the TAP. The **Async modifier** is used to specify that a method, lambda expression, or anonymous method is asynchronous. The **Await** operator is applied to a task in an asynchronous method to suspend the execution of the method until the awaited task completes.

Requirements

- **Async-Await** support requires .NET Framework 4.5 or later
- **TAP** support requires .NET Framework 4.0 or later
- MySQL Connector/.NET 6.9 or later

Methods

The following methods can be used with either TAP or Async-Await.

- Namespace `MySql.Data.Entity`
 - Class `EFMySqlCommand`
 - `Task PrepareAsync()`
 - `Task PrepareAsync(CancellationToken)`
- Namespace `MySql.Data`
 - Class `MySqlBulkLoader`
 - `Task<int> LoadAsync()`
 - `Task<int> LoadAsync(CancellationToken)`
 - Class `MySqlConnection`

- `Task<MySqlTransaction> BeginTransactionAsync()`
- `Task<MySqlTransaction> BeginTransactionAsync (CancellationToken)`
- `Task<MySqlTransaction> BeginTransactionAsync(IsolationLevel)`
- `Task<MySqlTransaction> BeginTransactionAsync (IsolationLevel , CancellationToken)`
- `Task ChangeDatabaseAsync(string)`
- `Task ChangeDatabaseAsync(string, CancellationToken)`
- `Task CloseAsync()`
- `Task CloseAsync(CancellationToken)`
- `Task ClearPoolAsync(MySqlConnection)`
- `Task ClearPoolAsync(MySqlConnection, CancellationToken)`
- `Task ClearAllPoolsAsync()`
- `Task ClearAllPoolsAsync(CancellationToken)`
- `Task<MySqlSchemaCollection> GetSchemaCollection(string, string[])`
- `Task<MySqlSchemaCollection> GetSchemaCollection(string, string[], CancellationToken)`
- **Class MySqlDataAdapter**
 - `Task<int> FillAsync(DataSet)`
 - `Task<int> FillAsync(DataSet, CancellationToken)`
 - `Task<int> FillAsync(DataTable)`
 - `Task<int> FillAsync(DataTable, CancellationToken)`
 - `Task<int> FillAsync(DataSet, string)`
 - `Task<int> FillAsync(DataSet, string, CancellationToken)`
 - `Task<int> FillAsync(DataTable, IDataReader)`
 - `Task<int> FillAsync(DataTable, IDataReader, CancellationToken)`
 - `Task<int> FillAsync(DataTable, IDbCommand, CommandBehavior)`
 - `Task<int> FillAsync(DataTable, IDbCommand, CommandBehavior, CancellationToken)`
 - `Task<int> FillAsync(int, int, params DataTable[])`
 - `Task<int> FillAsync(int, int, params DataTable[], CancellationToken)`
 - `Task<int> FillAsync(DataSet, int, int, string)`
 - `Task<int> FillAsync(DataSet, int, int, string, CancellationToken)`
 - `Task<int> FillAsync(DataSet, string, IDataReader, int, int)`

- `Task<int> FillAsync(DataSet, string, IDataReader, int, int, CancellationToken)`
- `Task<int> FillAsync(DataTable[], int, int, IDbCommand, CommandBehavior)`
- `Task<int> FillAsync(DataTable[], int, int, IDbCommand, CommandBehavior, CancellationToken)`
- `Task<int> FillAsync(DataSet, int, int, string, IDbCommand, CommandBehavior)`
- `Task<int> FillAsync(DataSet, int, int, string, IDbCommand, CommandBehavior, CancellationToken)`
- `Task<DataTable[]> FillSchemaAsync(DataSet, SchemaType)`
- `Task<DataTable[]> FillSchemaAsync(DataSet, SchemaType, CancellationToken)`
- `Task<DataTable[]> FillSchemaAsync(DataSet, SchemaType, string)`
- `Task<DataTable[]> FillSchemaAsync(DataSet, SchemaType, string, CancellationToken)`
- `Task<DataTable[]> FillSchemaAsync(DataSet, SchemaType, string, IDataReader)`
- `Task<DataTable[]> FillSchemaAsync(DataSet, SchemaType, string, IDataReader, CancellationToken)`
- `Task<DataTable[]> FillSchemaAsync(DataSet, SchemaType, IDbCommand, string, CommandBehavior)`
- `Task<DataTable[]> FillSchemaAsync(DataSet, SchemaType, IDbCommand, string, CommandBehavior, CancellationToken)`
- `Task<DataTable> FillSchemaAsync(DataTable, SchemaType)`
- `Task<DataTable> FillSchemaAsync(DataTable, SchemaType, CancellationToken)`
- `Task<DataTable> FillSchemaAsync(DataTable, SchemaType, IDataReader)`
- `Task<DataTable> FillSchemaAsync(DataTable, SchemaType, IDataReader, CancellationToken)`
- `Task<DataTable> FillSchemaAsync(DataTable, SchemaType, IDbCommand, CommandBehavior)`
- `Task<DataTable> FillSchemaAsync(DataTable, SchemaType, IDbCommand, CommandBehavior, CancellationToken)`
- `Task<int> UpdateAsync(DataRow[])`
- `Task<int> UpdateAsync(DataRow[], CancellationToken)`
- `Task<int> UpdateAsync(DataSet)`
- `Task<int> UpdateAsync(DataSet, CancellationToken)`
- `Task<int> UpdateAsync(DataTable)`

- `Task<int> UpdateAsync(DataTable, CancellationToken)`
- `Task<int> UpdateAsync(DataRow[], DataTableMapping, CancellationToken)`
- `Task<int> UpdateAsync(DataSet, string)`
- `Task<int> UpdateAsync(DataSet, string, CancellationToken)`
- **Class MySqlHelper**
 - `Task<DataRow> ExecuteDataRowAsync(string, string, params MySqlParameter[])`
 - `Task<DataRow> ExecuteDataRowAsync(string, string, CancellationToken, params MySqlParameter[])`
 - `Task<int> ExecuteNonQueryAsync(MySqlConnection, string, params MySqlParameter[])`
 - `Task<int> ExecuteNonQueryAsync(MySqlConnection, string, CancellationToken, params MySqlParameter[])`
 - `Task<int> ExecuteNonQueryAsync(string, string, params MySqlParameter[])`
 - `Task<int> ExecuteNonQueryAsync(string, string, CancellationToken, params MySqlParameter[])`
 - `Task<DataSet> ExecuteDatasetAsync(string, string)`
 - `Task<DataSet> ExecuteDatasetAsync(string, string, CancellationToken)`
 - `Task<DataSet> ExecuteDatasetAsync(string, string, CancellationToken, params MySqlParameter[])`
 - `Task<DataSet> ExecuteDatasetAsync(MySqlConnection, string)`
 - `Task<DataSet> ExecuteDatasetAsync(MySqlConnection, string, CancellationToken)`
 - `Task<DataSet> ExecuteDatasetAsync(MySqlConnection, string, params MySqlParameter[])`
 - `Task<DataSet> ExecuteDatasetAsync(MySqlConnection, string, CancellationToken, params MySqlParameter[])`
 - `Task UpdateDataSetAsync(string, string, DataSet, string)`
 - `Task UpdateDataSetAsync(string, string, DataSet, string, CancellationToken)`
 - `Task<MySqlDataReader> ExecuteReaderAsync(MySqlConnection, MySqlTransaction, string, MySqlParameter[], bool)`
 - `Task<MySqlDataReader> ExecuteReaderAsync(MySqlConnection, MySqlTransaction, string, MySqlParameter[], bool, CancellationToken)`
 - `Task<MySqlDataReader> ExecuteReaderAsync(string, string)`
 - `Task<MySqlDataReader> ExecuteReaderAsync(string, string, CancellationToken)`

- `Task<MySqlDataReader> ExecuteReaderAsync(MySqlConnection, string)`
- `Task<MySqlDataReader> ExecuteReaderAsync(MySqlConnection, string, CancellationToken)`
- `Task<MySqlDataReader> ExecuteReaderAsync(string, string, params MySqlParameter[])`
- `Task<MySqlDataReader> ExecuteReaderAsync(string, string, CancellationToken, params MySqlParameter[])`
- `Task<MySqlDataReader> ExecuteReaderAsync(MySqlConnection, string, params MySqlParameter[])`
- `Task<MySqlDataReader> ExecuteReaderAsync(MySqlConnection, string, CancellationToken, params MySqlParameter[])`
- `Task<object> ExecuteScalarAsync(string, string)`
- `Task<object> ExecuteScalarAsync(string, string, CancellationToken)`
- `Task<object> ExecuteScalarAsync(string, string, params MySqlParameter[])`
- `Task<object> ExecuteScalarAsync(string, string, CancellationToken, params MySqlParameter[])`
- `Task<object> ExecuteScalarAsync(MySqlConnection, string)`
- `Task<object> ExecuteScalarAsync(MySqlConnection, string, CancellationToken)`
- `Task<object> ExecuteScalarAsync(MySqlConnection, string, params MySqlParameter[])`
- `Task<object> ExecuteScalarAsync(MySqlConnection, string, CancellationToken, params MySqlParameter[])`
- **Class** `MySqlScript`
 - `Task<int> ExecuteAsync()`
 - `Task<int> ExecuteAsync(CancellationToken)`

In addition to the methods listed above, the following are methods inherited from the .NET Framework:

- Namespace `MySql.Data.Entity`
 - Class `EFMySqlCommand`
 - `Task<DbDataReader> ExecuteDbDataReaderAsync(CommandBehaviour, CancellationToken)`
 - `Task<int> ExecuteNonQueryAsync()`
 - `Task<int> ExecuteNonQueryAsync(CancellationToken)`
 - `Task<DbDataReader> ExecuteReaderAsync()`
 - `Task<DbDataReader> ExecuteReaderAsync(CancellationToken)`

- `Task<DbDataReader> ExecuteReaderAsync(CommandBehaviour)`
- `Task<DbDataReader> ExecuteReaderAsync(CommandBehaviour, CancellationToken)`
- `Task<object> ExecuteScalarAsync()`
- `Task<object> ExecuteScalarAsync(CancellationToken)`
- Namespace `MySql.Data`
 - Class `MySqlCommand`
 - `Task<DbDataReader> ExecuteDbDataReaderAsync(CommandBehaviour, CancellationToken)`
 - `Task<int> ExecuteNonQueryAsync()`
 - `Task<int> ExecuteNonQueryAsync(CancellationToken)`
 - `Task<DbDataReader> ExecuteReaderAsync()`
 - `Task<DbDataReader> ExecuteReaderAsync(CancellationToken)`
 - `Task<DbDataReader> ExecuteReaderAsync(CommandBehaviour)`
 - `Task<DbDataReader> ExecuteReaderAsync(CommandBehaviour, CancellationToken)`
 - `Task<object> ExecuteScalarAsync()`
 - `Task<object> ExecuteScalarAsync(CancellationToken)`
 - Class `MySqlConnection`
 - `Task OpenAsync()`
 - `Task OpenAsync(CancellationToken)`
 - Class `MySqlDataReader`
 - `Task<T> GetFieldValueAsync<T>(int)`
 - `Task<T> GetFieldValueAsync<T>(int, CancellationToken)`
 - `Task<bool> IsDBNullAsync(int)`
 - `Task<bool> IsDBNullAsync(int, CancellationToken)`
 - `Task<bool> NextResultAsync()`
 - `Task<bool> NextResultAsync(CancellationToken)`
 - `Task<bool> ReadAsync()`
 - `Task<bool> ReadAsync(CancellationToken)`

Examples

The following examples demonstrate how to use the asynchronous methods:

In this example, a method has the `async` modifier because the method `await` call made applies to the method `LoadAsync`. The method returns a `Task` object that contains information about the result of the awaited method. Returning `Task` is like having a void method, but you should not use `async void` if your method is not a top-level access method like an event.

```
public async Task BulkLoadAsync()
{
    MySqlConnection myConn = new MySqlConnection("MyConnectionString");
    MySqlBulkLoader loader = new MySqlBulkLoader(myConn);

    loader.TableName      = "BulkLoadTest";
    loader.FileName       = @"c:\MyPath\MyFile.txt";
    loader.Timeout        = 0;

    var result            = await loader.LoadAsync();
}
```

In this example, an "async void" method is used with "await" for the `ExecuteNonQueryAsync` method, to correspond to the onclick event of a button. This is why the method does not return a `Task`.

```
private async void myButton_Click()
{
    MySqlConnection myConn = new MySqlConnection("MyConnectionString");
    MySqlCommand proc      = new MySqlCommand("MyAsyncSpTest", myConn);

    proc.CommandType      = CommandType.StoredProcedure;

    int result            = await proc.ExecuteNonQueryAsync();
}
```

4.5.10 Using the Connector/.NET Interceptor Classes

An interceptor is a software design pattern that provides a transparent way to extend or modify some aspect of a program, similar to a user exit. No recompiling is required. With MySQL Connector/.NET, the interceptors are enabled and disabled by updating the connection string to refer to different sets of interceptor classes that you instantiate.

Note

The classes and methods presented in this section do not apply to Connector/.NET applications developed with the .NET Core 1.1 framework.

Connector/.NET includes the following interceptor classes:

- The `BaseCommandInterceptor` lets you perform additional operations when a program issues a SQL command. For example, you can examine the SQL statement for logging or debugging purposes, substitute your own result set to implement a caching mechanism, and so on. Depending on the use case, your code can supplement the SQL command or replace it entirely.

The `BaseCommandInterceptor` class has these methods that you can override:

```
public virtual bool ExecuteScalar(string sql, ref object returnValue);
public virtual bool ExecuteNonQuery(string sql, ref int returnValue);
public virtual bool ExecuteReader(string sql, CommandBehavior behavior, ref MySqlDataReader returnValue);
public virtual void Init(MySqlConnection connection);
```

If your interceptor overrides one of the `Execute...` methods, set the `returnValue` output parameter and return `true` if you handled the event, or `false` if you did not handle the event. The SQL command is processed normally only when all command interceptors return `false`.

The connection passed to the `Init` method is the connection that is attached to this interceptor.

- The `BaseExceptionInterceptor` lets you perform additional operations when a program encounters an SQL exception. The exception interception mechanism is modeled after the Connector/J model. You can code an interceptor class and connect it to an existing program without recompiling, and intercept exceptions when they are created. You can then change the exception

type and optionally attach information to it. This capability lets you turn on and off logging and debugging code without hardcoding anything in the application. This technique applies to exceptions raised at the SQL level, not to lower-level system or I/O errors.

You develop an exception interceptor first by creating a subclass of the `BaseExceptionInterceptor` class. You must override the `InterceptException()` method. You can also override the `Init()` method to do some one-time initialization.

Each exception interceptor has 2 methods:

```
public abstract Exception InterceptException(Exception exception,
    MySqlConnection connection);
public virtual void Init(MySqlConnection connection);
```

The connection passed to `Init()` is the connection that is attached to this interceptor.

Each interceptor is required to override `InterceptException` and return an exception. It can return the exception it is given, or it can wrap it in a new exception. We currently do not offer the ability to suppress the exception.

Here are examples of using the FQN (fully qualified name) on the connection string:

```
MySqlConnection c1 = new MySqlConnection(@"server=localhost;pooling=false;
commandinterceptors=CommandApp.MyCommandInterceptor,CommandApp");
MySqlConnection c2 = new MySqlConnection(@"server=localhost;pooling=false;
exceptioninterceptors=ExceptionStackTraceTest.MyExceptionInterceptor,ExceptionStackTraceTest");
```

In this example, the command interceptor is called `CommandApp.MyCommandInterceptor` and exists in the `CommandApp` assembly. The exception interceptor is called `ExceptionStackTraceTest.MyExceptionInterceptor` and exists in the `ExceptionStackTraceTest` assembly.

To shorten the connection string, you can register your exception interceptors in your `app.config` or `web.config` file like this:

```
<configSections>
<section name="MySQL" type=" MySql.Data.MySqlClient.MySqlConfiguration, MySql.Data" />
</configSections>
<MySQL>
<CommandInterceptors>
  <add name="myC" type="CommandApp.MyCommandInterceptor,CommandApp" />
</CommandInterceptors>
</MySQL>
<configSections>
<section name="MySQL" type=" MySql.Data.MySqlClient.MySqlConfiguration,
MySql.Data" />
</configSections>
<MySQL>
<ExceptionInterceptors>
  <add name="myE"
    type="ExceptionStackTraceTest.MyExceptionInterceptor,ExceptionStackTraceTest" />
</ExceptionInterceptors>
</MySQL>
```

After you have done that, your connection strings can look like these:

```
MySqlConnection c1 = new MySqlConnection(@"server=localhost;pooling=false;
commandinterceptors=myC");
MySqlConnection c2 = new MySqlConnection(@"server=localhost;pooling=false;
exceptioninterceptors=myE");
```

4.5.11 Handling Date and Time Information in Connector/NET

MySQL and the .NET languages handle date and time information differently, with MySQL allowing dates that cannot be represented by a .NET data type, such as '0000-00-00 00:00:00'. These differences can cause problems if not properly handled.

The following sections demonstrate how to properly handle date and time information when using MySQL Connector/NET.

4.5.11.1 Fractional Seconds

MySQL Connector/NET supports the fractional seconds feature in MySQL, where the fractional seconds part of temporal values is preserved in data stored and retrieved through SQL. For fractional second handling in MySQL 5.6.4 and higher, see [Fractional Seconds in Time Values](#).

To use the more precise date and time types, specify a value from 1 to 6 when creating the table column, for example `TIME(3)` or `DATETIME(6)`, representing the number of digits of precision after the decimal point. Specifying a precision of 0 leaves the fractional part out entirely. In your C# or Visual Basic code, refer to the `Millisecond` member to retrieve the fractional second value from the `MySqlDateTime` object returned by the `GetMySqlDateTime` function. The `DateTime` object returned by the `GetDateTime` function also contains the fractional value, but only the first 3 digits.

For related code examples, see the following blog post: https://blogs.oracle.com/MySQLOnWindows/entry/milliseconds_value_support_on_datetime

4.5.11.2 Problems when Using Invalid Dates

The differences in date handling can cause problems for developers who use invalid dates. Invalid MySQL dates cannot be loaded into native .NET `DateTime` objects, including `NULL` dates.

Because of this issue, .NET `DataSet` objects cannot be populated by the `Fill` method of the `MySqlDataAdapter` class as invalid dates will cause a `System.ArgumentOutOfRangeException` exception to occur.

4.5.11.3 Restricting Invalid Dates

The best solution to the date problem is to restrict users from entering invalid dates. This can be done on either the client or the server side.

Restricting invalid dates on the client side is as simple as always using the .NET `DateTime` class to handle dates. The `DateTime` class will only allow valid dates, ensuring that the values in your database are also valid. The disadvantage of this is that it is not useful in a mixed environment where .NET and non .NET code are used to manipulate the database, as each application must perform its own date validation.

Users of MySQL 5.0.2 and higher can use the new `traditional` SQL mode to restrict invalid date values. For information on using the `traditional` SQL mode, see [Server SQL Modes](#).

4.5.11.4 Handling Invalid Dates

Although it is strongly recommended that you avoid the use of invalid dates within your .NET application, it is possible to use invalid dates by means of the `MySqlDateTime` data type.

The `MySqlDateTime` data type supports the same date values that are supported by the MySQL server. The default behavior of Connector/NET is to return a .NET `DateTime` object for valid date values, and return an error for invalid dates. This default can be modified to cause Connector/NET to return `MySqlDateTime` objects for invalid dates.

To instruct Connector/NET to return a `MySqlDateTime` object for invalid dates, add the following line to your connection string:

```
Allow Zero Datetime=True
```

The `MySqlDateTime` class can still be problematic. The following are some known issues:

- Data binding for invalid dates can still cause errors (zero dates like 0000-00-00 do not seem to have this problem).
- The `ToString` method return a date formatted in the standard MySQL format (for example, `2005-02-23 08:50:25`). This differs from the `ToString` behavior of the .NET DateTime class.
- The `MySqlDateTime` class supports NULL dates, while the .NET DateTime class does not. This can cause errors when trying to convert a MySQLDateTime to a DateTime if you do not check for NULL first.

Because of the known issues, the best recommendation is still to use only valid dates in your application.

4.5.11.5 Handling NULL Dates

The .NET `DateTime` data type cannot handle `NULL` values. As such, when assigning values from a query to a `DateTime` variable, you must first check whether the value is in fact `NULL`.

When using a `MySqlDataReader`, use the `.IsDBNull` method to check whether a value is `NULL` before making the assignment:

Visual Basic Example

```
If Not myReader.IsDBNull(myReader.GetOrdinal("mytime")) Then
    myTime = myReader.GetDateTime(myReader.GetOrdinal("mytime"))
Else
    myTime = DateTime.MinValue
End If
```

C# Example

```
if (! myReader.IsDBNull(myReader.GetOrdinal("mytime")))
    myTime = myReader.GetDateTime(myReader.GetOrdinal("mytime"));
else
    myTime = DateTime.MinValue;
```

`NULL` values will work in a data set and can be bound to form controls without special handling.

4.5.12 Using the MySqlBulkLoader Class

MySQL Connector/.NET features a bulk loader class that wraps the MySQL statement `LOAD DATA INFILE`. This gives Connector/.NET the ability to load a data file from a local or remote host to the server. The class concerned is `MySqlBulkLoader`. This class has various methods, the main one being `load` to cause the specified file to be loaded to the server. Various parameters can be set to control how the data file is processed. This is achieved through setting various properties of the class. For example, the field separator used, such as comma or tab, can be specified, along with the record terminator, such as newline.

The following code shows a simple example of using the `MySqlBulkLoader` class. First an empty table needs to be created, in this case in the `test` database.

```
CREATE TABLE Career (
    Name VARCHAR(100) NOT NULL,
    Age INTEGER,
    Profession VARCHAR(200)
);
```

A simple tab-delimited data file is also created (it could use any other field delimiter such as comma).

```
Table Career in Test Database
Name  Age   Profession
Tony   47   Technical Writer
Ana    43   Nurse
Fred   21   IT Specialist
Simon  45   Hairy Biker
```

The first three lines need to be ignored with this test file, as they do not contain table data. This can be achieved using the `NumberOfLinesToSkip` property. This file can then be loaded and used to populate the `Career` table in the `test` database.

Note

As of Connector/NET 8.0.15, the `Local` property must be set to `True` explicitly to enable the local-infile capability. Previous versions set this value to `True` by default.

```
using System;
using System.Text;
using MySql.Data;
using MySql.Data.MySqlClient;
namespace ConsoleApplication1
{
    class Program
    {
        static void Main(string[] args)
        {
            string connStr = "server=localhost;user=root;database=test;port=3306;password=*****";
            MySqlConnection conn = new MySqlConnection(connStr);
            MySqlBulkLoader bl = new MySqlBulkLoader(conn);
            bl.Local = true;
            bl.TableName = "Career";
            bl.FieldTerminator = "\t";
            bl.LineTerminator = "\n";
            bl.FileName = "c:/career_data.txt";
            bl.NumberOfLinesToSkip = 3;
            try
            {
                Console.WriteLine("Connecting to MySQL...");
                conn.Open();
                // Upload data from file
                int count = bl.Load();
                Console.WriteLine(count + " lines uploaded.");
                string sql = "SELECT Name, Age, Profession FROM Career";
                MySqlCommand cmd = new MySqlCommand(sql, conn);
                MySqlDataReader rdr = cmd.ExecuteReader();
                while (rdr.Read())
                {
                    Console.WriteLine(rdr[0] + " -- " + rdr[1] + " -- " + rdr[2]);
                }
                rdr.Close();
                conn.Close();
            }
            catch (Exception ex)
            {
                Console.WriteLine(ex.ToString());
            }
            Console.WriteLine("Done.");
        }
    }
}
```

Further information on `LOAD DATA INFILE` can be found in [LOAD DATA Statement](#). Further information on `MySqlBulkLoader` can be found in the reference documentation that was included with your connector.

4.5.13 Using the Connector/NET Trace Source Object

The .NET 2.0 tracing architecture consists of four main parts:

- **Source** - This is the originator of the trace information. The source is used to send trace messages. The name of the source provided by Connector/NET is `mysql`.
- **Switch** - This defines the level of trace information to emit. Typically, this is specified in the `app.config` file, so that it is not necessary to recompile an application to change the trace level.

- *Listener* - Trace listeners define where the trace information will be written to. Supported listeners include, for example, the Visual Studio Output window, the Windows Event Log, and the console.
- *Filter* - Filters can be attached to listeners. Filters determine the level of trace information that will be written. While a switch defines the level of information that will be written to all listeners, a filter can be applied on a per-listener basis, giving finer grained control of trace information.

To use tracing **MySql.Data.MySqlClient.MySqlTrace** can be used as a TraceSource for Connector/.NET and the connection string must include "Logging=True".

To enable trace messages, configure a trace switch. Trace switches have associated with them a trace level enumeration, these are **Off**, **Error**, **Warning**, **Info**, and **Verbose**.

```
MySqlTrace.Switch.Level = SourceLevels.Verbose;
```

This sets the trace level to **Verbose**, meaning that all trace messages will be written.

It is convenient to be able to change the trace level without having to recompile the code. This is achieved by specifying the trace level in application configuration file, [app.config](#). You then simply need to specify the desired trace level in the configuration file and restart the application. The trace source is configured within the `system.diagnostics` section of the file. The following XML snippet illustrates this:

```
<configuration>
  ...
  <system.diagnostics>
    <sources>
      <source name="mysql" switchName="MySwitch"
             switchType="System.Diagnostics.SourceSwitch" />
      ...
    </sources>
    <switches>
      <add name="MySwitch" value="Verbose" />
      ...
    </switches>
  </system.diagnostics>
  ...
</configuration>
```

By default, trace information is written to the Output window of Microsoft Visual Studio. There are a wide range of listeners that can be attached to the trace source, so that trace messages can be written out to various destinations. You can also create custom listeners to allow trace messages to be written to other destinations as mobile devices and web services. A commonly used example of a listener is [ConsoleTraceListener](#), which writes trace messages to the console.

To add a listener at runtime, use code such as the following:

```
ts.Listeners.Add(new ConsoleTraceListener());
```

Then, call methods on the trace source object to generate trace information. For example, the [TraceInformation\(\)](#), [TraceEvent\(\)](#), or [TraceData\(\)](#) methods can be used.

4.5.13.1 Viewing MySQL Trace Information

This section describes how to set up your application to view MySQL trace information.

The first thing you need to do is create a suitable [app.config](#) file for your application. An example is shown in the following code:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
  <system.diagnostics>
    <sources>
      <source name="mysql" switchName="SourceSwitch"
```

```

switchType="System.Diagnostics.SourceSwitch" >
<listeners>
    <add name="console" />
    <remove name = "Default" />
</listeners>
</source>
</sources>
<switches>
    <!-- You can set the level at which tracing is to occur -->
    <add name="SourceSwitch" value="Verbose" />
    <!-- You can turn tracing off -->
    <!--add name="SourceSwitch" value="Off" -->
</switches>
<sharedListeners>
    <add name="console"
        type="System.Diagnostics.ConsoleTraceListener"
        initializeData="false"/>
</sharedListeners>
</system.diagnostics>
</configuration>

```

This ensures a suitable trace source is created, along with a switch. The switch level in this case is set to `Verbose` to display the maximum amount of information.

In the application the only other step required is to add `logging=true` to the connection string. An example application could be:

```

using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Diagnostics;
using MySql.Data;
using MySql.Data.MySqlClient;
using MySql.Web;
namespace ConsoleApplication1
{
    class Program
    {
        static void Main(string[] args)
        {
            string connStr = "server=localhost;user=root;database=world;port=3306;password=*****;logging=t";
            MySqlConnection conn = new MySqlConnection(connStr);
            try
            {
                Console.WriteLine("Connecting to MySQL...");
                conn.Open();
                string sql = "SELECT Name, HeadOfState FROM Country WHERE Continent='Oceania'";
                MySqlCommand cmd = new MySqlCommand(sql, conn);
                MySqlDataReader rdr = cmd.ExecuteReader();
                while (rdr.Read())
                {
                    Console.WriteLine(rdr[0] + " -- " + rdr[1]);
                }
                rdr.Close();
                conn.Close();
            }
            catch (Exception ex)
            {
                Console.WriteLine(ex.ToString());
            }
            Console.WriteLine("Done.");
        }
    }
}

```

This simple application will then generate the following output:

```

Connecting to MySQL...
mysql Information: 1 : 1: Connection Opened: connection string = 'server=localhost;User Id=root;database=world
;password=*****;logging=True'

```

```

mysql Information: 3 : 1: Query Opened: SHOW VARIABLES
mysql Information: 4 : 1: Resultset Opened: field(s) = 2, affected rows = -1, inserted id = -1
mysql Information: 5 : 1: Resultset Closed. Total rows=272, skipped rows=0, size (bytes)=7058
mysql Information: 6 : 1: Query Closed
mysql Information: 3 : 1: Query Opened: SHOW COLLATION
mysql Information: 4 : 1: Resultset Opened: field(s) = 6, affected rows = -1, inserted id = -1
mysql Information: 5 : 1: Resultset Closed. Total rows=127, skipped rows=0, size (bytes)=4102
mysql Information: 6 : 1: Query Closed
mysql Information: 3 : 1: Query Opened: SET character_set_results=NULL
mysql Information: 4 : 1: Resultset Opened: field(s) = 0, affected rows = 0, inserted id = 0
mysql Information: 5 : 1: Resultset Closed. Total rows=0, skipped rows=0, size (bytes)=0
mysql Information: 6 : 1: Query Closed
mysql Information: 10 : 1: Set Database: world
mysql Information: 3 : 1: Query Opened: SELECT Name, HeadOfState FROM Country WHERE Continent='Oceania'
mysql Information: 4 : 1: Resultset Opened: field(s) = 2, affected rows = -1, inserted id = -1
American Samoa -- George W. Bush
Australia -- Elisabeth II
...
Wallis and Futuna -- Jacques Chirac
Vanuatu -- John Bani
United States Minor Outlying Islands -- George W. Bush
mysql Information: 5 : 1: Resultset Closed. Total rows=28, skipped rows=0, size (bytes)=788
mysql Information: 6 : 1: Query Closed
Done.
mysql Information: 2 : 1: Connection Closed

```

The first number displayed in the trace message corresponds to the MySQL event type:

Event	Description
1	ConnectionOpened: connection string
2	ConnectionClosed:
3	QueryOpened: mysql server thread id, query text
4	ResultOpened: field count, affected rows (-1 if select), inserted id (-1 if select)
5	ResultClosed: total rows read, rows skipped, size of resultset in bytes
6	QueryClosed:
7	StatementPrepared: prepared sql, statement id
8	StatementExecuted: statement id, mysql server thread id
9	StatementClosed: statement id
10	NonQuery: [varies]
11	UsageAdvisorWarning: usage advisor flag. NolIndex = 1, BadIndex = 2, SkippedRows = 3, SkippedColumns = 4, FieldConversion = 5.
12	Warning: level, code, message
13	Error: error number, error message

The second number displayed in the trace message is the connection count.

Although this example uses the [ConsoleTraceListener](#), any of the other standard listeners could have been used. Another possibility is to create a custom listener that uses the information passed using the [TraceEvent](#) method. For example, a custom trace listener could be created to perform active monitoring of the MySQL event messages, rather than simply writing these to an output device.

It is also possible to add listeners to the MySQL Trace Source at runtime. This can be done with the following code:

```
MySqlTrace.Listeners.Add(new ConsoleTraceListener());
```

Connector/NET provides the ability to switch tracing on and off at runtime. This can be achieved using the calls [MySqlTrace.EnableQueryAnalyzer\(string host, int postInterval\)](#)

and `MySqlTrace.DisableQueryAnalyzer()`. The parameter `host` is the URL of the MySQL Enterprise Monitor server to monitor. The parameter `postInterval` is how often to post the data to MySQL Enterprise Monitor, in seconds.

4.5.13.2 Building Custom Listeners

To build custom listeners that work with the MySQL Connector/NET Trace Source, it is necessary to understand the key methods used, and the event data formats used.

The main method involved in passing trace messages is the `TraceSource.TraceEvent` method. This has the prototype:

```
public void TraceEvent(
    TraceEventType eventType,
    int id,
    string format,
    params Object[] args
)
```

This trace source method will process the list of attached listeners and call the listener's `TraceListener.TraceEvent` method. The prototype for the `TraceListener.TraceEvent` method is as follows:

```
public virtual void TraceEvent(
    TraceEventCache eventCache,
    string source,
    TraceEventType eventType,
    int id,
    string format,
    params Object[] args
)
```

The first three parameters are used in the standard as [defined by Microsoft](#). The last three parameters contain MySQL-specific trace information. Each of these parameters is now discussed in more detail.

`int id`

This is a MySQL-specific identifier. It identifies the MySQL event type that has occurred, resulting in a trace message being generated. This value is defined by the `MySqlTraceEventType` public enum contained in the Connector/NET code:

```
public enum MySqlTraceEventType : int
{
    ConnectionOpened = 1,
    ConnectionClosed,
    QueryOpened,
    ResultOpened,
    ResultClosed,
    QueryClosed,
    StatementPrepared,
    StatementExecuted,
    StatementClosed,
    NonQuery,
    UsageAdvisorWarning,
    Warning,
    Error
}
```

The MySQL event type also determines the contents passed using the parameter `params Object[] args`. The nature of the `args` parameters are described in further detail in the following material.

`string format`

This is the format string that contains zero or more format items, which correspond to objects in the `args` array. This would be used by a listener such as `ConsoleTraceListener` to write a message to the output device.

```
params Object[] args
```

This is a list of objects that depends on the MySQL event type, `id`. However, the first parameter passed using this list is always the driver id. The driver id is a unique number that is incremented each time the connector is opened. This enables groups of queries on the same connection to be identified. The parameters that follow driver id depend on the MySQL event id, and are as follows:

MySQL-specific event type	Arguments (params Object[] args)
ConnectionOpened	Connection string
ConnectionClosed	No additional parameters
QueryOpened	mysql server thread id, query text
ResultOpened	field count, affected rows (-1 if select), inserted id (-1 if select)
ResultClosed	total rows read, rows skipped, size of resultset in bytes
QueryClosed	No additional parameters
StatementPrepared	prepared sql, statement id
StatementExecuted	statement id, mysql server thread id
StatementClosed	statement id
NonQuery	Varies
UsageAdvisorWarning	usage advisor flag. NoIndex = 1, BadIndex = 2, SkippedRows = 3, SkippedColumns = 4, FieldConversion = 5.
Warning	level, code, message
Error	error number, error message

This information will allow you to create custom trace listeners that can actively monitor the MySQL-specific events.

4.5.14 Binary/Nonbinary Issues

There are certain situations where MySQL will return incorrect metadata about one or more columns. More specifically, the server can sometimes report that a column is binary when it is not (and the reverse). In these situations, it becomes practically impossible for the connector to be able to correctly identify the correct metadata.

Some examples of situations that may return incorrect metadata are:

- Execution of `SHOW PROCESSLIST`. Some of the columns are returned as binary even though they only hold string data.
- When a temporary table is used to process a resultset, some columns may be returned with incorrect binary flags.
- Some server functions such `DATE_FORMAT` return the column incorrectly as binary.

With the availability of `BINARY` and `VARBINARY` data types, it is important to respect the metadata returned by the server. However, some existing applications may encounter issues with this change and can use a connection string option to enable or disable it. By default, Connector/NET respects the binary flags returned by the server. You might need to make small changes to your application to accommodate this change.

In the event that the changes required to your application are too large, adding '`respect binary flags=false`' to your connection string causes the connector to use the prior behavior: any column that is marked as string, regardless of binary flags, will be returned as string. Only columns that are specifically marked as a `BLOB` will be returned as `BLOB`.

4.5.15 Character Set Considerations for Connector/NET

Treating Binary Blobs As UTF8

Before the introduction of [4-byte UTF-8 character set](#), MySQL did not support 4-byte UTF8 sequences. This makes it difficult to represent some multibyte languages such as Japanese. To try and alleviate this, MySQL Connector/NET supports a mode where binary blobs can be treated as strings.

To do this, you set the '[Treat Blobs As UTF8](#)' connection string keyword to `true`. This is all that needs to be done to enable conversion of all binary blobs to UTF8 strings. To convert only some of your BLOB columns, you can make use of the '[BlobAsUTF8IncludePattern](#)' and '[BlobAsUTF8ExcludePattern](#)' keywords. Set these to a regular expression pattern that matches the column names to include or exclude respectively.

When the regular expression patterns both match a single column, the include pattern is applied before the exclude pattern. The result, in this case, is that the column is excluded. Also, be aware that this mode does not apply to columns of type [BINARY](#) or [VARBINARY](#) and also do not apply to nonbinary [BLOB](#) columns.

This mode only applies to reading strings out of MySQL. To insert 4-byte UTF8 strings into blob columns, use the .NET [Encoding.GetBytes](#) function to convert your string to a series of bytes. You can then set this byte array as a parameter for a [BLOB](#) column.

4.5.16 Using Connector/NET with Crystal Reports

Crystal Reports is a common tool used by Windows application developers to perform reporting and document generation. In this section we will show how to use Crystal Reports XI with MySQL and MySQL Connector/NET.

4.5.16.1 Creating a Data Source

When creating a report in Crystal Reports there are two options for accessing the MySQL data while designing your report.

The first option is to use Connector/ODBC as an ADO data source when designing your report. You will be able to browse your database and choose tables and fields using drag and drop to build your report. The disadvantage of this approach is that additional work must be performed within your application to produce a data set that matches the one expected by your report.

The second option is to create a data set in VB.NET and save it as XML. This XML file can then be used to design a report. This works quite well when displaying the report in your application, but is less versatile at design time because you must choose all relevant columns when creating the data set. If you forget a column you must re-create the data set before the column can be added to the report.

The following code can be used to create a data set from a query and write it to disk:

Visual Basic Example

```
Dim myData As New DataSet
Dim conn As New MySqlConnection
Dim cmd As New MySqlCommand
Dim myAdapter As New MySqlDataAdapter
conn.ConnectionString = "server=127.0.0.1;" _
    & "uid=root;" _
    & "pwd=12345;" _
    & "database=world"
Try
    conn.Open()
    cmd.CommandText = "SELECT city.name AS cityName, city.population AS CityPopulation, " _
        & "country.name, country.population, country.continent" _
```

```
& "FROM country, city ORDER BY country.continent, country.name"
cmd.Connection = conn
myAdapter.SelectCommand = cmd
myAdapter.Fill(myData)
myData.WriteXml("C:\dataset.xml", XmlWriteMode.WriteSchema)
Catch ex As Exception
    MessageBox.Show(ex.Message, "Report could not be created", MessageBoxButtons.OK, MessageBoxIcon.Error)
End Try
```

C# Example

```
DataSet myData = new DataSet();
MySql.Data.MySqlClient.MySqlConnection conn;
MySql.Data.MySqlClient.MySqlCommand cmd;
MySql.Data.MySqlClient.MySqlDataAdapter myAdapter;
conn = new MySql.Data.MySqlClient.MySqlConnection();
cmd = new MySql.Data.MySqlClient.MySqlCommand();
myAdapter = new MySql.Data.MySqlClient.MySqlDataAdapter();
conn.ConnectionString = "server=127.0.0.1;uid=root;" +
    "pwd=12345;database=test";
try
{
    cmd.CommandText = "SELECT city.name AS cityName, city.population AS CityPopulation, " +
        "country.name, country.population, country.continent " +
        "FROM country, city ORDER BY country.continent, country.name";
    cmd.Connection = conn;
    myAdapter.SelectCommand = cmd;
    myAdapter.Fill(myData);
    myData.WriteXml(@"C:\dataset.xml", XmlWriteMode.WriteSchema);
}
catch (MySql.Data.MySqlClient.MySqlException ex)
{
    MessageBox.Show(ex.Message, "Report could not be created",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
}
```

The resulting XML file can be used as an ADO.NET XML datasource when designing your report.

If you choose to design your reports using Connector/ODBC, it can be downloaded from dev.mysql.com.

4.5.16.2 Creating the Report

For most purposes, the Standard Report wizard helps with the initial creation of a report. To start the wizard, open Crystal Reports and choose the **New > Standard Report** option from the File menu.

The wizard first prompts you for a data source. If you use Connector/ODBC as your data source, use the OLEDB provider for ODBC option from the OLE DB (ADO) tree instead of the ODBC (RDO) tree when choosing a data source. If using a saved data set, choose the ADO.NET (XML) option and browse to your saved data set.

The remainder of the report creation process is done automatically by the wizard.

After the report is created, choose the **Report Options** entry from the **File** menu. Un-check the **Save Data With Report** option. This prevents saved data from interfering with the loading of data within our application.

4.5.16.3 Displaying the Report

To display a report we first populate a data set with the data needed for the report, then load the report and bind it to the data set. Finally we pass the report to the crViewer control for display to the user.

The following references are needed in a project that displays a report:

- CrystalDecisions.CrystalReports.Engine

- CrystalDecisions.ReportSource
- CrystalDecisions.Shared
- CrystalDecisions.Windows.Forms

The following code assumes that you created your report using a data set saved using the code shown in [Section 4.5.16.1, “Creating a Data Source”](#), and have a crViewer control on your form named `myViewer`.

Visual Basic Example

```
Imports CrystalDecisions.CrystalReports.Engine
Imports System.Data
Imports MySql.Data.MySqlClient
Dim myReport As New ReportDocument
Dim myData As New DataSet
Dim conn As New MySqlConnection
Dim cmd As New MySqlCommand
Dim myAdapter As New MySqlDataAdapter
conn.ConnectionString = _
    "server=127.0.0.1;" _
    & "uid=root;" _
    & "pwd=12345;" _
    & "database=test"
Try
    conn.Open()
    cmd.CommandText = "SELECT city.name AS cityName, city.population AS CityPopulation, " _
        & "country.name, country.population, country.continent " _
        & "FROM country, city ORDER BY country.continent, country.name"
    cmd.Connection = conn
    myAdapter.SelectCommand = cmd
    myAdapter.Fill(myData)
    myReport.Load(".\world_report.rpt")
    myReport.SetDataSource(myData)
    myViewer.ReportSource = myReport
Catch ex As Exception
    MessageBox.Show(ex.Message, "Report could not be created", MessageBoxButtons.OK, MessageBoxIcon.Error)
End Try
```

C# Example

```
using CrystalDecisions.CrystalReports.Engine;
using System.Data;
using MySql.Data.MySqlClient;
ReportDocument myReport = new ReportDocument();
DataSet myData = new DataSet();
MySql.Data.MySqlClient.MySqlConnection conn;
MySql.Data.MySqlClient.MySqlCommand cmd;
MySql.Data.MySqlClient.MySqlDataAdapter myAdapter;
conn = new MySql.Data.MySqlClient.MySqlConnection();
cmd = new MySql.Data.MySqlClient.MySqlCommand();
myAdapter = new MySql.Data.MySqlClient.MySqlDataAdapter();
conn.ConnectionString = "server=127.0.0.1;uid=root;" +
    "pwd=12345;database=test";
try
{
    cmd.CommandText = "SELECT city.name AS cityName, city.population AS CityPopulation, " +
        "country.name, country.population, country.continent " +
        "FROM country, city ORDER BY country.continent, country.name";
    cmd.Connection = conn;
    myAdapter.SelectCommand = cmd;
    myAdapter.Fill(myData);
    myReport.Load(@".\world_report.rpt");
    myReport.SetDataSource(myData);
    myViewer.ReportSource = myReport;
}
catch (MySql.Data.MySqlClient.MySqlException ex)
{
    MessageBox.Show(ex.Message, "Report could not be created",
```

```

    MessageBoxButtons.OK, MessageBoxIcon.Error);
}

```

A new data set is generated using the same query used to generate the previously saved data set. Once the data set is filled, a ReportDocument is used to load the report file and bind it to the data set. The ReportDocument is passed as the ReportSource of the crViewer.

This same approach is taken when a report is created from a single table using Connector/ODBC. The data set replaces the table used in the report and the report is displayed properly.

When a report is created from multiple tables using Connector/ODBC, a data set with multiple tables must be created in our application. This enables each table in the report data source to be replaced with a report in the data set.

We populate a data set with multiple tables by providing multiple `SELECT` statements in our MySqlCommand object. These `SELECT` statements are based on the SQL query shown in Crystal Reports in the Database menu's Show SQL Query option. Assume the following query:

```

SELECT `country`.`Name`, `country`.`Continent`, `country`.`Population`, `city`.`Name`, `city`.`Populati
FROM `world`.`country` `country` LEFT OUTER JOIN `world`.`city` `city` ON `country`.`Code`=`city`.`Coun
ORDER BY `country`.`Continent`, `country`.`Name`, `city`.`Name`

```

This query is converted to two `SELECT` queries and displayed with the following code:

Visual Basic Example

```

Imports CrystalDecisions.CrystalReports.Engine
Imports System.Data
Imports MySql.Data.MySqlClient
Dim myReport As New ReportDocument
Dim myData As New DataSet
Dim conn As New MySqlConnection
Dim cmd As New MySqlCommand
Dim myAdapter As New MySqlDataAdapter
conn.ConnectionString = "server=127.0.0.1;" +
    & "uid=root;" +
    & "pwd=12345;" +
    & "database=world"
Try
    conn.Open()
    cmd.CommandText = "SELECT name, population, countrycode FROM city ORDER BY countrycode, name;" +
        & "SELECT name, population, code, continent FROM country ORDER BY continent, name"
    cmd.Connection = conn
    myAdapter.SelectCommand = cmd
    myAdapter.Fill(myData)
    myReport.Load(".\world_report.rpt")
    myReport.Database.Tables(0).SetDataSource(myData.Tables(0))
    myReport.Database.Tables(1).SetDataSource(myData.Tables(1))
    myViewer.ReportSource = myReport
Catch ex As Exception
    MessageBox.Show(ex.Message, "Report could not be created", MessageBoxButtons.OK, MessageBoxIcon.Error)
End Try

```

C# Example

```

using CrystalDecisions.CrystalReports.Engine;
using System.Data;
using MySql.Data.MySqlClient;
ReportDocument myReport = new ReportDocument();
DataSet myData = new DataSet();
MySql.Data.MySqlClient.MySqlConnection conn;
MySql.Data.MySqlClient.MySqlCommand cmd;
MySql.Data.MySqlClient.MySqlDataAdapter myAdapter;
conn = new MySql.Data.MySqlClient.MySqlConnection();
cmd = new MySql.Data.MySqlClient.MySqlCommand();
myAdapter = new MySql.Data.MySqlClient.MySqlDataAdapter();
conn.ConnectionString = "server=127.0.0.1;uid=root;" +
    "pwd=12345;database=test";

```

```

try
{
    cmd.CommandText = "SELECT name, population, countrycode FROM city ORDER " +
        "BY countrycode, name; SELECT name, population, code, continent FROM " +
        "country ORDER BY continent, name";
    cmd.Connection = conn;
    myAdapter.SelectCommand = cmd;
    myAdapter.Fill(myData);
    myReport.Load(@".\world_report.rpt");
    myReport.Database.Tables(0).SetDataSource(myData.Tables(0));
    myReport.Database.Tables(1).SetDataSource(myData.Tables(1));
    myViewer.ReportSource = myReport;
}
catch (MySql.Data.MySqlClient.MySqlException ex)
{
    MessageBox.Show(ex.Message, "Report could not be created",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
}

```

It is important to order the `SELECT` queries in alphabetic order, as this is the order the report will expect its source tables to be in. One `SetDataSource` statement is needed for each table in the report.

This approach can cause performance problems because Crystal Reports must bind the tables together on the client-side, which will be slower than using a pre-saved data set.

4.5.17 ASP.NET Provider Model

MySQL Connector/.NET includes support for the ASP.NET 2.0 provider model. This model enables application developers to focus on the business logic of their application instead of having to recreate such boilerplate items as membership and roles support.

Connector/.NET supplies the following web providers:

- Membership provider
- Roles provider
- Profiles provider
- Session state provider

The following tables show the supported providers, their default provider and the corresponding MySQL provider.

Membership Provider

Default Provider	MySQL Provider
System.Web.Security.SqlMembershipProvider	MySql.Web.Security.MySQLMembershipProvider

Role Provider

Default Provider	MySQL Provider
System.Web.Security.SqlRoleProvider	MySql.Web.Security.MySQLRoleProvider

Profile Provider

Default Provider	MySQL Provider
System.Web.Profile.SqlProfileProvider	MySql.Web.Profile.MySQLProfileProvider

Session State Provider

Default Provider	MySQL Provider
System.Web.SessionState.InProcSessionStateStore	MySQL.Web.SessionState.MySqlSessionStateStore

Note

The MySQL session state provider uses slightly different capitalization on the class name compared to the other MySQL providers.

Installing the Providers

The installation of Connector/NET will install the providers and register them in your machine's .NET configuration file, `machine.config`. The additional entries created will result in the `system.web` section appearing similar to the following code:

```
<system.web>
  <processModel autoConfig="true" />
  <httpHandlers />
  <membership>
    <providers>
      <add name="AspNetSqlMembershipProvider" type="System.Web.Security.SqlMembershipProvider, System.Web, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b03f5f7f1434493e" />
      <add name="MySQLMembershipProvider" type="MySql.Web.Security.MySQLMembershipProvider, MySql.Web, Version=6.1.4, Culture=neutral, PublicKeyToken=c5687fc0bd34c4f7" />
    </providers>
  </membership>
  <profile>
    <providers>
      <add name="AspNetSqlProfileProvider" connectionStringName="LocalSqlServer" applicationName="/" type="System.Web.Profile.SqlProfileProvider, System.Web, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b03f5f7f1434493e" />
      <add name="MySQLProfileProvider" type="MySql.Web.Profile.MySQLProfileProvider, MySql.Web, Version=6.1.4, Culture=neutral, PublicKeyToken=c5687fc0bd34c4f7" />
    </providers>
  </profile>
  <roleManager>
    <providers>
      <add name="AspNetSqlRoleProvider" connectionStringName="LocalSqlServer" applicationName="/" type="System.Web.Security.SqlRoleProvider, System.Web, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b03f5f7f1434493e" />
      <add name="AspNetWindowsTokenRoleProvider" applicationName="/" type="System.Web.Security.WindowsTokenRoleProvider, System.Web, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b03f5f7f1434493e" />
      <add name="MySQLRoleProvider" type="MySql.Web.Security.MySQLRoleProvider, MySql.Web, Version=6.1.4, Culture=neutral, PublicKeyToken=c5687fc0bd34c4f7" />
    </providers>
  </roleManager>
</system.web>
```

Each provider type can have multiple provider implementations. The default provider can also be set here using the `defaultProvider` attribute, but usually this is set in the `web.config` file either manually or by using the ASP.NET configuration tool.

At time of writing, the `MySQLSessionStateStore` is not added to `machine.config` at install time, and so add the following:

```
<sessionState>
  <providers>
    <add name="MySQLSessionStateStore" type="MySql.Web.SessionState.MySqlSessionStateStore, MySql.Web, Version=6.1.4, Culture=neutral, PublicKeyToken=c5687fc0bd34c4f7" />
  </providers>
</sessionState>
```

The session state provider uses the `customProvider` attribute, rather than `defaultProvider`, to set the provider as the default. A typical `web.config` file might contain:

```
<system.web>
  <membership defaultProvider="MySQLMembershipProvider" />
  <roleManager defaultProvider="MySQLRoleProvider" />
  <profile defaultProvider="MySQLProfileProvider" />
  <sessionState customProvider="MySQLSessionStateStore" />
  <compilation debug="false">
    ...
  </compilation>
</system.web>
```

This sets the MySQL Providers as the defaults to be used in this web application.

The providers are implemented in the file `mysql.web.dll` and this file can be found in your Connector/.NET installation folder. There is no need to run any type of SQL script to set up the database schema, as the providers create and maintain the proper schema automatically.

Using the Providers

The easiest way to start using the providers is to use the ASP.NET configuration tool that is available on the Solution Explorer toolbar when you have a website project loaded.

In the web pages that open, you can select the MySQL membership and roles providers by picking a custom provider for each area.

When the provider is installed, it creates a dummy connection string named `LocalMySqlServer`. Although this has to be done so that the provider will work in the ASP.NET configuration tool, you override this connection string in your `web.config` file. You do this by first removing the dummy connection string and then adding in the proper one, as shown in the following example:

```
<connectionStrings>
  <remove name="LocalMySqlServer"/>
  <add name="LocalMySqlServer" connectionString="server=xxx;uid=xxx;pwd=xxx;database=xxx" />
</connectionStrings>
```

Note

You must specify the database in this connection.

Rather than manually editing configuration files, consider using the MySQL Application Configuration tool in MySQL for Visual Studio to configure your desired provider setup. The tool modifies your `Web.config` file to the desired configuration. A tutorial on doing this is available in the following section [MySQL Application Configuration Tool](#).

A tutorial demonstrating how to use the membership and role providers can be found in the following section [Section 4.6.2, “Tutorial: Connector/.NET ASP.NET Membership and Role Provider”](#).

Deployment

To use the providers on a production server, distribute the `MySql.Data` and the `MySql.Web` assemblies, and either register them in the remote systems Global Assembly Cache or keep them in your application's `bin/` directory.

4.5.18 Working with Partial Trust / Medium Trust

.NET applications operate under a given trust level. Normal desktop applications operate under full trust, while web applications that are hosted in shared environments are normally run under the partial trust level (also known as “medium trust”). Some hosting providers host shared applications in their own app pools and allow the application to run under full trust, but this configuration is relatively rare. The MySQL Connector/.NET support for partial trust has improved over time to simplify the configuration and deployment process for hosting providers.

4.5.18.1 Evolution of Partial Trust Support Across Connector/.NET Versions

The partial trust support for MySQL Connector/.NET has improved rapidly throughout the 6.5.x and 6.6.x versions. The latest enhancements do require some configuration changes in existing deployments. Here is a summary of the changes for each version.

6.6.4 and Above: Library Can Be Inside or Outside GAC

Now you can install the `MySql.Data.dll` library in the Global Assembly Cache (GAC) as explained in [Section 4.5.18.2, “Configuring Partial Trust with Connector/.NET Library Installed in GAC”](#), or in a `bin` or `lib` folder inside the project or solution as explained in [Section 4.5.18.3, “Configuring Partial Trust](#)

with Connector/NET Library Not Installed in GAC". If the library is not in the GAC, the only protocol supported is TCP/IP.

6.5.1 and Above: Partial Trust Requires Library in the GAC

Connector/NET 6.5 fully enables our provider to run in a partial trust environment when the library is installed in the Global Assembly Cache (GAC). The new `MySqlClientPermission` class, derived from the .NET `DBDataPermission` class, helps to simplify the permission setup.

5.0.8 / 5.1.3 and Above: Partial Trust Requires Socket Permissions

Starting with these versions, Connector/NET can be used under partial trust hosting that has been modified to allow the use of sockets for communication. By default, partial trust does not include `SocketPermission`. Connector/NET uses sockets to talk with the MySQL server, so the hosting provider must create a new trust level that is an exact clone of partial trust but that has the following permissions added:

- `System.Net.SocketPermission`
- `System.Security.Permissions.ReflectionPermission`
- `System.Net.DnsPermission`
- `System.Security.Permissions.SecurityPermission`

Prior to 5.0.8 / 5.1.3: Partial Trust Not Supported

Connector/NET versions prior to 5.0.8 and 5.1.3 were not compatible with partial trust hosting.

4.5.18.2 Configuring Partial Trust with Connector/NET Library Installed in GAC

If the library is installed in the GAC, you must include the connection option `includesecurityasserts=true` in your connection string. This is a new requirement as of MySQL Connector/NET 6.6.4.

The following list shows steps and code fragments needed to run a Connector/NET application in a partial trust environment. For illustration purposes, we use the Pipe Connections protocol in this example.

1. Install Connector/NET: version 6.6.1 or higher, or 6.5.4 or higher.
2. After installing the library, make the following configuration changes:

In the `SecurityClasses` section, add a definition for the `MySqlClientPermission` class, including the version to use.

```
<configuration>
  <mscorlib>
    <security>
      <policy>
        <PolicyLevel version="1">
          <SecurityClasses>
            ...
            <SecurityClass Name="MySqlClientPermission" Description="MySQL.Data.MySqlClient.MySqlClientPermission" Version="6.6.4.0" Culture="neutral" PublicKeyToken=c5687fc88969c44d" />
          </SecurityClasses>
        </PolicyLevel>
      </security>
    </mscorlib>
</configuration>
```

Scroll down to the `ASP.Net` section:

```
<PermissionSet class="NamedPermissionSet" version="1" Name="ASP.Net">
```

Add a new entry for the detailed configuration of the `MySqlClientPermission` class:

```
<IPermission class="MySqlClientPermission" version="1" Unrestricted="true" />
```

Note

This configuration is the most generalized way that includes all keywords.

3. Configure the MySQL server to accept pipe connections, by adding the `--enable-named-pipe` option on the command line. If you need more information about this, see [Installing MySQL on Microsoft Windows](#).
4. Confirm that the hosting provider has installed the Connector/NET library (`MySql.Data.dll`) in the GAC.
5. Optionally, the hosting provider can avoid granting permissions globally by using the new `MySqlClientPermission` class in the trust policies. (The alternative is to globally enable the permissions `System.Net.SocketPermission`, `System.Security.Permissions.ReflectionPermission`, `System.Net.DnsPermission`, and `System.Security.Permissions.SecurityPermission`.)
6. Create a simple web application using Visual Studio 2010.
7. Add the reference in your application for the `MySql.Data.MySqlClient` library.
8. Edit your `web.config` file so that your application runs using a Medium trust level:

```
<system.web>
  <trust level="Medium" />
</system.web>
```

9. Add the `MySql.Data.MySqlClient` namespace to your server-code page.
10. Define the connection string, in slightly different ways depending on the Connector/NET version.

Only for 6.6.4 or later: To use the connections inside any web application that will run in Medium trust, add the new `includesecurityasserts` option to the connection string. `includesecurityasserts=true` that makes the library request the following permissions when required: `SocketPermissions`, `ReflectionPermissions`, `DnsPermissions`, `SecurityPermissions` among others that are not granted in Medium trust levels.

For Connector/NET 6.6.3 or earlier: No special setting for security is needed within the connection string.

```
MySqlConnectionStringBuilder myconnString = new MySqlConnectionStringBuilder("server=localhost;User Id=...;...");  
myconnString.PipeName = "MySQL55";  
myconnString.ConnectionProtocol = MySqlConnectionProtocol.Pipe;  
// Following attribute is a new requirement when the library is in the GAC.  
// Could also be done by adding includesecurityasserts=true; to the string literal  
// in the constructor above.  
// Not needed with Connector/NET 6.6.3 and earlier.myconnString.IncludeSecurityAsserts = true;
```

11. Define the `MySqlConnection` to use:

```
MySqlConnection myconn = new MySqlConnection(myconnString.ConnectionString);  
myconn.Open();
```

12. Retrieve some data from your tables:

```
MySqlCommand cmd = new MySqlCommand("Select * from products", myconn);  
MySqlDataAdapter da = new MySqlDataAdapter(cmd);  
DataSet1 tds = new DataSet1();  
da.Fill(tds, tds.Tables[0].TableName);  
GridView1.DataSource = tds;  
GridView1.DataBind();  
myconn.Close()
```

13. Run the program. It should execute successfully, without requiring any special code or encountering any security problems.

4.5.18.3 Configuring Partial Trust with Connector/.NET Library Not Installed in GAC

When deploying a web application to a Shared Hosted environment, where this environment is configured to run all their .NET applications under a partial or medium trust level, you might not be able to install the MySQL Connector/.NET library in the GAC. Instead, you put a reference to the library in the `bin` or `lib` folder inside the project or solution. In this case, you configure the security in a different way than when the library is in the GAC.

Connector/.NET is commonly used by applications that run in Windows environments where the default communication for the protocol is used via sockets or by TCP/IP. For this protocol to operate is necessary have the required socket permissions in the web configuration file as follows:

1. Open the medium trust policy web configuration file, which should be under this folder:

```
%windir%\Microsoft.NET\Framework\{version}\CONFIG\web_mediumtrust.config
```

Use `Framework64` in the path instead of `Framework` if you are using a 64-bit installation of the framework.

2. Locate the `SecurityClasses` tag:

```
<SecurityClass Name="SocketPermission"  
Description="System.Net.SocketPermission, System, Version=4.0.0.0,  
Culture=neutral, PublicKeyToken=b77a5c561934e089"/>
```

3. Scroll down and look for the following `PermissionSet`:

```
<PermissionSet version="1" Name="ASP.NET">
```

4. Add the following inside this `PermissionSet`:

```
<IPermission class="SocketPermission" version="1" Unrestricted="true" />
```

This configuration lets you use the driver with the default Windows protocol TCP/IP without having any security issues. This approach only supports the TCP/IP protocol, so you cannot use any other type of connection.

Also, since the `MySQLClientPermissions` class is not added to the medium trust policy, you cannot use it. This configuration is the minimum required in order to work with Connector/.NET without the GAC.

4.6 Connector/.NET Tutorials

The following MySQL Connector/.NET tutorials illustrate how to develop MySQL programs using technologies such as Visual Studio, C#, ASP.NET, and the .NET, .NET Core, and Mono frameworks. Work through the first tutorial to verify that you have the right software components installed and configured, then choose other tutorials to try depending on the features you intend to use in your applications.

4.6.1 Tutorial: An Introduction to Connector/.NET Programming

This section provides a gentle introduction to programming with MySQL Connector/.NET. The code example is written in C#, and is designed to work on both Microsoft .NET Framework and Mono.

This tutorial is designed to get you up and running with Connector/.NET as quickly as possible, it does not go into detail on any particular topic. However, the following sections of this manual describe each of the topics introduced in this tutorial in more detail. In this tutorial you are encouraged to type in and run the code, modifying it as required for your setup.

This tutorial assumes you have MySQL and Connector/.NET already installed. It also assumes that you have installed the `world` database sample, which can be downloaded from the [MySQL Documentation page](#). You can also find details on how to install the database on the same page.

Note

Before compiling the code example, make sure that you have added References to your project as required. The References required are `System`, `System.Data` and `MySQL.Data`.

4.6.1.1 The MySqlConnection Object

For your MySQL Connector/.NET application to connect to a MySQL database, it must establish a connection by using a `MySqlConnection` object.

The `MySqlConnection` constructor takes a connection string as one of its parameters. The connection string provides necessary information to make the connection to the MySQL database. The connection string is discussed more fully in [Section 4.4, “Connector/.NET Connections”](#). For a list of supported connection string options, see [Section 4.4.5, “Connector/.NET 8.0 Connection Options Reference”](#).

The following code shows how to create a connection object/

```
using System;
using System.Data;

using MySql.Data;
using MySql.Data.MySqlClient;

public class Tutorial1
{
    public static void Main()
    {
        string connStr = "server=localhost;user=root;database=world;port=3306;password=*****";
        MySqlConnection conn = new MySqlConnection(connStr);
        try
        {
            Console.WriteLine("Connecting to MySQL...");
            conn.Open();
            // Perform database operations
        }
        catch (Exception ex)
        {
            Console.WriteLine(ex.ToString());
        }
        conn.Close();
        Console.WriteLine("Done.");
    }
}
```

When the `MySqlConnection` constructor is invoked, it returns a connection object, which is used for subsequent database operations. Open the connection before any other operations take place. Before the application exits, close the connection to the database by calling `Close` on the connection object.

Sometimes an attempt to perform an `Open` on a connection object can fail, generating an exception that can be handled using standard exception handling code.

In this section you have learned how to create a connection to a MySQL database, and open and close the corresponding connection object.

4.6.1.2 The MySqlCommand Object

When a connection has been established with the MySQL database, the next step is do carry out the desired database operations. This can be achieved through the use of the `MySqlCommand` object.

You will see how to create a `MySqlCommand` object. After it has been created, there are three main methods of interest that you can call:

- `ExecuteReader` to query the database. Results are usually returned in a `MySqlDataReader` object, created by `ExecuteReader`.

- `ExecuteNonQuery` to insert, update, and delete data.
- `ExecuteScalar` to return a single value.

Once a `MySqlCommand` object has been created, you will call one of the previous methods on it to carry out a database operation, such as perform a query. The results are usually returned into a `MySqlDataReader` object, and then processed, for example the results might be displayed. The following code demonstrates how this could be done.

```
using System;
using System.Data;

using MySql.Data;
using MySql.Data.MySqlClient;

public class Tutorial2
{
    public static void Main()
    {
        string connStr = "server=localhost;user=root;database=world;port=3306;password=*****";
        MySqlConnection conn = new MySqlConnection(connStr);
        try
        {
            Console.WriteLine("Connecting to MySQL...");
            conn.Open();

            string sql = "SELECT Name, HeadOfState FROM Country WHERE Continent='Oceania'";
            MySqlCommand cmd = new MySqlCommand(sql, conn);
            MySqlDataReader rdr = cmd.ExecuteReader();

            while (rdr.Read())
            {
                Console.WriteLine(rdr[0] + " -- " + rdr[1]);
            }
            rdr.Close();
        }
        catch (Exception ex)
        {
            Console.WriteLine(ex.ToString());
        }

        conn.Close();
        Console.WriteLine("Done.");
    }
}
```

When a connection has been created and opened, the code then creates a `MySqlCommand` object. Then the SQL query to be executed is passed to the `MySqlCommand` constructor. The `ExecuteReader` method is then used to generate a `MySqlReader` object. The `MySqlReader` object contains the results generated by the SQL executed on the command object. Once the results have been obtained in a `MySqlReader` object, the results can be processed. In this case, the information is printed out by a `while` loop. Finally, the `MySqlReader` object is disposed of by running its `Close` method on it.

In the next example, you will see how to use the `ExecuteNonQuery` method.

The procedure for performing an `ExecuteNonQuery` method call is simpler, as there is no need to create an object to store results. This is because `ExecuteNonQuery` is only used for inserting, updating and deleting data. The following example illustrates a simple update to the `Country` table:

```
using System;
using System.Data;

using MySql.Data;
using MySql.Data.MySqlClient;

public class Tutorial3
{
```

```

public static void Main()
{
    string connStr = "server=localhost;user=root;database=world;port=3306;password=*****";
    MySqlConnection conn = new MySqlConnection(connStr);
    try
    {
        Console.WriteLine("Connecting to MySQL...");
        conn.Open();

        string sql = "INSERT INTO Country (Name, HeadOfState, Continent) VALUES ('Disneyland','Mickey Mouse')";
        MySqlCommand cmd = new MySqlCommand(sql, conn);
        cmd.ExecuteNonQuery();
    }
    catch (Exception ex)
    {
        Console.WriteLine(ex.ToString());
    }

    conn.Close();
    Console.WriteLine("Done.");
}
}

```

The query is constructed, the command object created and the `ExecuteNonQuery` method called on the command object. You can access your MySQL database with the `mysql` command interpreter and verify that the update was carried out correctly.

Finally, you will see how the `ExecuteScalar` method can be used to return a single value. Again, this is straightforward, as a `MySqlDataReader` object is not required to store results, a simple variable will do. The following code illustrates how to use `ExecuteScalar`:

```

using System;
using System.Data;

using MySql.Data;
using MySql.Data.MySqlClient;

public class Tutorial4
{
    public static void Main()
    {
        string connStr = "server=localhost;user=root;database=world;port=3306;password=*****";
        MySqlConnection conn = new MySqlConnection(connStr);
        try
        {
            Console.WriteLine("Connecting to MySQL...");
            conn.Open();

            string sql = "SELECT COUNT(*) FROM Country";
            MySqlCommand cmd = new MySqlCommand(sql, conn);
            object result = cmd.ExecuteScalar();
            if (result != null)
            {
                int r = Convert.ToInt32(result);
                Console.WriteLine("Number of countries in the world database is: " + r);
            }
        }
        catch (Exception ex)
        {
            Console.WriteLine(ex.ToString());
        }

        conn.Close();
        Console.WriteLine("Done.");
    }
}

```

This example uses a simple query to count the rows in the `Country` table. The result is obtained by calling `ExecuteScalar` on the command object.

4.6.1.3 Working with Decoupled Data

Previously, when using `MySqlDataReader`, the connection to the database was continually maintained, unless explicitly closed. It is also possible to work in a manner where a connection is only established when needed. For example, in this mode, a connection could be established to read a chunk of data, the data could then be modified by the application as required. A connection could then be reestablished only if and when the application writes data back to the database. This decouples the working data set from the database.

This decoupled mode of working with data is supported by MySQL Connector/.NET. There are several parts involved in allowing this method to work:

- **Data Set.** The Data Set is the area in which data is loaded to read or modify it. A `DataSet` object is instantiated, which can store multiple tables of data.
- **Data Adapter.** The Data Adapter is the interface between the Data Set and the database itself. The Data Adapter is responsible for efficiently managing connections to the database, opening and closing them as required. The Data Adapter is created by instantiating an object of the `MySqlDataAdapter` class. The `MySqlDataAdapter` object has two main methods: `Fill` which reads data into the Data Set, and `Update`, which writes data from the Data Set to the database.
- **Command Builder.** The Command Builder is a support object. The Command Builder works in conjunction with the Data Adapter. When a `MySqlDataAdapter` object is created, it is typically given an initial `SELECT` statement. From this `SELECT` statement the Command Builder can work out the corresponding `INSERT`, `UPDATE` and `DELETE` statements that would be required to update the database. To create the Command Builder, an object of the class `MySqlCommandBuilder` is created.

Each of these classes will now be discussed in more detail.

Instantiating a DataSet Object

A `DataSet` object can be created simply, as shown in the following code-snippet:

```
DataSet dsCountry;
...
dsCountry = new DataSet();
```

Although this creates the `DataSet` object, it has not yet filled it with data. For that, a Data Adapter is required.

Instantiating a MySqlDataAdapter Object

The `MySqlDataAdapter` can be created as illustrated by the following example:

```
MySqlDataAdapter daCountry;
...
string sql = "SELECT Code, Name, HeadOfState FROM Country WHERE Continent='North America'";
daCountry = new MySqlDataAdapter(sql, conn);
```

Note

The `MySqlDataAdapter` is given the SQL specifying the data to work with.

Instantiating a MySqlCommandBuilder Object

Once the `MySqlDataAdapter` has been created, it is necessary to generate the additional statements required for inserting, updating and deleting data. There are several ways to do this, but in this tutorial you will see how this can most easily be done with `MySqlCommandBuilder`. The following code snippet illustrates how this is done:

```
MySqlCommandBuilder cb = new MySqlCommandBuilder(daCountry);
```

Note

The `MySqlDataAdapter` object is passed as a parameter to the command builder.

Filling the Data Set

To do anything useful with the data from your database, you need to load it into a Data Set. This is one of the jobs of the `MySqlDataAdapter` object, and is carried out with its `Fill` method. The following code example illustrates this point.

```
DataSet dsCountry;
...
dsCountry = new DataSet();
...
daCountry.Fill(dsCountry, "Country");
```

The `Fill` method is a `MySqlDataAdapter` method, and the Data Adapter knows how to establish a connection with the database and retrieve the required data, and then populate the Data Set when the `Fill` method is called. The second parameter “Country” is the table in the Data Set to update.

Updating the Data Set

The data in the Data Set can now be manipulated by the application as required. At some point, changes to data will need to be written back to the database. This is achieved through a `MySqlDataAdapter` method, the `Update` method.

```
daCountry.Update(dsCountry, "Country");
```

Again, the Data Set and the table within the Data Set to update are specified.

Working Example

The interactions between the `DataSet`, `MySqlDataAdapter` and `MySqlCommandBuilder` classes can be a little confusing, so their operation can perhaps be best illustrated by working code.

In this example, data from the `world` database is read into a Data Grid View control. Here, the data can be viewed and changed before clicking an update button. The update button then activates code to write changes back to the database. The code uses the principles explained previously. The application was built using the Microsoft Visual Studio to place and create the user interface controls, but the main code that uses the key classes described previously is shown in the next code example, and is portable.

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;

using MySql.Data;
using MySql.Data.MySqlClient;

namespace WindowsFormsApplication5
{
    public partial class Form1 : Form
    {
        MySqlCommandBuilder cbCountry;
        MySqlDataAdapter daCountry;
        DataSet dsCountry;

        public Form1()
        {
            InitializeComponent();
        }
    }
}
```

```

private void Form1_Load(object sender, EventArgs e)
{
    string connStr = "server=localhost;user=root;database=world;port=3306;password=*****";
    MySqlConnection conn = new MySqlConnection(connStr);
    try
    {
        label2.Text = "Connecting to MySQL...";

        string sql = "SELECT Code, Name, HeadOfState FROM Country WHERE Continent='North America'";
        daCountry = new MySqlDataAdapter(sql, conn);
        MySqlCommandBuilder cb = new MySqlCommandBuilder(daCountry);

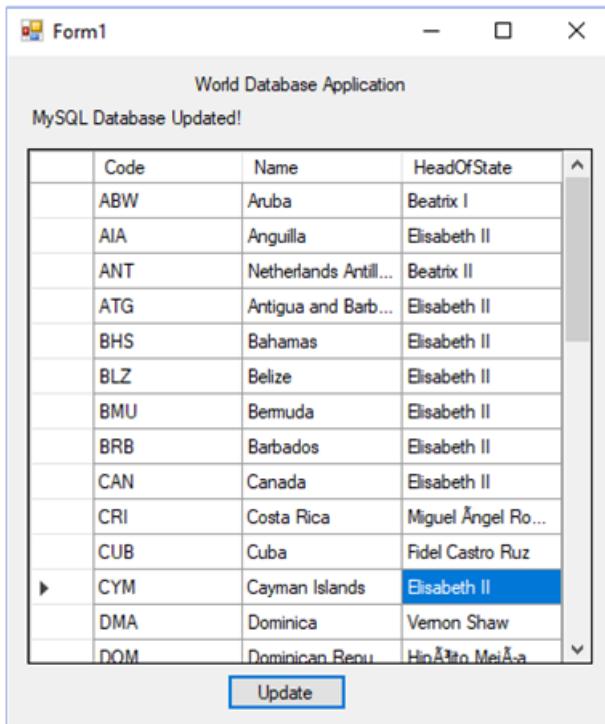
        dsCountry = new DataSet();
        daCountry.Fill(dsCountry, "Country");
        dataGridView1.DataSource = dsCountry;
        dataGridView1.DataMember = "Country";
    }
    catch (Exception ex)
    {
        label2.Text = ex.ToString();
    }
}

private void button1_Click(object sender, EventArgs e)
{
    daCountry.Update(dsCountry, "Country");
    label2.Text = "MySQL Database Updated!";
}
}

```

The following figure shows the application started. The World Database Application updated data in three columns: Code, Name, and HeadOfState.

Figure 4.1 World Database Application



4.6.1.4 Working with Parameters

This part of the tutorial shows you how to use parameters in your MySQL Connector/.NET application.

Although it is possible to build SQL query strings directly from user input, this is not advisable as it does not prevent erroneous or malicious information being entered. It is safer to use parameters as they will be processed as field data only. For example, imagine the following query was constructed from user input:

```
string sql = "SELECT Name, HeadOfState FROM Country WHERE Continent = "+user_continent;
```

If the string `user_continent` came from a Text Box control, there would potentially be no control over the string entered by the user. The user could enter a string that generates a runtime error, or in the worst case actually harms the system. When using parameters it is not possible to do this because a parameter is only ever treated as a field parameter, rather than an arbitrary piece of SQL code.

The same query written using a parameter for user input is:

```
string sql = "SELECT Name, HeadOfState FROM Country WHERE Continent = @Continent";
```

Note

The parameter is preceded by an '@' symbol to indicate it is to be treated as a parameter.

As well as marking the position of the parameter in the query string, it is necessary to add a parameter to the Command object. This is illustrated by the following code snippet:

```
cmd.Parameters.AddWithValue("@Continent", "North America");
```

In this example the string "North America" is supplied as the parameter value statically, but in a more practical example it would come from a user input control.

A further example illustrates the complete process:

```
using System;
using System.Data;

using MySql.Data;
using MySql.Data.MySqlClient;

public class Tutorial5
{
    public static void Main()
    {
        string connStr = "server=localhost;user=root;database=world;port=3306;password=*****";
        MySqlConnection conn = new MySqlConnection(connStr);
        try
        {
            Console.WriteLine("Connecting to MySQL...");
            conn.Open();

            string sql = "SELECT Name, HeadOfState FROM Country WHERE Continent=@Continent";
            MySqlCommand cmd = new MySqlCommand(sql, conn);

            Console.WriteLine("Enter a continent e.g. 'North America', 'Europe': ");
            string user_input = Console.ReadLine();

            cmd.Parameters.AddWithValue("@Continent", user_input);

            MySqlDataReader rdr = cmd.ExecuteReader();

            while (rdr.Read())
            {
                Console.WriteLine(rdr["Name"] + " --- " + rdr["HeadOfState"]);
            }
            rdr.Close();
        }
        catch (Exception ex)
        {
            Console.WriteLine(ex.ToString());
        }
    }
}
```

```

        conn.Close();
        Console.WriteLine("Done.");
    }
}

```

In this part of the tutorial you have seen how to use parameters to make your code more secure.

4.6.1.5 Working with Stored Procedures

This section illustrates how to work with stored procedures. Putting database-intensive operations into stored procedures lets you define an API for your database application. You can reuse this API across multiple applications and multiple programming languages. This technique avoids duplicating database code, saving time and effort when you make updates due to schema changes, tune the performance of queries, or add new database operations for logging, security, and so on. Before working through this tutorial, familiarize yourself with the [CREATE PROCEDURE](#) and [CREATE FUNCTION](#) statements that create different kinds of stored routines.

For the purposes of this tutorial, you will create a simple stored procedure to see how it can be called from MySQL Connector/.NET. In the MySQL Client program, connect to the `world` database and enter the following stored procedure:

```

DELIMITER //
CREATE PROCEDURE country_hos
(IN con CHAR(20))
BEGIN
    SELECT Name, HeadOfState FROM Country
    WHERE Continent = con;
END //
DELIMITER ;

```

Test that the stored procedure works as expected by typing the following into the `mysql` command interpreter:

```
CALL country_hos('Europe');
```

Note

The stored routine takes a single parameter, which is the continent to restrict your search to.

Having confirmed that the stored procedure is present and correct, you can see how to access it from Connector/.NET.

Calling a stored procedure from your Connector/.NET application is similar to techniques you have seen earlier in this tutorial. A `MySqlCommand` object is created, but rather than taking an SQL query as a parameter, it takes the name of the stored procedure to call. Set the `MySqlCommand` object to the type of stored procedure, as shown by the following code snippet:

```

string rtn = "country_hos";
MySqlCommand cmd = new MySqlCommand(rtn, conn);
cmd.CommandType = CommandType.StoredProcedure;

```

In this case, the stored procedure requires you to pass a parameter. This can be achieved using the techniques seen in the previous section on parameters, [Section 4.6.1.4, “Working with Parameters”](#), as shown in the following code snippet:

```
cmd.Parameters.AddWithValue("@con", "Europe");
```

The value of the parameter `@con` could more realistically have come from a user input control, but for simplicity it is set as a static string in this example.

At this point, everything is set up and you can call the routine using techniques also learned in earlier sections. In this case, the `ExecuteReader` method of the `MySqlCommand` object is used.

The following code shows the complete stored procedure example.

```
using System;
using System.Data;

using MySql.Data;
using MySql.Data.MySqlClient;

public class Tutorial6
{
    public static void Main()
    {
        string connStr = "server=localhost;user=root;database=world;port=3306;password=*****";
        MySqlConnection conn = new MySqlConnection(connStr);
        try
        {
            Console.WriteLine("Connecting to MySQL...");
            conn.Open();

            string rtn = "country_hos";
            MySqlCommand cmd = new MySqlCommand(rtn, conn);
            cmd.CommandType = CommandType.StoredProcedure;

            cmd.Parameters.AddWithValue("@con", "Europe");

            MySqlDataReader rdr = cmd.ExecuteReader();
            while (rdr.Read())
            {
                Console.WriteLine(rdr[0] + " --- " + rdr[1]);
            }
            rdr.Close();
        }
        catch (Exception ex)
        {
            Console.WriteLine(ex.ToString());
        }

        conn.Close();
        Console.WriteLine("Done.");
    }
}
```

In this section, you have seen how to call a stored procedure from Connector/.NET. For the moment, this concludes our introductory tutorial on programming with Connector/.NET.

4.6.2 Tutorial: Connector/.NET ASP.NET Membership and Role Provider

Many websites feature the facility for the user to create a user account. They can then log into the website and enjoy a personalized experience. This requires that the developer creates database tables to store user information, along with code to gather and process this data. This represents a burden on the developer, and there is the possibility for security issues to creep into the developed code. However, ASP.NET 2.0 introduced the membership system. This system is designed around the concept of membership, profile, and role providers, which together provide all of the functionality to implement a user system, that previously would have to have been created by the developer from scratch.

Currently, MySQL Connector/.NET includes web providers for membership (or simple membership), roles, profiles, session state, site map, and web personalization.

This tutorial shows you how to set up your ASP.NET web application to use the Connector/.NET membership and role providers. It assumes that you have MySQL Server installed, along with Connector/.NET and Microsoft Visual Studio. This tutorial was tested with Connector/.NET 6.0.4 and Microsoft Visual Studio 2008 Professional Edition. It is recommended you use 6.0.4 or above for this tutorial.

1. Create a new MySQL database using the MySQL Command-Line Client program ([mysql](#)), or other suitable tool. It does not matter what name is used for the database, but record it. You specify it in the connection string constructed later in this tutorial. This database contains the tables, automatically created for you later, used to store data about users and roles.

2. Create a new ASP.NET website in Visual Studio. If you are not sure how to do this, refer to [Section 4.6.7, "Tutorial: Data Binding in ASP.NET Using LINQ on Entities"](#), which demonstrates how to create a simple ASP.NET website.
3. Add References to `MySql.Data` and `MySql.Web` to the website project.
4. Locate the `machine.config` file on your system, which is the configuration file for the .NET Framework.
5. Search the `machine.config` file to find the membership provider `MySQLMembershipProvider`.
6. Add the attribute `autogenerateschema="true"`. The appropriate section should now resemble the following example.

Note

For the sake of brevity, some information is excluded.

```
<membership>
  <providers>
    <add name="AspNetSqlMembershipProvider"
        type="System.Web.Security.SqlMembershipProvider"
        ...
        connectionStringName="LocalSqlServer"
        ... />
    <add name="MySQLMembershipProvider"
        autogenerateschema="true"
        type="MySql.Web.Security.MySQLMembershipProvider, MySql.Web, Version=6.0.4.0, Culture=neutral,
        connectionStringName="LocalMySqlServer"
        ... />
  </providers>
</membership>
```

Note

The connection string, `LocalMySqlServer`, connects to the MySQL server that contains the membership database.

The `autogenerateschema="true"` attribute will cause Connector/NET to silently create, or upgrade, the schema on the database server, to contain the required tables for storing membership information.

7. It is now necessary to create the connection string referenced in the previous step. Load the `web.config` file for the website into Visual Studio.
8. Locate the section marked `<connectionStrings>`. Add the following connection string information.

```
<connectionStrings>
  <remove name="LocalMySqlServer" />
  <add name="LocalMySqlServer"
    connectionString="Datasource=localhost;Database=users;uid=root;pwd=password"
    providerName="MySql.Data.MySqlClient" />
</connectionStrings>
```

The database specified is the one created in the first step. You could alternatively have used an existing database.

9. At this point build the solution to ensure no errors are present. This can be done by selecting **Build**, **Build Solution** from the main menu, or pressing **F6**.
10. ASP.NET supports the concept of locally and remotely authenticated users. With local authentication the user is validated using their Windows credentials when they attempt to access the website. This can be useful in an Intranet environment. With remote authentication, a user is prompted for their login details when accessing the website, and these credentials are checked

against the membership information stored in a database server such as MySQL Server. You will now see how to choose this form of authentication.

Start the ASP.NET Website Administration Tool. This can be done quickly by clicking the small hammer/Earth icon in the Solution Explorer. You can also launch this tool by selecting **Website** and then **ASP.NET Configuration** from the main menu.

11. In the ASP.NET Website Administration Tool click the **Security** tab and do the following:
 - a. Click the **User Authentication Type** link.
 - b. Select the **From the internet** option. The website will now need to provide a form to allow the user to enter their login details. The details will be checked against membership information stored in the MySQL database.
12. You now need to specify the role and membership provider to be used. Click the **Provider** tab and do the following:
 - a. Click the **Select a different provider for each feature (advanced)** link.
 - b. For membership provider, select the **MySQLMembershipProvider** option and for role provider, select the **MySQLRoleProvider** option.
13. In Visual Studio, rebuild the solution by clicking **Build** and then **Rebuild Solution** from the main menu.
14. Check that the necessary schema has been created. This can be achieved using `SHOW DATABASES;` and `SHOW TABLES;` the `mysql` command interpreter.

```
mysql> SHOW DATABASES;
+-----+
| Database      |
+-----+
| information_schema |
| mysql          |
| test           |
| users          |
| world          |
+-----+
5 rows in set (0.01 sec)

mysql> SHOW TABLES;
+-----+
| Tables_in_users |
+-----+
| my_aspnet_applications |
| my_aspnet_membership |
| my_aspnet_profiles   |
| my_aspnet_roles       |
| my_aspnet_schemaversion |
| my_aspnet_users       |
| my_aspnet_usersinroles |
+-----+
7 rows in set (0.00 sec)
```

15. Assuming all is present and correct, you can now create users and roles for your web application. The easiest way to do this is with the ASP.NET Website Administration Tool. However, many web applications contain their own modules for creating roles and users. For simplicity, the ASP.NET Website Administration Tool will be used in this tutorial.
16. In the ASP.NET Website Administration Tool, click the **Security** tab. Now that both the membership and role provider are enabled, you will see links for creating roles and users. Click the **Create or Manage Roles** link.
17. You can now enter the name of a new Role and click **Add Role** to create the new Role. Create new Roles as required.

18. Click the **Back** button.
19. Click the **Create User** link. You can now fill in information about the user to be created, and also allocate that user to one or more Roles.
20. Using the `mysql` command interpreter, you can check that your database has been correctly populated with the membership and role data.

```
mysql> SELECT * FROM my_aspnet_users;  
mysql> SELECT * FROM my_aspnet_roles;
```

In this tutorial, you have seen how to set up the Connector/NET membership and role providers for use in your ASP.NET web application.

4.6.3 Tutorial: Connector/NET ASP.NET Profile Provider

This tutorial shows you how to use the MySQL Profile Provider to store user profile information in a MySQL database. The tutorial uses MySQL Connector/NET 6.9.9, MySQL Server 5.7.21 and Microsoft Visual Studio 2017 Professional Edition.

Many modern websites allow the user to create a personal profile. This requires a significant amount of code, but ASP.NET reduces this considerable by including the functionality in its Profile classes. The Profile Provider provides an abstraction between these classes and a data source. The MySQL Profile Provider enables profile data to be stored in a MySQL database. This enables the profile properties to be written to a persistent store, and be retrieved when required. The Profile Provider also enables profile data to be managed effectively, for example it enables profiles that have not been accessed since a specific date to be deleted.

The following steps show you how you can select the MySQL Profile Provider:

1. Create a new ASP.NET web project.
2. Select the MySQL Application Configuration tool.
3. In the MySQL Application Configuration tool navigate through the tool to the Profiles page (see [Profiles Provider](#)).
4. Select the **Use MySQL to manage my profiles** check box.
5. Select the **Autogenerate Schema** check box.
6. Click **Edit** and then configure a connection string for the database that will be used to store user profile information.
7. Navigate to the last page of the tool and click **Finish** to save your changes and exit the tool.

At this point you are now ready to start using the MySQL Profile Provider. With the following steps you can carry out a preliminary test of your installation.

1. Open your `web.config` file.
2. Add a simple profile such as the following example.

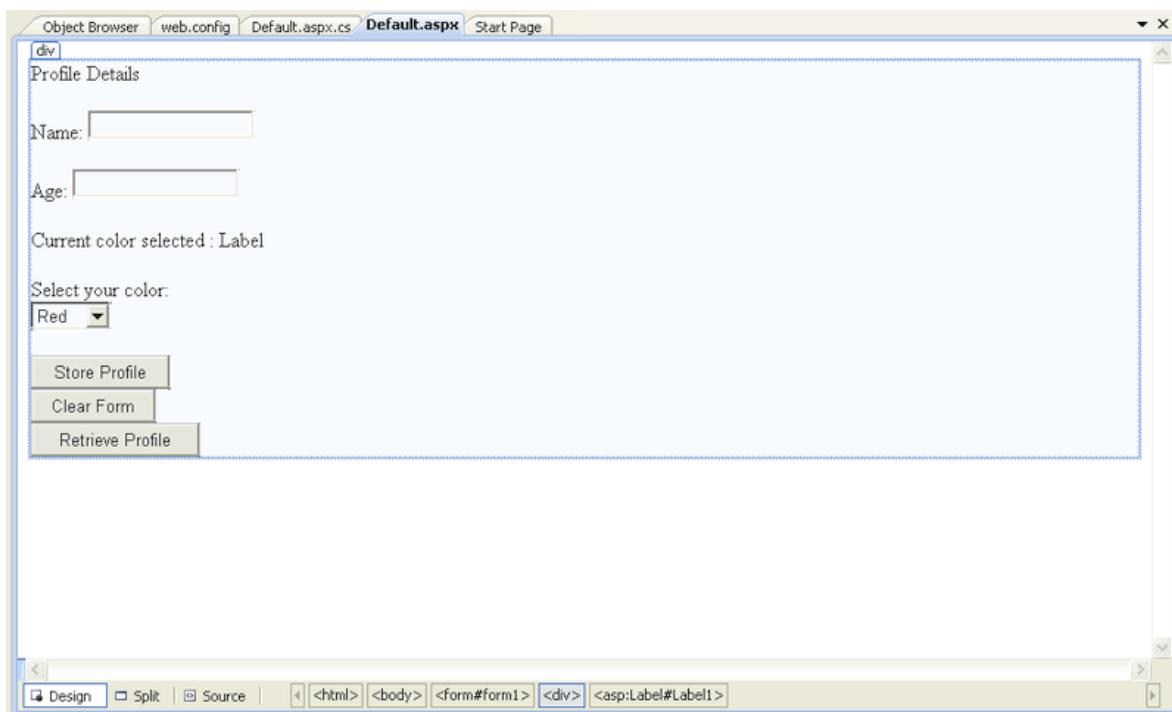
```
<system.web>  
  <anonymousIdentification enabled="true"/>  
  <profile defaultProvider="MySQLProfileProvider">  
    ...  
    <properties>  
      <add name="Name" allowAnonymous="true"/>  
      <add name="Age" allowAnonymous="true" type="System.UInt16"/>  
      <group name="UI">  
        <add name="Color" allowAnonymous="true" defaultValue="Blue"/>  
        <add name="Style" allowAnonymous="true" defaultValue="Plain"/>  
      </group>  
    </properties>  
  </profile>
```

Setting `anonymousIdentification` to true enables unauthenticated users to use profiles. They are identified by a GUID in a cookie rather than by a user name.

Now that the simple profile has been defined in `web.config`, the next step is to write some code to test the profile.

1. In Design View, design a simple page with the added controls. The following figure shows the **Default.aspx** tab open with various text box, list, and button controls.

Figure 4.2 Simple Profile Application



These will allow the user to enter some profile information. The user can also use the buttons to save their profile, clear the page, and restore their profile data.

2. In the Code View add the following code snippet.

```
...
protected void Page_Load(object sender, EventArgs e)
{
    if (!IsPostBack)
    {
        TextBox1.Text = Profile.Name;
        TextBox2.Text = Profile.Age.ToString();
        Label1.Text = Profile.UI.Color;
    }
}

// Store Profile
protected void Button1_Click(object sender, EventArgs e)
{
    Profile.Name = TextBox1.Text;
    Profile.Age = UInt16.Parse(TextBox2.Text);
}

// Clear Form
protected void Button2_Click(object sender, EventArgs e)
{
    TextBox1.Text = "";
    TextBox2.Text = "";
```

```

        Label1.Text = "";
    }

    // Retrieve Profile
protected void Button3_Click(object sender, EventArgs e)
{
    TextBox1.Text = Profile.Name;
    TextBox2.Text = Profile.Age.ToString();
    Label1.Text = Profile.UI.Color;
}

protected void DropDownList1_SelectedIndexChanged(object sender, EventArgs e)
{
    Profile.UI.Color = DropDownList1.SelectedValue;
}
...

```

3. Save all files and build the solution to check that no errors have been introduced.
4. Run the application.
5. Enter your name, age, and select a color from the list. Now store this information in your profile by clicking **Store Profile**.

Not selecting a color from the list uses the default color, *Blue*, that was specified in the `web.config` file.

6. Click **Clear Form** to clear text from the text boxes and the label that displays your chosen color.
7. Now click **Retrieve Profile** to restore your profile data from the MySQL database.
8. Now exit the browser to terminate the application.
9. Run the application again, which also restores your profile information from the MySQL database.

In this tutorial you have seen how to using the MySQL Profile Provider with Connector/.NET.

4.6.4 Tutorial: Web Parts Personalization Provider

MySQL Connector/.NET provides a web parts personalization provider that allows you to use a MySQL server to store personalization data.

Note

This feature was added in Connector/.NET 6.9.0.

This tutorial demonstrates how to configure the web parts personalization provider using Connector/.NET.

Minimum Requirements

- An ASP.NET website or web application with a membership provider
- .NET Framework 3.0
- MySQL 5.5

Configuring MySQL Web Parts Personalization Provider

To configure the provider, do the following:

1. Add References to `MySql.Data` and `MySql.Web` to the website or web application project.
2. Include a Connector/.NET personalization provider into the `system.web` section in the `web.config` file.

```

<webParts>
    <personalization defaultProvider="MySQLPersonalizationProvider">

```

```

<providers>
    <clear/>
    <add name="MySQLPersonalizationProvider"
        type="MySQL.Web.Personalization.MySQLPersonalizationProvider,
        MySQL.Web, Version=6.9.3.0, Culture=neutral,
        PublicKeyToken=c5687fc88969c44d"
        connectionStringName="LocalMySQLServer"
        applicationName="/" />
</providers>
<authorization>
    <allow verbs="modifyState" users="*" />
    <allow verbs="enterSharedScope" users="*" />
</authorization>
</personalization>
</webParts>

```

Creating Web Part Controls

To create the web part controls, follow these steps:

1. Create a web application using Connector/NET ASP.NET Membership. For information about doing this, see [Section 4.6.2, "Tutorial: Connector/NET ASP.NET Membership and Role Provider"](#).
2. Create a new ASP.NET page and then change to the Design view.
3. From the **Toolbox**, drag a **WebPartManager** control to the page.
4. Now define an HTML table with three columns and one row.
5. From the **WebParts Toolbox**, drag and drop a **WebPartZone** control into both the first and second columns.
6. From the **WebParts Toolbox**, drag and drop a **CatalogZone** with **PageCatalogPart** and **EditorZone** controls into the third column.
7. Add controls to the **WebPartZone**, which should look similar to the following example:

```

<table>
    <tr>
        <td>
            <asp:WebPartZone ID="LeftZone" runat="server" HeaderText="Left Zone">
                <ZoneTemplate>
                    <asp:Label ID="Label1" runat="server" title="Left Zone">
                        <asp:BulletedList ID="BulletedList1" runat="server">
                            <asp:ListItem Text="Item 1"></asp:ListItem>
                            <asp:ListItem Text="Item 2"></asp:ListItem>
                            <asp:ListItem Text="Item 3"></asp:ListItem>
                        </asp:BulletedList>
                    </asp:Label>
                </ZoneTemplate>
            </asp:WebPartZone>
        </td>
        <td>
            <asp:WebPartZone ID="MainZone" runat="server" HeaderText="Main Zone">
                <ZoneTemplate>
                    <asp:Label ID="Label11" runat="server" title="Main Zone">
                        <h2>This is the Main Zone</h2>
                    </asp:Label>
                </ZoneTemplate>
            </asp:WebPartZone>
        </td>
        <td>
            <asp:CatalogZone ID="CatalogZone1" runat="server">
                <ZoneTemplate>
                    <asp:PageCatalogPart ID="PageCatalogPart1" runat="server" />
                </ZoneTemplate>
            </asp:CatalogZone>
            <asp:EditorZone ID="EditorZone1" runat="server">
                <ZoneTemplate>
                    <asp:LayoutEditorPart ID="LayoutEditorPart1" runat="server" />
                </ZoneTemplate>
            </asp:EditorZone>
        </td>
    </tr>

```

```

        <asp:AppearanceEditorPart ID="AppearanceEditorPart1" runat="server" />
    </ZoneTemplate>
</asp:EditorZone>
</td>
</tr>
</table>

```

8. Outside of the HTML table, add a drop-down list, two buttons, and a label as follows.

```

<asp:DropDownList ID="DisplayModes" runat="server" AutoPostBack="True"
    OnSelectedIndexChanged="DisplayModes_SelectedIndexChanged">
</asp:DropDownList>
<asp:Button ID="ResetButton" runat="server" Text="Reset"
    OnClick="ResetButton_Click" />
<asp:Button ID="ToggleButton" runat="server" OnClick="ToggleButton_Click"
    Text="Toggle Scope" />
<asp:Label ID="ScopeLabel" runat="server"></asp:Label>

```

9. The following code fills the list for the display modes, shows the current scope, resets the personalization state, toggles the scope (between user and the shared scope), and changes the display mode.

```

public partial class WebPart : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        if (!IsPostBack)
        {
            foreach (WebPartDisplayMode mode in WebPartManager1.SupportedDisplayModes)
            {
                if (mode.IsEnabled(WebPartManager1))
                {
                    DisplayModes.Items.Add(mode.Name);
                }
            }
            ScopeLabel.Text = WebPartManager1.Personalization.Scope.ToString();
        }
    }

    protected void ResetButton_Click(object sender, EventArgs e)
    {
        if (WebPartManager1.Personalization.IsEnabled &&
            WebPartManager1.Personalization.IsModifiable)
        {
            WebPartManager1.Personalization.ResetPersonalizationState();
        }
    }

    protected void ToggleButton_Click(object sender, EventArgs e)
    {
        WebPartManager1.Personalization.ToggleScope();
    }

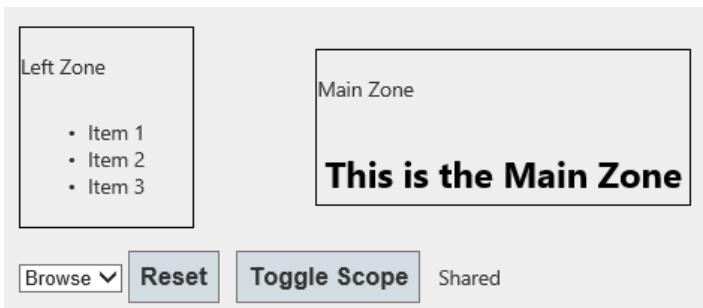
    protected void DisplayModes_SelectedIndexChanged(object sender, EventArgs e)
    {
        var mode = WebPartManager1.SupportedDisplayModes[DisplayModes.SelectedValue];
        if (mode != null && mode.IsEnabled(WebPartManager1))
        {
            WebPartManager1.DisplayMode = mode;
        }
    }
}

```

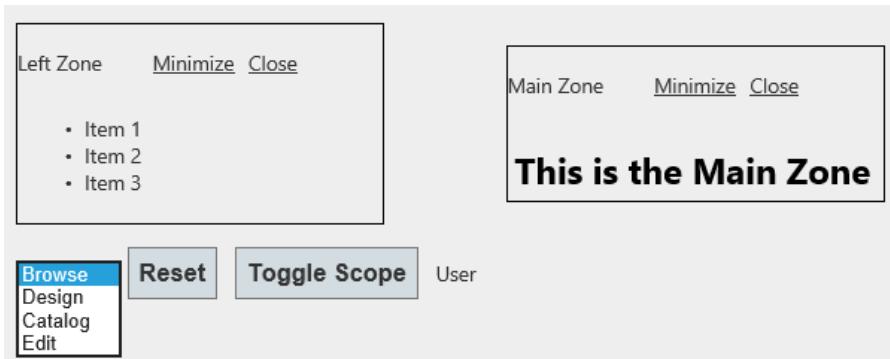
Testing Web Part Changes

Use the following steps to validate your changes:

1. Run the application and open the web part page. The page should look like similar to the example shown in the following figure in which the Toggle Scope button is set to **Shared**. The page also includes the drop-down list, the Reset button, and the Left Zone and Main Zone controls.

Figure 4.3 Web Parts Page

Initially when the user account is not authenticated, the scope is *Shared* by default. The user account must be authenticated to change settings on the web-part controls. The following figure shows an example in which an authenticated user is able to customize the controls by using the Browse drop-down list. The options in the list are [Design](#), [Catalog](#), and [Edit](#).

Figure 4.4 Authenticated User Controls

2. Click **Toggle Scope** to switch the application back to the shared scope.
3. Now you can personalize the zones using the [Edit](#) or [Catalog](#) display modes at a specific user or all-users level. The next figure shows [Catalog](#) selected from the drop-down list, which include the Catalog Zone control that was added previously.

Figure 4.5 Personalize Zones

4.6.5 Tutorial: Simple Membership Web Provider

This section documents the ability to use a simple membership provider on MVC 4 templates. The configuration OAuth compatible for the application to login using external credentials from third-party providers like Google, Facebook, Twitter, or others.

This tutorial creates an application using a simple membership provider and then adds third-party (Google) OAuth authentication support.

Note

This feature was added in MySQL Connector/NET 6.9.0.

Requirements

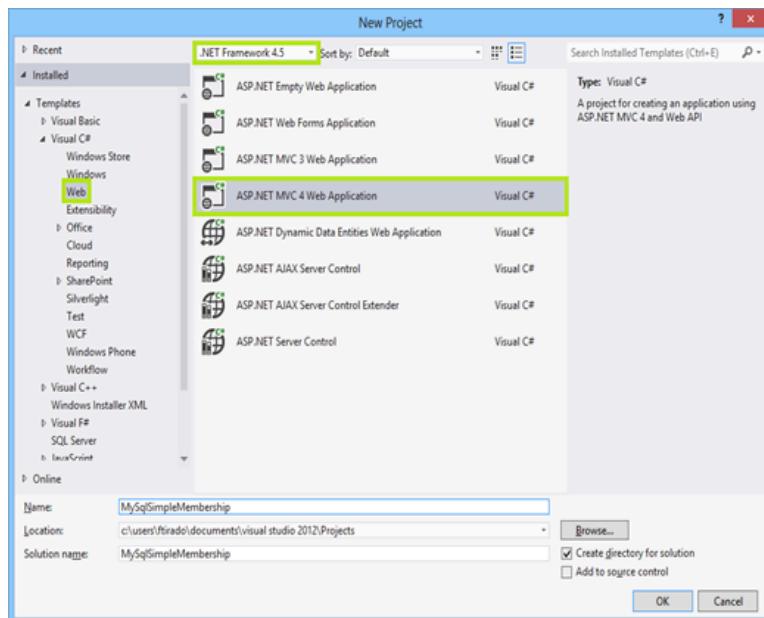
- Connector/NET 6.9.x or higher
- .NET Framework 4.0 or higher
- Visual Studio 2012 or higher
- MVC 4

Creating and Configuring a New Project

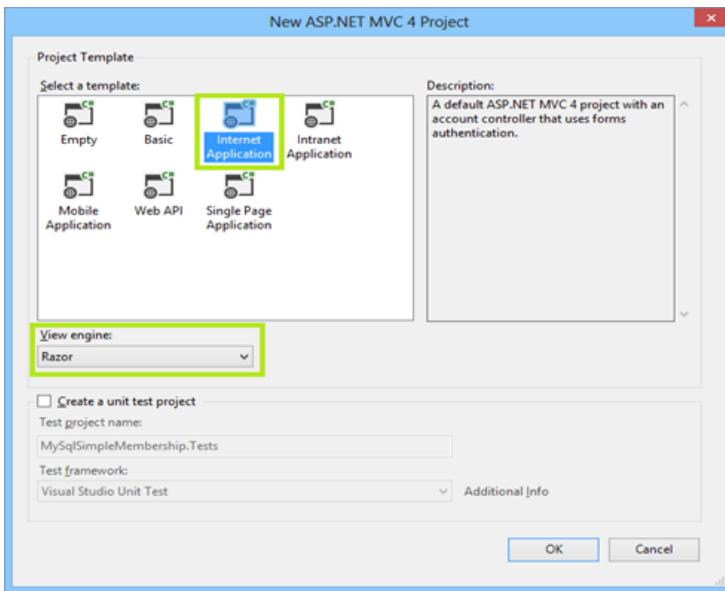
To get started with a new project, do the following:

1. Open Visual Studio, create a new project of **ASP.NET MVC 4 Web Application** type, and configure the project to use .NET Framework 4.5. The following figure shows and example of the New Project window with the items selected.

Figure 4.6 Simple Membership: New Project



2. Choose the template and view engine that you like. This tutorial uses the **Internet Application Template** with the Razor view engine (see the next figure). Optionally, you can add a unit test project by selecting **Create a unit test project**.

Figure 4.7 Simple Membership: Choose Template and Engine

3. Add references to the `MySQL.Data`, `MySQL.Data.Entities`, and `MySQL.Web` assemblies. The assemblies chosen must match the .NET Framework and Entity Framework versions added to the project by the template.
4. Add a valid MySQL connection string to the `web.config` file, similar to the following example.

```
<add
    name="MyConnection"
    connectionString="server=localhost;UserId=root;password=pass;database=MySqlSimpleMembership;logging=t
    providerName="MySQL.Data.MySqlClient" />
```

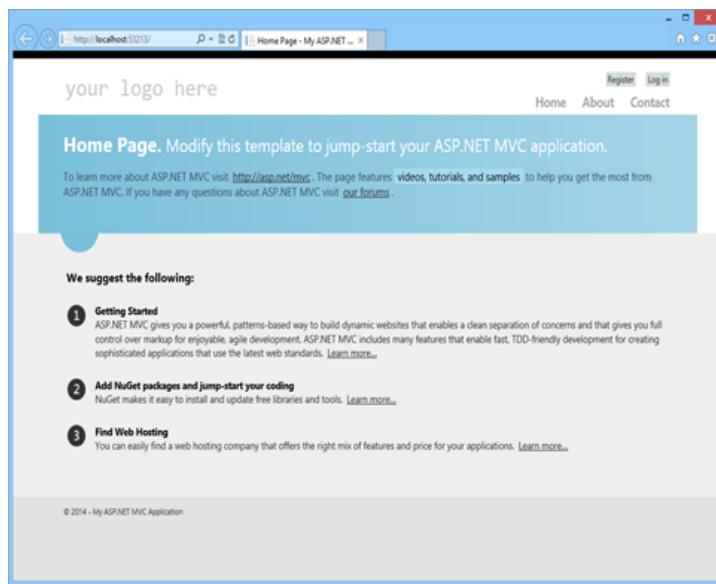
5. Under the `<system.data>` node, add configuration information similar to the following example.

```
<membership defaultProvider="MySqlSimpleMembershipProvider">
<providers>
<clear/>
<add
    name="MySqlSimpleMembershipProvider"
    type="MySQL.Web.Security.MySqlSimpleMembershipProvider,MySQL.Web,Version=6.9.2.0,Culture=neutral,Publ
    applicationName="MySqlSimpleMembershipTest"
    description="MySQLdefaultapplication"
    connectionStringName="MyConnection"
    userTableName="MyUserTable"
    userIdColumn="MyUserIdColumn"
    userNameColumn="MyUserNameColumn"
    autoGenerateTables="True" />
</providers>
</membership>
```

6. Update the configuration with valid values for the following properties: `connectionStringName`, `userTableName`, `userIdColumn`, `userNameColumn`, and `autoGenerateTables`.
 - `userTableName`: Name of the table to store the user information. This table is independent from the schema generated by the provider, and it can be changed in the future.
 - `userId`: Name of the column that stores the ID for the records in the `userTableName`.
 - `userName`: Name of the column that stores the name/user for the records in the `userTableName`.
 - `connectionStringName`: This property must match a connection string defined in `web.config` file.

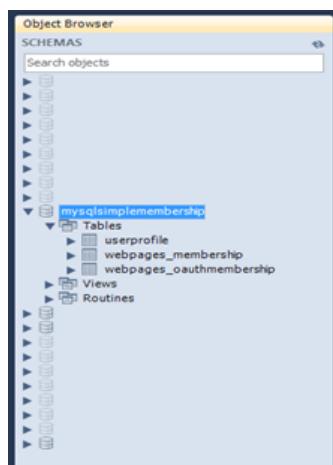
- `autoGenerateTables`: This must be set to `false` if the table to handle the credentials already exists.
7. Update your `DbContext` class with the connection string name configured.
 8. Open the `InitializeSimpleMembershipAttribute.cs` file from the `Filters/` folder and locate the `SimpleMembershipInitializer` class. Then find the `WebSecurity.InitializeDatabaseConnection` method call and update the parameters with the configuration for `connectionStringName`, `userTableName`, `userIdColumn`, and `userNameColumn`.
 9. If the database configured in the connection string does not exist, then create it.
 10. After running the web application, the generated home page is displayed on success (see the figure that follows).

Figure 4.8 Simple Membership: Generated Home Page



11. If the application executed with success, then the generated schema will be similar to the following figure showing an object browser open to the tables.

Figure 4.9 Simple Membership: Generated Schema and Tables



12. To create a user login, click **Register** on the generated web page. Type the user name and password, and then execute the registration form. This action redirects you to the home page with the newly created user logged in.

The data for the newly created user can be located in the `UserProfile` and `Webpages_Membership` tables.

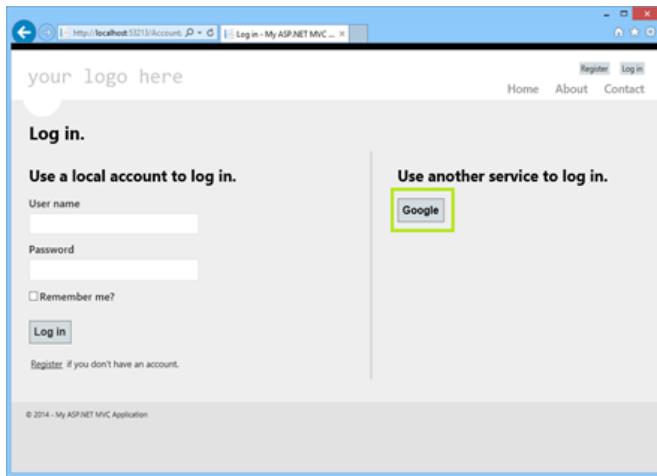
Adding OAuth Authentication to a Project

OAuth is another authentication option for websites that use the simple membership provider. A user can be validated using an external account like Facebook, Twitter, Google, and others.

Use the following steps to enable authentication using a Google account in the application:

1. Locate the `AuthConfig.cs` file in the `App_Start` folder.
2. As this tutorial uses Google, find the `RegisterAuth` method and uncomment the last line where it calls `OauthWebSecurity.RegisterGoogleClient`.
3. Run the application. When the application is running, click **Log in** to open the log in page. Then, click **Google** under **Use another service to log in** (shown in the figure that follows).

Figure 4.10 Simple Membership with OAuth: Google Service



4. This action redirects to the Google login page (at google.com), and requests you to sign in with your Google account information.
5. After submitting the correct credentials, a message requests permission for your application to access the user's information. Read the description and then click **Accept** to allow the quoted actions, and to redirect back to the login page of the application.
6. The application now can register the account. The **User name** field will be filled in with the appropriate information (in this case, the email address that is associated with the Google account). Click **Register** to register the user with your application.

Now the new user is logged into the application from an external source using OAuth. Information about the new user is stored in the `UserProfile` and `Webpages_OauthMembership` tables.

To use another external option to authenticate users, you must enable the client in the same class where we enabled the Google provider in this tutorial. Typically, providers require you to register your application before allowing OAuth authentication, and once registered they typically provide a token/key and an ID that must be used when registering the provider in the application.

4.6.6 Tutorial: Using an Entity Framework Entity as a Windows Forms Data Source

In this tutorial you will learn how to create a Windows Forms Data Source from an Entity in an Entity Data Model. This tutorial assumes that you have installed the [world](#) database sample, which can be downloaded from the [MySQL Documentation page](#). You can also find details on how to install the database on the same page.

Creating a New Windows Forms Application

The first step is to create a new Windows Forms application.

1. In Visual Studio, select **File**, **New**, and then **Project** from the main menu.
2. Choose the **Windows Forms Application** installed template. Click **OK**. The solution is created.

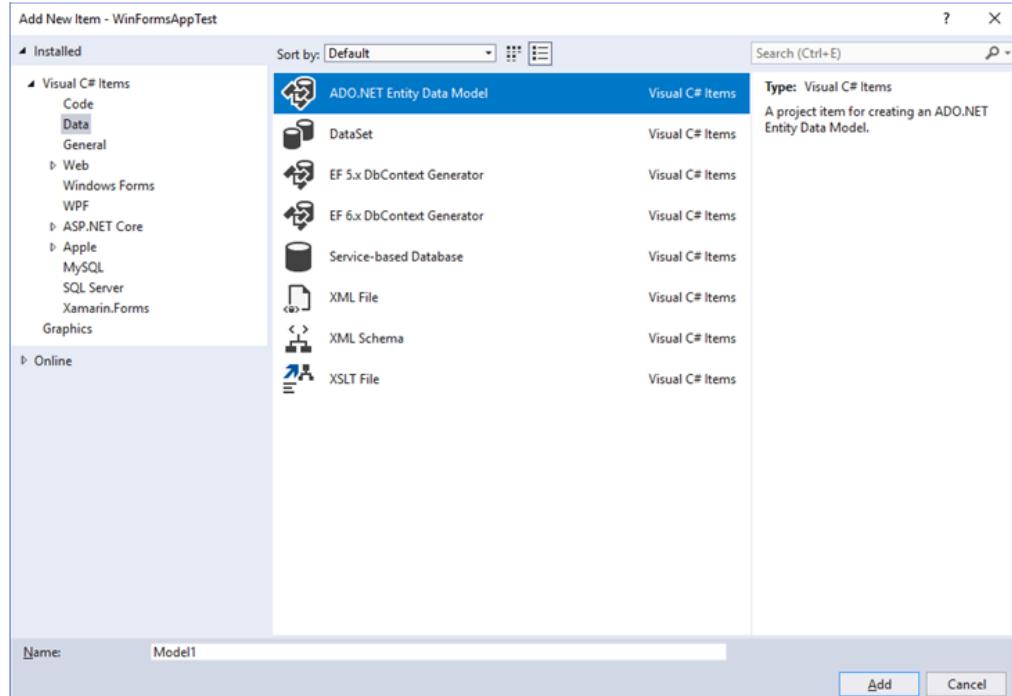
To acquire the latest Entity Framework assembly for MySQL, download the NuGet package. Alternatively, use the MySQL Application Configuration tool provided by MySQL for Visual Studio 1.2.9 (or higher) to acquire the latest package and coordinate the configuration. For more information about using the tool, see [Entity Framework](#).

Adding an Entity Data Model

To add an Entity Data Model to your solution, do the following:

1. In the Solution Explorer, right-click your application and select **Add** and then **New Item**. From **Visual Studio installed templates**, select **ADO.NET Entity Data Model** (see the figure that follows). Click **Add**.

Figure 4.11 Add Entity Data Model



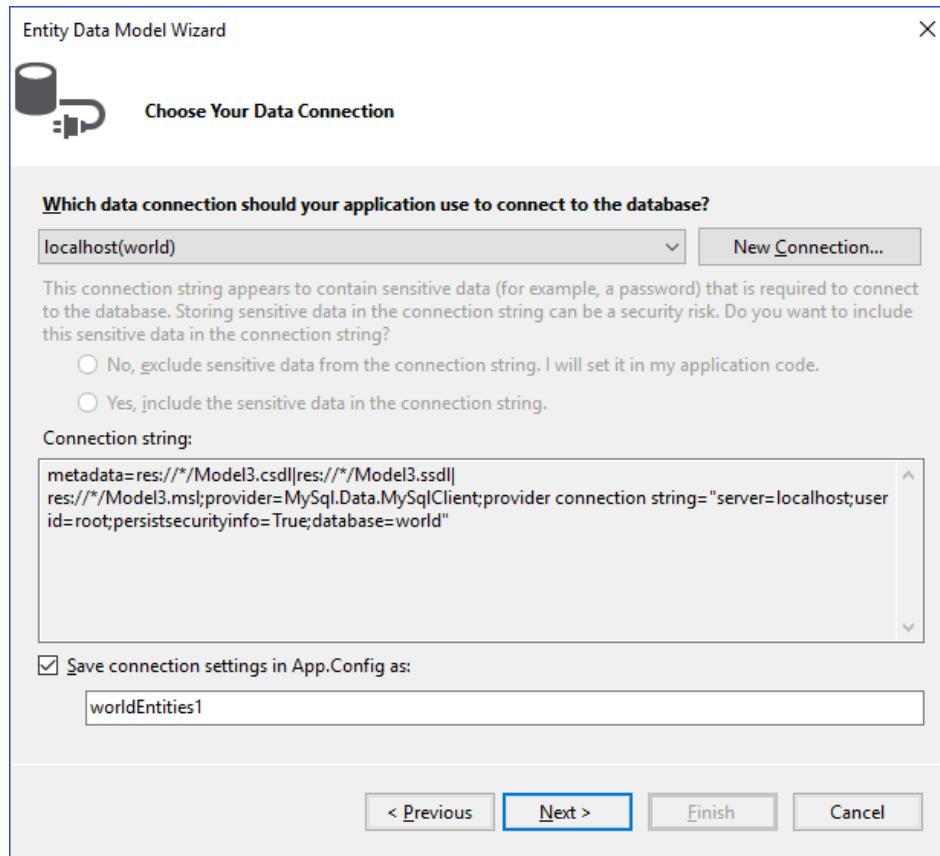
2. You will now see the Entity Data Model Wizard. You will use the wizard to generate the Entity Data Model from the [world](#) database sample. Select the icon **EF Designer from database** (or **Generate from database** in older versions of Visual Studio). Click **Next**.
3. You can now select the [localhost\(world\)](#) connection you made earlier to the database. Select the following items:

- Yes, include the sensitive data in the connection string.
- Save entity connection settings in App.config as:

worldEntities

If you have not already done so, you can create the new connection at this time by clicking **New Connection** (see the figure that follows). For additional instructions on creating a connection to a database see [Making a Connection](#).

Figure 4.12 Entity Data Model Wizard - Connection



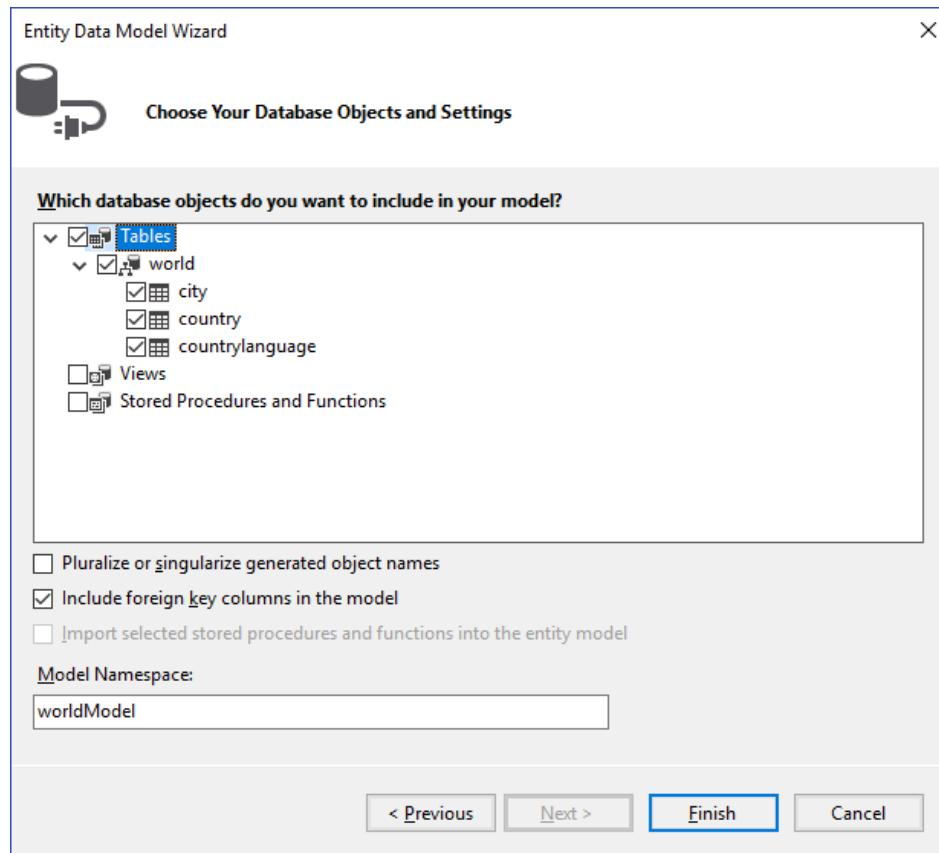
Make a note of the entity connection settings to be used in [App.Config](#), as these will be used later to write the necessary control code. Click **Next**.

4. The Entity Data Model Wizard connects to the database.

As the next figure shows, you are then presented with a tree structure of the database. From here you can select the object you would like to include in your model. If you also created Views and

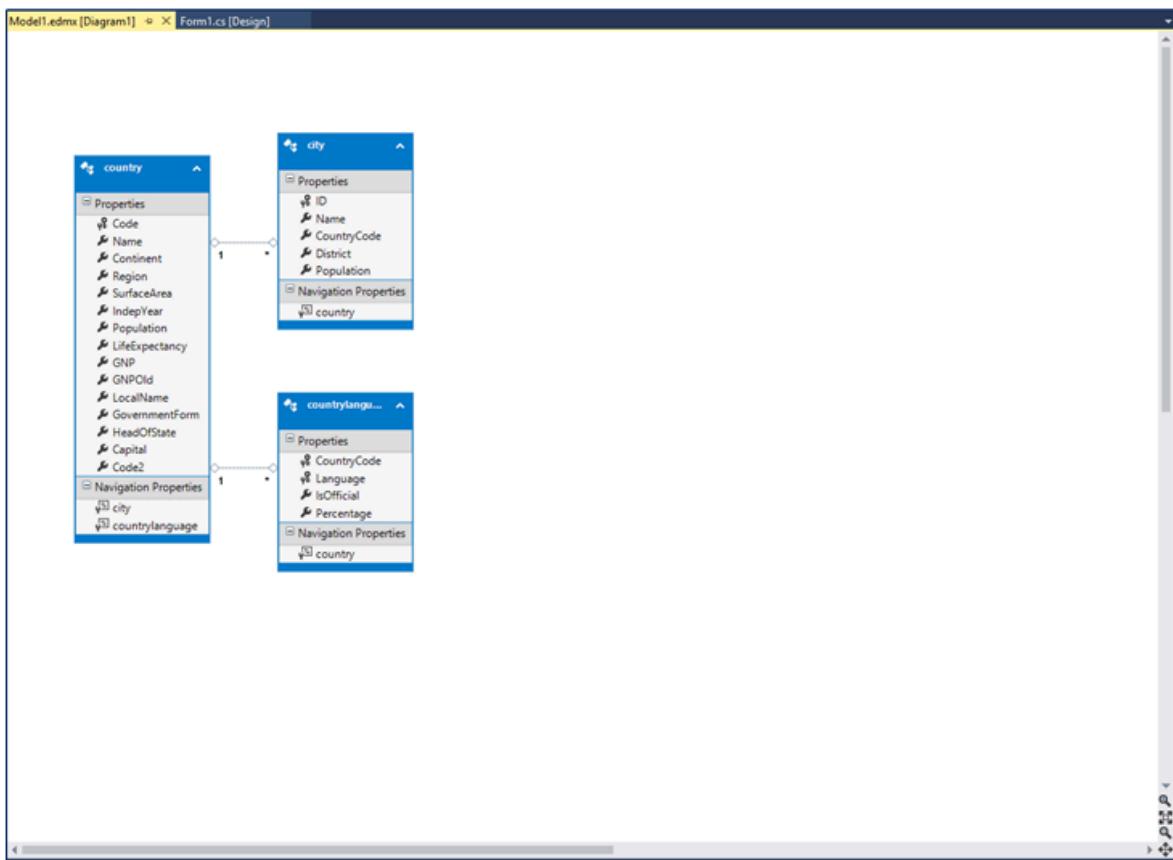
Stored Routines, these items will be displayed along with any tables. In this example you just need to select the tables. Click **Finish** to create the model and exit the wizard.

Figure 4.13 Entity Data Model Wizard - Objects and Settings



Visual Studio generates a model with three tables (city, country, and countrylanguage) and then display it, as the following figure shows.

Figure 4.14 Entity Data Model Diagram



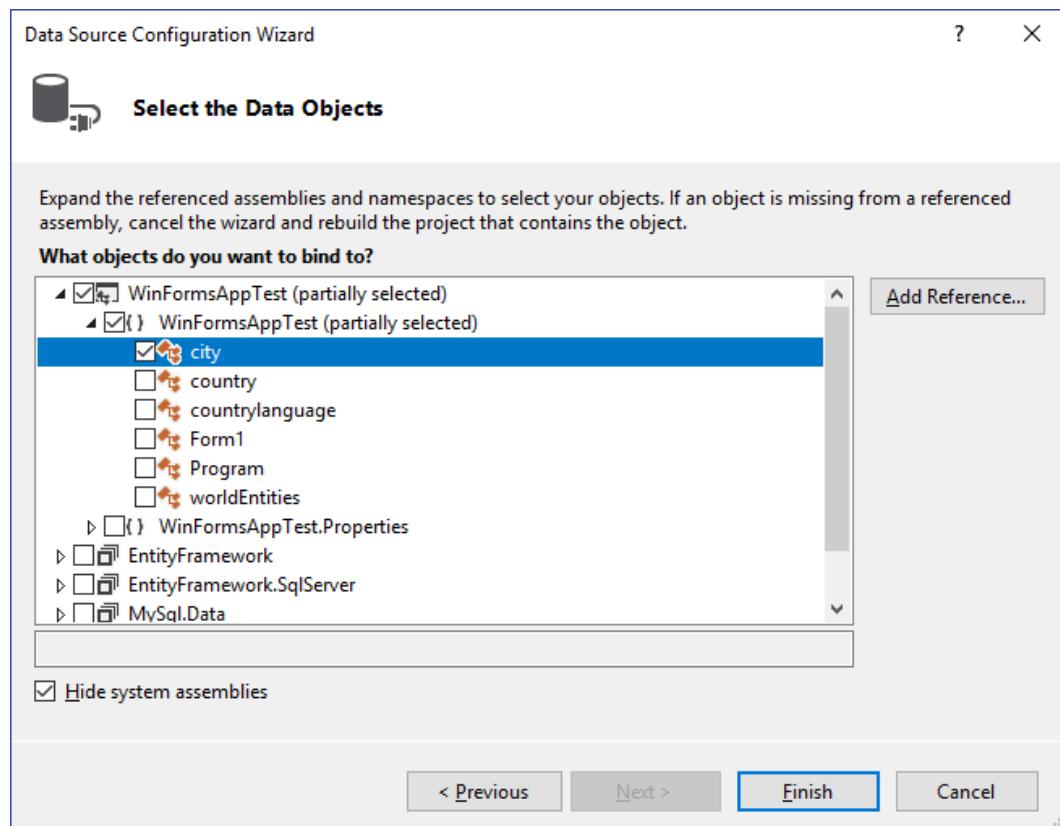
5. From the Visual Studio main menu, select **Build** and then **Build Solution** to ensure that everything compiles correctly so far.

Adding a new Data Source

You will now add a new Data Source to your project and see how it can be used to read and write to the database.

1. From the Visual Studio main menu select **Data** and then **Add New Data Source**. You will be presented with the Data Source Configuration Wizard.
2. Select the **Object** icon. Click **Next**.
3. Select the object to bind to. Expand the tree as the next figure shows.

In this tutorial, you will select the **city** table. After the **city** table has been selected click **Next**.

Figure 4.15 Data Source Configuration Wizard

4. The wizard will confirm that the city object is to be added. Click **Finish**.
5. The city object will now appear in the Data Sources panel. If the Data Sources panel is not displayed, select **Data** and then **Show Data Sources** from the Visual Studio main menu. The docked panel will then be displayed.

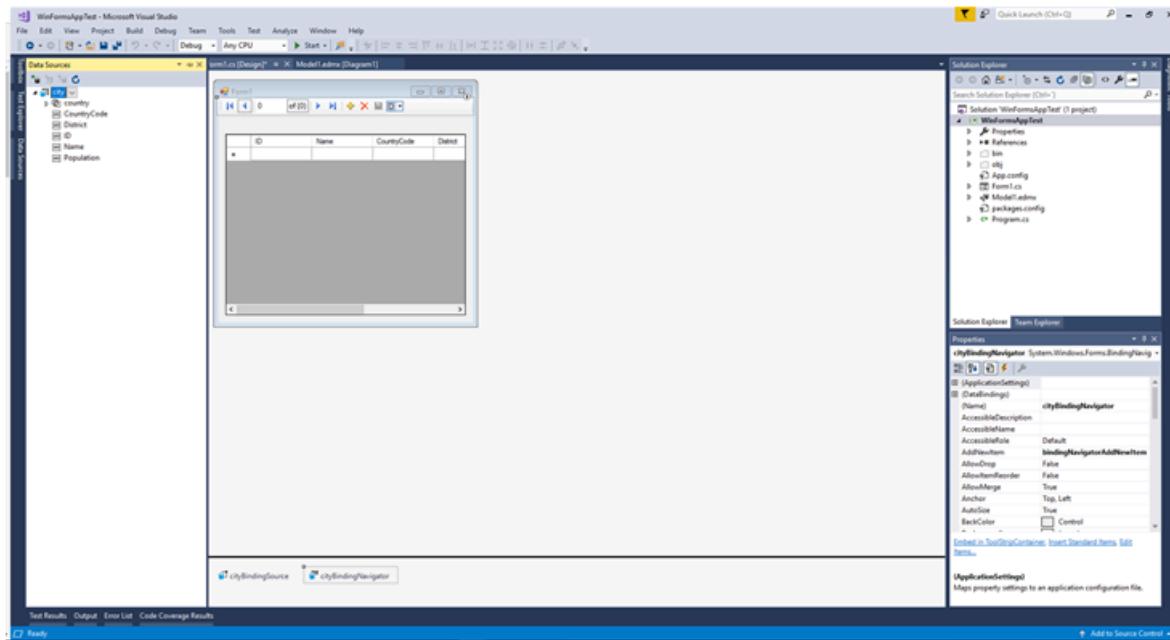
Using the Data Source in a Windows Form

This step describes how to use the Data Source in a Windows Form.

1. In the Data Sources panel select the Data Source you just created and drag and drop it onto the Form Designer. By default, the Data Source object will be added as a Data Grid View control as the following figure shows.

Note

The Data Grid View control is bound to `cityBindingSource`, and the Navigator control is bound to `cityBindingNavigator`.

Figure 4.16 Data Form Designer

2. Save and rebuild the solution before continuing.

Adding Code to Populate the Data Grid View

You are now ready to add code to ensure that the Data Grid View control will be populated with data from the city database table.

1. Double-click the form to access its code.
2. Add the following code to instantiate the Entity Data Model `EntityContainer` object and retrieve data from the database to populate the control.

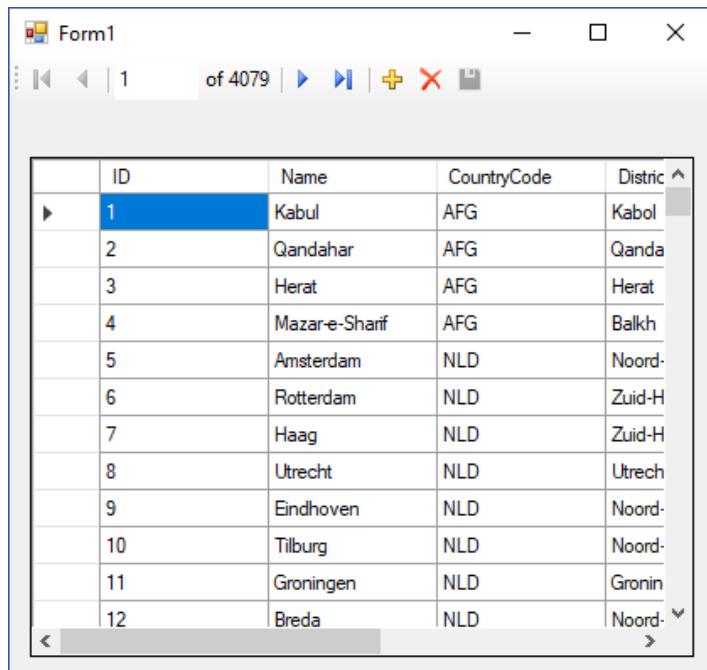
```
using System.Windows.Forms;

namespace WindowsFormsApplication4
{
    public partial class Form1 : Form
    {
        worldEntities we;

        public Form1()
        {
            InitializeComponent();
        }

        private void Form1_Load(object sender, EventArgs e)
        {
            we = new worldEntities();
            cityBindingSource.DataSource = we.city.ToList();
        }
    }
}
```

3. Save and rebuild the solution.
4. Run the solution. Confirm that the grid is populated (see the next figure for an example) and that you can navigate the database.

Figure 4.17 The Populated Grid Control

Adding Code to Save Changes to the Database

This step explains how to add code that enables you to save changes to the database.

The Binding source component ensures that changes made in the Data Grid View control are also made to the Entity classes bound to it. However, that data needs to be saved back from the entities to the database itself. This can be achieved by the enabling of the Save button in the Navigator control, and the addition of some code.

1. In the Form Designer, click the Save icon in the Form toolbar and confirm that its **Enabled** property is set to `True`.
2. Double-click the Save icon in the Form toolbar to display its code.
3. Add the following (or similar) code to ensure that data is saved to the database when a user clicks the save button in the application.

```
public Form1()
{
    InitializeComponent();
}

private void Form1_Load(object sender, EventArgs e)
{
    we = new worldEntities();
    cityBindingSource.DataSource = we.city.ToList();
}
private void cityBindingNavigatorSaveItem_Click(object sender, EventArgs e)
{
    we.SaveChanges();
}
```

4. When the code has been added, save the solution and then rebuild it. Run the application and verify that changes made in the grid are saved.

4.6.7 Tutorial: Data Binding in ASP.NET Using LINQ on Entities

In this tutorial you create an ASP.NET web page that binds LINQ queries to entities using the Entity Framework mapping with MySQL Connector/.NET.

If you have not already done so, install the [world](#) database sample prior to attempting this tutorial. See the tutorial [Section 4.6.6, “Tutorial: Using an Entity Framework Entity as a Windows Forms Data Source”](#) for instructions on downloading and installing this database.

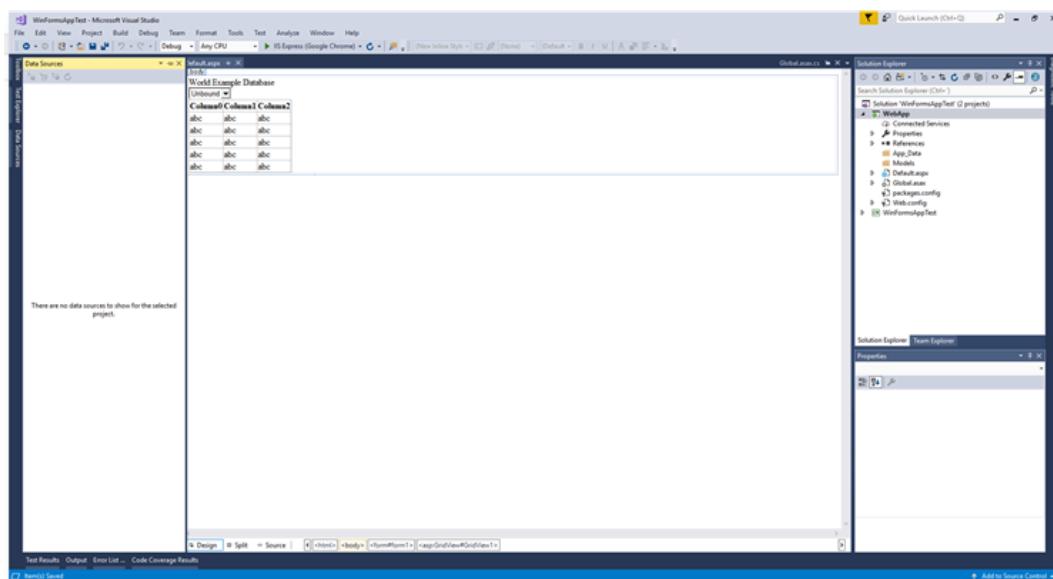
Creating an ASP.NET Website

In this part of the tutorial, you create an ASP.NET website. The website uses the [world](#) database. The main web page features a drop-down list from which you can select a country. Data about the cities of that country is then displayed in a GridView control.

1. From the Visual Studio main menu select **File**, **New**, and then **Web Site**.
2. From the Visual Studio installed templates select **ASP.NET Web Site**. Click **OK**. You will be presented with the Source view of your web page by default.
3. Click the Design view tab situated underneath the Source view panel.
4. In the Design view panel, enter some text to decorate the blank web page.
5. Click **Toolbox**. From the list of controls, select **DropDownList**. Drag and drop the control to a location beneath the text on your web page.
6. From the **DropDownList** control context menu, ensure that the **Enable AutoPostBack** check box is enabled. This will ensure the control's event handler is called when an item is selected. The user's choice will in turn be used to populate the **GridView** control.
7. From the Toolbox select the **GridView** control. Drag and drop the **GridView** control to a location just below the drop-down list you already placed.

The following figure shows an example of the decorative text and two controls in the Design view tab. The added GridView control produced a grid with three columns ([Column0](#), [Column1](#), and [Column3](#)) and the string [abc](#) in each cell of the grid.

Figure 4.18 Placed GridView Control



8. At this point it is recommended that you save your solution, and build the solution to ensure that there are no errors.

9. If you run the solution you will see that the text and drop down list are displayed, but the list is empty. Also, the grid view does not appear at all. Adding this functionality is described in the following sections.

At this stage you have a website that will build, but further functionality is required. The next step will be to use the Entity Framework to create a mapping from the `world` database into entities that you can control programmatically.

Creating an ADO.NET Entity Data Model

In this stage of the tutorial you will add an ADO.NET Entity Data Model to your project, using the `world` database at the storage level. The procedure for doing this is described in the tutorial [Section 4.6.6, "Tutorial: Using an Entity Framework Entity as a Windows Forms Data Source"](#), and so will not be repeated here.

Populating a List Box by Using the Results of a Entity LINQ Query

In this part of the tutorial you will write code to populate the **DropDownList** control. When the web page loads the data to populate the list will be achieved by using the results of a LINQ query on the model created previously.

1. In the Design view panel, double-click any blank area. This brings up the `Page_Load` method.
2. Modify the relevant section of code according to the following listing example.

```
...
public partial class _Default : System.Web.UI.Page
{
    worldModel.worldEntities we;

    protected void Page_Load(object sender, EventArgs e)
    {
        we = new worldModel.worldEntities();

        if (!IsPostBack)
        {
            var countryQuery = from c in we.country
                               orderby c.Name
                               select new { c.Code, c.Name };
            DropDownList1.DataValueField = "Code";
            DropDownList1.DataTextField = "Name";
            DropDownList1.DataSource = countryQuery.ToList();
            DataBind();
        }
    }
    ...
}
```

The list control only needs to be populated when the page first loads. The conditional code ensures that if the page is subsequently reloaded, the list control is not repopulated, which would cause the user selection to be lost.

3. Save the solution, build it and run it. You should see that the list control has been populated. You can select an item, but as yet the GridView control does not appear.

At this point you have a working Drop Down List control, populated by a LINQ query on your entity data model.

Populating a Grid View Control by Using an Entity LINQ Query

In the last part of this tutorial you will populate the Grid View Control using a LINQ query on your entity data model.

1. In the Design view, double-click the **DropDownList** control. This action causes its `SelectedIndexChanged` code to be displayed. This method is called when a user selects an item in the list control and thus generates an AutoPostBack event.

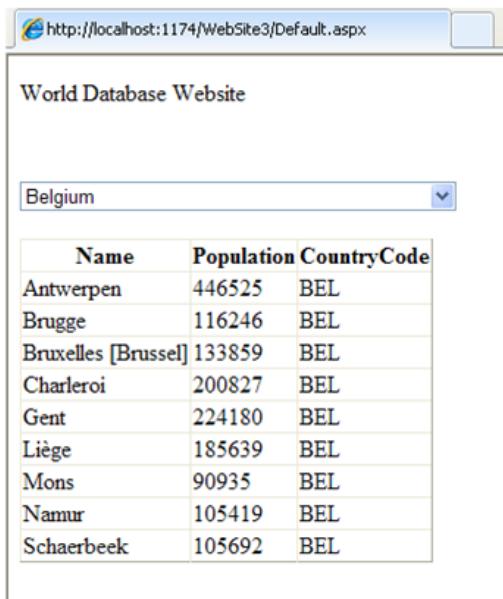
2. Modify the relevant section of code accordingly to the following listing example.

```
...
protected void DropDownList1_SelectedIndexChanged(object sender, EventArgs e)
{
    var cityQuery = from c in we.city
                    where c.CountryCode == DropDownList1.SelectedValue
                    orderby c.Name
                    select new { c.Name, c.Population, c.CountryCode };
    GridView1.DataSource = cityQuery;
    DataBind();
}
...
```

The grid view control is populated from the result of the LINQ query on the entity data model.

3. Save, build, and run the solution. As you select a country you will see its cities are displayed in the GridView control. The following figure shows Belgium selected from the list box and a table with three columns: **Name**, **Population**, and **CountryCode**.

Figure 4.19 The Working Website



In this tutorial you have seen how to create an ASP.NET website, you have also seen how you can access a MySQL database using LINQ queries on an entity data model.

4.6.8 Tutorial: Generating MySQL DDL from an Entity Framework Model

In this tutorial, you will learn how to create MySQL **DDL** from an Entity Framework model. Minimally, you will need Microsoft Visual Studio 2017 and MySQL Connector/.NET 6.10 to perform this tutorial.

1. Create a new console application in Visual Studio 2017.
2. Using the **Solution Explorer**, add a reference to [MySql.Data.Entity](#).
3. From the **Solution Explorer** select **Add, New Item**. In the **Add New Item** dialog select **Online Templates**. Select **ADO.NET Entity Data Model** and click **Add**. The **Entity Data Model** dialog will be displayed.
4. In the **Entity Data Model** dialog select **Empty Model**. Click **Finish**. A blank model will be created.
5. Create a simple model. A single Entity will do for the purposes of this tutorial.
6. In the **Properties** panel select **ConceptualEntityModel** from the drop-down list.

7. In the **Properties** panel, locate the **DDL Generation Template** in the category **Database Script Generation**.
8. For the **DDL Generation** property select **SSDLToMySQL.tt(VS)** from the drop-down list.
9. Save the solution.
10. Right-click an empty space in the model design area. The context-sensitive menu will be displayed.
11. From the context-sensitive menu select **Generate Database from Model**. The **Generate Database Wizard** dialog will be displayed.
12. In the **Generate Database Wizard** dialog select an existing connection, or create a new connection to a server. Select an appropriate radio button to show or hide sensitive data. For the purposes of this tutorial you can select **Yes** (although you might skip this for commercial applications).
13. Click **Next**. MySQL compatible DDL code will be generated. Click **Finish** to exit the wizard.

You have seen how to create MySQL DDL code from an Entity Framework model.

4.6.9 Tutorial: Basic CRUD Operations with Connector/NET

This tutorial provides instructions to get you started using MySQL as a document store with MySQL Connector/NET. For concepts and additional usage examples, see [X DevAPI User Guide](#).

Minimum Requirements

- MySQL Server 8.0.11 with X Protocol enabled
- Connector/NET 8.0.11
- Visual Studio 2013/2015/2017
- [world_x](#) database sample

Import the Document Store Sample

A MySQL script is provided with data and a JSON collection. The sample contains the following:

- Collection
 - countryinfo: Information about countries in the world.
- Tables
 - country: Minimal information about countries of the world.
 - city: Information about some of the cities in those countries.
 - countrylanguage: Languages spoken in each country.

To install the [world_x](#) database sample, follow these steps:

1. Download [world_x.zip](#) from <http://dev.mysql.com/doc/index-other.html>.
2. Extract the installation archive to a temporary location such as [/tmp/](#).
Unpacking the archive results in two files, one of them named [world_x.sql](#).
3. Connect to the MySQL server using the MySQL Client with the following command:

```
shell> mysql -u root -p
```

Enter your password when prompted. A non-root account can be used as long as the account has privileges to create new databases. For more information about using the MySQL Client, see [mysql — The MySQL Command-Line Client](#).

4. Execute the `world_x.sql` script to create the database structure and insert the data as follows:

```
mysql> SOURCE /temp/world_x.sql;
```

Replace `/temp/` with the path to the `world_x.sql` file on your system.

Add References to Required DLLs

Create a new Visual Studio Console Project targeting .NET Framework 4.5.2 (or later), .NET Core 1.1, or .NET Core 2.0. The code examples in this tutorial are shown in the C# language, but you can use any .NET language.

Add a reference in your project to the following DLLs:

- `MySql.Data.dll`
- `Google.Protobuf.dll`

Import Namespaces

Import the required namespaces by adding the following statements:

```
using MySqlX.XDevAPI;
using MySqlX.XDevAPI.Common;
using MySqlX.XDevAPI.CRUD;
```

Create a Session

A session in the X DevAPI is a high-level database session concept that is different from working with traditional low-level MySQL connections. It is important to understand that this session is not the same as a traditional MySQL session. Sessions encapsulate one or more actual MySQL connections.

The following example opens a session, which you can use later to retrieve a schema and perform basic CRUD operations.

```
string schemaName = "world_x";
// Define the connection string
string connectionURI = "mysqlx://test:test@localhost:33060";
Session session = MySQLX.GetSession(connectionURI);
// Get the schema object
Schema schema = session.GetSchema(schemaName);
```

Find a Row Within a Collection

After the session is instantiated, you can execute a find operation. The next example uses the session object that you created:

```
// Use the collection 'countryinfo'
var myCollection = schema.GetCollection("countryinfo");
var docParams = new DbDoc(new { name1 = "Albania", _id1 = "ALB" });

// Find a document
DocResult foundDocs = myCollection.Find("Name = :name1 || _id = :_id1").Bind(docParams).Execute();

while (foundDocs.Next())
{
    Console.WriteLine(foundDocs.Current["Name"]);
    Console.WriteLine(foundDocs.Current["_id"]);
}
```

Insert a New Document into a Collection

```
//Insert a new document with an identifier
var obj = new { _id = "UKN", Name = "Unknown" };
Result r = myCollection.Add(obj).Execute();
```

Update an Existing Document

```
// using the same docParams object previously created
docParams = new DbDoc(new { name1 = "Unknown", _id1 = "UKN" });
r = myCollection.Modify("_id = :Id").Bind("id", "UKN").Set("GNP", "3308").Execute();
if (rAffectedItemsCount == 1)
{
    foundDocs = myCollection.Find("Name = :name1 || _id = :_id1").Bind(docParams).Execute();
    while (foundDocs.Next())
    {
        Console.WriteLine(foundDocs.Current["Name"]);
        Console.WriteLine(foundDocs.Current["_id"]);
        Console.WriteLine(foundDocs.Current["GNP"]);
    }
}
```

Delete a Specific Document

```
r = myCollection.Remove("_id = :id").Bind("id", "UKN").Execute();
```

Close the Session

```
session.Close();
```

Complete Code Example

The following example shows the basic operations that you can perform with a collection.

```
using MySqlX.XDevAPI;
using MySqlX.XDevAPI.Common;
using MySqlX.XDevAPI.CRUD;
using System;

namespace MySQLX_Tutorial
{
    class Program
    {
        static void Main(string[] args)
        {

            string schemaName = "world_x";
            string connectionURI = "mysqlx://test:test@localhost:33060";
            Session session = MySQLX.GetSession(connectionURI);
            Schema schema = session.GetSchema(schemaName);

            // Use the collection 'countryinfo'
            var myCollection = schema.GetCollection("countryinfo");
            var docParams = new DbDoc(new { name1 = "Albania", _id1 = "ALB" });

            // Find a document
            DocResult foundDocs = myCollection.Find("Name = :name1 || _id = :_id1").Bind(docParams).Execute();

            while (foundDocs.Next())
            {
                Console.WriteLine(foundDocs.Current["Name"]);
                Console.WriteLine(foundDocs.Current["_id"]);
            }

            //Insert a new document with an id
            var obj = new { _id = "UKN", Name = "Unknown" };
            Result r = myCollection.Add(obj).Execute();

            //update an existing document
            docParams = new DbDoc(new { name1 = "Unknown", _id1 = "UKN" });
            r = myCollection.Modify("_id = :Id").Bind("id", "UKN").Set("GNP", "3308").Execute();
```

```
if (rAffectedItemCount == 1)
{
    foundDocs = myCollection.Find("Name = :name1 || _id = :_id1").Bind(docParams).Execute();
    while (foundDocs.Next())
    {
        Console.WriteLine(foundDocs.Current["Name"]);
        Console.WriteLine(foundDocs.Current["_id"]);
        Console.WriteLine(foundDocs.Current["GNP"]);
    }
}

// delete a row in a document
r = myCollection.Remove("_id = :id").Bind("id", "UKN").Execute();

//close the session
session.Close();

Console.ReadKey();

}
}
```

4.6.10 Tutorial: Configuring SSL with Connector/NET

In this tutorial you will learn how you can use MySQL Connector/.NET to connect to a MySQL server configured to use SSL. Support for SSL client PFX certificates was added to the Connector/.NET 6.2 release series. PFX is the native format of certificates on Microsoft Windows. More recently, support for SSL client PEM certificates was added in the Connector/.NET 8.0.16 release.

MySQL Server uses the PEM format for certificates and private keys. Connector/NET enables the use of either PEM or PFX certificates with both classic MySQL protocol and X Protocol. This tutorial uses the test certificates from the server test suite by way of example. You can obtain the MySQL Server source code from [MySQL Downloads](#). The certificates can be found in the `./mysql-test/std_data` directory.

To apply the server-side startup configuration for SSL connections:

1. In the MySQL Server configuration file, set the SSL parameters as shown in the follow PEM format example. Adjust the directory paths according to the location in which you installed the MySQL source code.

```
ssl-ca=path/to/repo/mysql-test/std_data/cacert.pem  
ssl-cert=path/to/repo/mysql-test/std_data/server-cert.pem  
ssl-key=path/to/repo/mysql-test/std_data/server-key.pem
```

The `SslCa` connection option accepts both PEM and PFX format certificates, using the file extension to determine how to process certificates. Change `cacert.pem` to `cacert.pfx` if you intend to continue with the PFX portion of this tutorial.

For a description of the connection string options used in this tutorial, see [Section 4.4.5, "Connector/NET 8.0 Connection Options Reference"](#).

2. Create a test user account to use in this tutorial and set the account to require SSL. Using the MySQL Command-Line Client, connect as `root` and create the user `sslclient` (with `test` as the account password). Then, grant all privileges to the new user account as follows:

```
CREATE USER sslclient@'%' IDENTIFIED BY 'test' REQUIRE SSL;  
  
GRANT ALL PRIVILEGES ON *.* TO sslclient@'%';
```

For detailed information about account-management strategies, see [Access Control and Account Management](#).

Now that the server-side configuration is finished, you can begin the client-side configuration using either PEM or PFX format certificates in Connector/NET.

4.6.10.1 Using PEM Certificates in Connector/.NET

The direct use of PEM format certificates was introduced to simplify certificate management in multiplatform environments that include similar MySQL products. In previous versions of Connector/.NET, your only choice was to use platform-dependent PFX format certificates.

For this example, use the test client certificates from the MySQL server repository (`server-repository-root/mysql-test/std_data`). In your application, add a connection string using the `test` database and the `sslclient` user account (created previously). For example:

1. Set the `SslMode` connection option to the level of security needed. PEM certificates are only validated for `VerifyCA` and `VerifyFull` SSL mode values. All other mode values ignore certificates even if they are provided.

```
using (MySqlConnection connection = new MySqlConnection(  
    "database=test;user=sslclient;" +  
    "SslMode=VerifyFull")
```

2. Add the appropriate SSL certificates. Because this tutorial sets the `SslMode` option to `VerifyFull`, you must also provide values for the `SslCa`, `SslCert`, and `SslKey` connection options. Each option must point to a file with the `.pem` file extension.

```
"SslCa=ca.pem;" +  
"SslCert=client-cert.pem;" +  
"SslKey=client-key.pem;" )
```

Alternatively, if you set the SSL mode to `VerifyCA`, only the `SslCa` connection option is required.

3. Open a connection. The following example opens a connection using the classic MySQL protocol, but you can perform a similar test using X Protocol.

```
using (MySqlConnection connection = new MySqlConnection(  
    "database=test;user=sslclient;" +  
    "SslMode=VerifyFull" +  
    "SslCa=ca.pem;" +  
    "SslCert=client-cert.pem;" +  
    "SslKey=client-key.pem;" )  
  
{  
    connection.Open();  
}
```

Errors found when processing the PEM certificates will result in an exception being thrown. For additional information, see [Command Options for Encrypted Connections](#).

4.6.10.2 Using PFX Certificates in Connector/.NET

.NET does not provide native support the PEM format. Instead, Windows includes a certificate store that provides platform-dependent certificates in PFX format. For the purposes of this example, use test client certificates from the MySQL server repository (`./mysql-test/std_data`). Convert these to PFX format first. This format is also known as PKCS#12.

To complete the steps in this tutorial for PFX certificates, you must have Open SSL installed. This can be downloaded for Microsoft Windows at no charge from [Shining Light Productions](#).

Creating a Certificate File to Use with the .NET Client

1. From the directory `server-repository-root/mysql-test/std_data`, issue the following command.

```
openssl pkcs12 -export -in client-cert.pem -inkey client-key.pem -certfile cacert.pem -out client.pfx
```

2. When asked for an export password, enter the password “pass”. The file `client.pfx` will be generated. This file is used in the remainder of the tutorial.

Connecting to the Server Using a File-Based Certificate

1. You will use the PFX file, `client.pfx`, that you created in the previous step to authenticate the client. The following example demonstrates how to connect using the `SslMode`, `CertificateFile`, and `CertificatePassword` connection string options.

```
using (MySqlConnection connection = new MySqlConnection(
    "database=test;user=sslclient;" +
    "CertificateFile=H:\\\\git\\\\mysql-trunk\\\\mysql-test\\\\std_data\\\\client.pfx;" +
    "CertificatePassword=pass;" +
    "SslMode=Required"))

{
    connection.Open();
}
```

The path to the certificate file will need to be changed to reflect your individual installation. When using PFX format certificates, the `SslMode` connection option validates certificates for all SSL mode values, except `None`.

Connecting to the Server Using a Store-Based Certificate

1. The first step is to import the PFX file, `client.pfx`, into the Personal Store. Double-click the file in Windows explorer. This launches the Certificate Import Wizard.
2. Follow the steps dictated by the wizard, and when prompted for the password for the PFX file, enter "pass".
3. Click **Finish** to close the wizard and import the certificate into the personal store.

Examining Certificates in the Personal Store

1. Start the Microsoft Management Console by entering `mmc.exe` at a command prompt.
2. Select **File**, **Add/Remove snap-in**. Click **Add**. Select **Certificates** from the list of available snap-ins in the dialog.
3. Click **Add** button in the dialog, and select the **My user account** radio button. This is used for personal certificates.
4. Click the **Finish** button.
5. Click **OK** to close the Add/Remove Snap-in dialog.
6. You will now have **Certificates – Current User** displayed in the left panel of the Microsoft Management Console. Expand the Certificates - Current User tree item and select **Personal, Certificates**. The right panel will display a certificate issued to MySQL. This is the certificate that was previously imported. Double-click the certificate to display its details.
7. After you have imported the certificate to the Personal Store, you can use a more succinct connection string to connect to the database, as illustrated by the following code:

```
using (MySqlConnection connection = new MySqlConnection(
    "database=test;user=sslclient;" +
    "Certificate Store Location=CurrentUser;" +
    "SslMode=Required"))

{
    connection.Open();
}
```

Certificate Thumbprint Parameter

If you have a large number of certificates in your store, and many have the same Issuer, this can be a source of confusion and result in the wrong certificate being used. To alleviate this situation, there is an optional Certificate Thumbprint parameter that can additionally be specified as part of the connection

string. As mentioned before, you can double-click a certificate in the Microsoft Management Console to display the certificate's details. When the Certificate dialog is displayed click the **Details** tab and scroll down to see the thumbprint. The thumbprint will typically be a number such as #47 94 36 00 9a 40 f3 01 7a 14 5c f8 47 9e 76 94 d7 aa de f0. This thumbprint can be used in the connection string, as the following code illustrates:

```
using (MySqlConnection connection = new MySqlConnection(
    "database=test;user=sslclient;" +
    "Certificate Store Location=CurrentUser;" +
    "Certificate Thumbprint=479436009a40f3017a145cf8479e7694d7aadef0;" +
    "SSL Mode=Required"))
{
    connection.Open();
}
```

Spaces in the thumbprint parameter are optional and the value is not case-sensitive.

4.6.11 Tutorial: Using MySqlScript

This tutorial teaches you how to use the [MySqlScript](#) class. This class enables you to execute a series of statements. Depending on the circumstances, this can be more convenient than using the [MySqlCommand](#) approach.

Further details of the [MySqlScript](#) class can be found in the reference documentation supplied with MySQL Connector/NET.

To run the example programs in this tutorial, set up a simple test database and table using the [mysql](#) Command-Line Client or MySQL Workbench. Commands for the [mysql](#) Command-Line Client are given here:

```
CREATE DATABASE TestDB;
USE TestDB;
CREATE TABLE TestTable (id INT NOT NULL PRIMARY KEY
    AUTO_INCREMENT, name VARCHAR(100));
```

The main method of the [MySqlScript](#) class is the [Execute](#) method. This method causes the script (sequence of statements) assigned to the [Query](#) property of the [MySqlScript](#) object to be executed. The [Query](#) property can be set through the [MySqlScript](#) constructor or by using the [Query](#) property. [Execute](#) returns the number of statements executed.

The [MySqlScript](#) object will execute the specified script on the connection set using the [Connection](#) property. Again, this property can be set directly or through the [MySqlScript](#) constructor. The following code snippets illustrate this:

```
string sql = "SELECT * FROM TestTable";
...
MySqlScript script = new MySqlScript(conn, sql);
...
MySqlScript script = new MySqlScript();
script.Query = sql;
script.Connection = conn;
...
script.Execute();
```

The [MySqlScript](#) class has several events associated with it. There are:

1. Error - generated if an error occurs.
2. ScriptCompleted - generated when the script successfully completes execution.
3. StatementExecuted - generated after each statement is executed.

It is possible to assign event handlers to each of these events. These user-provided routines are called back when the connected event occurs. The following code shows how the event handlers are set up.

```
script.Error += new MySqlScriptErrorHandler(script_Error);
```

```
script.ScriptCompleted += new EventHandler(script_ScriptCompleted);
script.StatementExecuted += new MySqlStatementExecutedEventHandler(script_StatementExecuted);
```

In VisualStudio, you can save typing by using tab completion to fill out stub routines. Start by typing, for example, “script.Error +=”. Then press **TAB**, and then press **TAB** again. The assignment is completed, and a stub event handler created. A complete working example is shown below:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

using System.Data;
using MySql.Data;
using MySql.Data.MySqlClient;

namespace MySqlScriptTest
{
    class Program
    {
        static void Main(string[] args)
        {
            string connStr = "server=localhost;user=root;database=TestDB;port=3306;password=*****";
            MySqlConnection conn = new MySqlConnection(connStr);

            try
            {
                Console.WriteLine("Connecting to MySQL...");
                conn.Open();

                string sql = "INSERT INTO TestTable(name) VALUES ('Superman');" +
                             "INSERT INTO TestTable(name) VALUES ('Batman');" +
                             "INSERT INTO TestTable(name) VALUES ('Wolverine');" +
                             "INSERT INTO TestTable(name) VALUES ('Storm');";

                MySqlScript script = new MySqlScript(conn, sql);

                script.Error += new MySqlScriptErrorEventHandler(script_Error);
                script.ScriptCompleted += new EventHandler(script_ScriptCompleted);
                script.StatementExecuted += new MySqlStatementExecutedEventHandler(script_StatementExecuted);

                int count = script.Execute();

                Console.WriteLine("Executed " + count + " statement(s).");
                Console.WriteLine("Delimiter: " + script.Delimiter);
            }
            catch (Exception ex)
            {
                Console.WriteLine(ex.ToString());
            }

            conn.Close();
            Console.WriteLine("Done.");
        }

        static void script_StatementExecuted(object sender, MySqlScriptEventArgs args)
        {
            Console.WriteLine("script_StatementExecuted");
        }

        static void script_ScriptCompleted(object sender, EventArgs e)
        {
            // EventArgs e will be EventArgs.Empty for this method
            Console.WriteLine("script_ScriptCompleted!");
        }

        static void script_Error(Object sender, MySqlScriptErrorEventArgs args)
        {
            Console.WriteLine("script_Error: " + args.Exception.ToString());
        }
    }
}
```

In the `script_ScriptCompleted` event handler, the `EventArgs` parameter `e` will be `EventArgs.Empty`. In the case of the `ScriptCompleted` event there is no additional data to be obtained, which is why the event object is `EventArgs.Empty`.

Using Delimiters with MySqlScript

Depending on the nature of the script, you may need control of the delimiter used to separate the statements that will make up a script. The most common example of this is where you have a multi-statement stored routine as part of your script. In this case if the default delimiter of ";" is used you will get an error when you attempt to execute the script. For example, consider the following stored routine:

```
CREATE PROCEDURE test_routine()
BEGIN
    SELECT name FROM TestTable ORDER BY name;
    SELECT COUNT(name) FROM TestTable;
END
```

This routine actually needs to be executed on the MySQL Server as a single statement. However, with the default delimiter of ";", the `MySqlScript` class would interpret the above as two statements, the first being:

```
CREATE PROCEDURE test_routine()
BEGIN
    SELECT name FROM TestTable ORDER BY name;
```

Executing this as a statement would generate an error. To solve this problem `MySqlScript` supports the ability to set a different delimiter. This is achieved through the `Delimiter` property. For example, you could set the delimiter to "??", in which case the above stored routine would no longer generate an error when executed. Multiple statements can be delimited in the script, so for example, you could have a three statement script such as:

```
string sql = "DROP PROCEDURE IF EXISTS test_routine???" +
    "CREATE PROCEDURE test_routine() " +
    "BEGIN " +
    "SELECT name FROM TestTable ORDER BY name;" +
    "SELECT COUNT(name) FROM TestTable;" +
    "END???" +
    "CALL test_routine();"
```

You can change the delimiter back at any point by setting the `Delimiter` property. The following code shows a complete working example:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

using MySql.Data;
using MySql.Data.MySqlClient;

namespace ConsoleApplication8
{
    class Program
    {
        static void Main(string[] args)
        {
            string connStr = "server=localhost;user=root;database=TestDB;port=3306;password=*****";
            MySqlConnection conn = new MySqlConnection(connStr);

            try
            {
                Console.WriteLine("Connecting to MySQL...");
                conn.Open();

                string sql = "DROP PROCEDURE IF EXISTS test_routine???" +
                    "CREATE PROCEDURE test_routine() " +
                    "BEGIN " +
                    "SELECT name FROM TestTable ORDER BY name;" +
                    "SELECT COUNT(name) FROM TestTable;" +
                    "END???" +
                    "CALL test_routine();"
            }
        }
    }
}
```

```

        "SELECT COUNT(name) FROM TestTable;" +
        "END???" +
        "CALL test_routine();"

    MySqlScript script = new MySqlScript(conn);

    script.Query = sql;
    script.Delimiter = "??";
    int count = script.Execute();
    Console.WriteLine("Executed " + count + " statement(s)");
    script.Delimiter = ";";
    Console.WriteLine("Delimiter: " + script.Delimiter);
    Console.WriteLine("Query: " + script.Query);
}
catch (Exception ex)
{
    Console.WriteLine(ex.ToString());
}

conn.Close();
Console.WriteLine("Done..");
}
}

```

4.7 Connector/NET for Windows Store

Starting with version 6.7, MySQL Connector/NET fully supports building .NET for Windows 8.x Store apps (Windows RT Store apps). Windows Store applications are based on .NET Framework, but use a very restrictive subset of that functionality. The main difference is the complete lack of the ADO.NET data subsystem.

The following differences exist between the standard library and the RT library (`MySql.Data.RT.dll`) in Connector/NET 6.7:

- No support for `MySqlDataAdapter`, `MySqlCommand` and `MySqlDataReader` are supported.
 - Connector/.NET RT library does not support SSL connections or Windows authentication. Also, SHA256 is not currently supported.
 - Connector/.NET RT library only supports TCP connections. Named pipe and shared memory connections are not supported.
 - Connector/.NET RT library does not support tracing.

This version of Connector/NET is no longer supported.

- Connector/NET RT library does not support load balancing. Command and Exception interceptors are supported.

This version of Connector/NET is no longer supported.

- `MySqlConnection.GetSchema` methods do not return `DataTable` types. Instead, they return a new object called `MySqlSchemaCollection`. You can query this object for the schema information. Standard Connector/NET includes support for returning schema information in both `DataTable` and `MySqlSchemaCollection` format.

This version of Connector/NET is no longer supported.

- Some constructors and other APIs on supported classes may have been removed or altered. Any API that used `DataTable`, `DataSet`, or `DataRow` has been altered or removed.

This version of Connector/NET is no longer supported.

Using the Connector/NET RT library is easy. Simply create a Windows Store application using Microsoft Visual Studio and then reference the `MySql.Data.RT.dll` assembly in your project. The

code you write should be exactly the same as for the standard Connector/.NET library (including using the same `MySql.Data.MySqlClient` namespace), except for the differences listed in this section.

4.8 Connector/.NET for Entity Framework

Entity Framework is the name given to a set of technologies that support the development of data-oriented software applications. MySQL Connector/.NET supports Entity Framework 6.x (EF6) and Entity Framework Core (EF Core), which is the most recent framework available to .NET developers who work with MySQL data using .NET objects.

The following table shows the set of Connector/.NET versions that support Entity Framework features.

Table 4.3 Connector/.NET Versions and Entity Framework Support

Connector/.NET Version	EF6	EF Core
8.0	Full support	EF Core 2.1: Full support in 8.0.13 and higher. EF Core 2.0: Partial support in 8.0.8 to 8.0.12 (<i>No scaffolding</i>).
6.10	Full support	EF Core 2.0: Full support in 6.10.8 and higher. Partial support in 6.10.5 to 6.10.7 (<i>No scaffolding</i>). EF Core 1.1: Full support in 6.10.4 and higher; otherwise, partially supported.

4.8.1 Entity Framework 6 Support

MySQL Connector/.NET integrates support for Entity Framework 6.0 (EF6). This chapter describes how to configure and use the EF6 features that are implemented in Connector/.NET.

In this section:

- [Requirements for EF6](#)
- [Configuration](#)
- [EF6 Features](#)
- [Code First Features](#)
- [Example for Using EF6](#)

Requirements for EF6

- Connector/.NET 6.10.x or 8.0.x
- MySQL Server 5.6 or higher
- Entity Framework 6 assemblies
- .NET Framework 4.0 or higher (.NET Framework 4.5.1 or higher is required for Connector/.NET 6.10 and 8.0)

Configuration

To configure Connector/.NET support for EF6:

1. Edit the configuration sections in the `app.config` file to add the connection string and the Connector/.NET provider for EF6:

```

<connectionStrings>
    <add name="MyContext" providerName=" MySql.Data.MySqlClient "
        connectionString="server=localhost;port=3306;database=mycontext;uid=root;password=*****" />
</connectionStrings>
<entityFramework>
    <defaultConnectionFactory type="System.Data.Entity.Infrastructure.SqlConnectionFactory, EntityFrame
    <providers>
        <provider invariantName=" MySql.Data.MySqlClient "
            type=" MySql.Data.MySqlClient.MySqlProviderServices, MySql.Data.Entity.EF6" />
        <provider invariantName=" System.Data.SqlClient "
            type=" System.Data.Entity.SqlServer.SqlProviderServices, EntityFramework.SqlServer" />
    </providers>
</entityFramework>

```

2. Apply the reference for `MySql.Data.Entity` automatically or manually as follows:

- Install the `MySql.Data.Entity` NuGet package to add this reference automatically within `app.config` or `web.config` file during the installation. For more information about the `MySql.Data.Entity` NuGet package and its uses, see <https://www.nuget.org/packages/MySql.Data.Entity/>.

Proceed to step 3.

- Otherwise, add a reference for the `MySql.Data.Entity.EF6` assembly to your project. Depending on the .NET Framework version used, the assembly is taken from either the `v4.0` or the `v4.5` folder).

Unless Connector/NET was installed with the standalone MSI or MySQL Installer, which adds the reference, insert the following data provider information into the `app.config` or `web.config` file:

```

<system.data>
    <DbProviderFactories>
        <remove invariant=" MySql.Data.MySqlClient " />
        <add name="MySQL Data Provider" invariant=" MySql.Data.MySqlClient " description=".Net Framework D
            type=" MySql.Data.MySqlClient.MySqlClientFactory, MySql.Data, Version=8.0.10.0, Culture=neut
        </DbProviderFactories>
    </system.data>

```

Important

Always update the version number to match the one in the `MySql.Data.dll` assembly.

3. Set the new `DbConfiguration` class for MySQL. This step is optional but highly recommended, because it adds all the dependency resolvers for MySQL classes. This can be done in three ways:

- Adding the `DbConfigurationTypeAttribute` on the context class:

```
[DbConfigurationType(typeof(MySqlEFConfiguration))]
```

- Calling `DbConfiguration.SetConfiguration(new MySqlEFConfiguration())` at the application start up.

- Set the `DbConfiguration` type in the configuration file:

```
<entityFramework codeConfigurationType=" MySql.Data.Entity.MySqlEFConfiguration, MySql.Data.Entity.EF6"
```

It is also possible to create a custom `DbConfiguration` class and add the dependency resolvers needed.

EF6 Features

Following are the new features in Entity Framework 6 implemented in Connector/NET:

- *Async Query and Save* adds support for the task-based asynchronous patterns that have been introduced since .NET 4.5. The new asynchronous methods supported by Connector/NET are:
 - `ExecuteNonQueryAsync`
 - `ExecuteScalarAsync`
 - `PrepareAsync`
- *Connection Resiliency / Retry Logic* enables automatic recovery from transient connection failures. To use this feature, add to the `OnModelCreating` method:

```
SetExecutionStrategy(MySqlProviderInvariantName.ProviderName, () => new MySqlExecutionStrategy());
```

- *Code-Based Configuration* gives you the option of performing configuration in code, instead of performing it in a configuration file, as it has been done traditionally.
- *Dependency Resolution* introduces support for the Service Locator. Some pieces of functionality that can be replaced with custom implementations have been factored out. To add a dependency resolver, use:

```
AddDependencyResolver(new MySqlDependencyResolver());
```

The following resolvers can be added:

- `DbProviderFactory -> MySqlClientFactory`
- `IDbConnectionFactory -> MySqlConnectionFactory`
- `MigrationSqlGenerator -> MySqlMigrationSqlGenerator`
- `DbProviderServices -> MySqlProviderServices`
- `IProviderInvariantName -> MySqlProviderInvariantName`
- `IDbProviderFactoryResolver -> MySqlProviderFactoryResolver`
- `IManifestTokenResolver -> MySqlManifestTokenResolver`
- `IDbModelCacheKey -> MySqlModelCacheKeyFactory`
- `IDbExecutionStrategy -> MySqlExecutionStrategy`
- *Interception/SQL logging* provides low-level building blocks for interception of Entity Framework operations with simple SQL logging built on top:

```
myContext.Database.Log = delegate(string message) { Console.WriteLine(message); };
```

- *DbContext* can now be created with a *DbContext* that is already opened, which enables scenarios where it would be helpful if the connection could be open when creating the context (such as sharing a connection between components when you cannot guarantee the state of the connection)

```
[DbConfigurationType(typeof(MySqlEFConfiguration))]
class JourneyContext : DbContext
{
    public DbSet<MyPlace> MyPlaces { get; set; }

    public JourneyContext()
        : base()
    {

    }

    public JourneyContext(DbConnection existingConnection, bool contextOwnsConnection)
```

```
    : base(existingConnection, contextOwnsConnection)
    {
    }

using (MySqlConnection conn = new MySqlConnection("<connectionString>"))
{
    conn.Open();
    ...

    using (var context = new JourneyContext(conn, false))
    {
        ...
    }
}
```

- *Improved Transaction Support* provides support for a transaction external to the framework as well as improved ways of creating a transaction within the Entity Framework. Starting with Entity Framework 6, `Database.ExecuteSqlCommand()` will wrap by default the command in a transaction if one was not already present. There are overloads of this method that allow users to override this behavior if wished. Execution of stored procedures included in the model through APIs such as `ObjectContext.ExecuteFunction()` does the same. It is also possible to pass an existing transaction to the context.
- `DbSet.AddRange/RemoveRange` provides an optimized way to add or remove multiple entities from a set.

Code First Features

Following are new Code First features supported by Connector/.NET:

- *Code First Mapping to Insert/Update/Delete Stored Procedures* supported:

```
modelBuilder.Entity<EntityType>().MapToStoredProcedures();
```

- *Idempotent migrations scripts* allow you to generate an SQL script that can upgrade a database at any version up to the latest version. To do so, run the `Update-Database -Script -SourceMigration: $InitialDatabase` command in Package Manager Console.
- *Configurable Migrations History Table* allows you to customize the definition of the migrations history table.

Example for Using EF6

The following C# code example represents the structure of an Entity Framework 6 model.

```
using MySql.Data.Entity;
using System.Data.Common;
using System.Data.Entity;

namespace EF6
{
    // Code-Based Configuration and Dependency resolution
    [DbConfigurationType(typeof(MySqlEFConfiguration))]
    public class Parking : DbContext
    {
        public DbSet<Car> Cars { get; set; }

        public Parking()
            : base()
        {

        }

        // Constructor to use on a DbConnection that is already opened
        public Parking(DbConnection existingConnection, bool contextOwnsConnection)
            : base(existingConnection, contextOwnsConnection)
        {
        }
}
```

```

    }

    protected override void OnModelCreating(DbModelBuilder modelBuilder)
    {
        base.OnModelCreating(modelBuilder);
        modelBuilder.Entity<Car>().MapToStoredProcedures();
    }
}

public class Car
{
    public int CarId { get; set; }

    public string Model { get; set; }

    public int Year { get; set; }

    public string Manufacturer { get; set; }
}

```

The C# code example that follows shows how to use the entities from the previous model in an application that stores the data within a MySQL table.

```

using MySql.Data.MySqlClient;
using System;
using System.Collections.Generic;

namespace EF6
{
    class Example
    {
        public static void ExecuteExample()
        {
            string connectionString = "server=localhost;port=3305;database=parking;uid=root";

            using (MySqlConnection connection = new MySqlConnection(connectionString))
            {
                // Create database if not exists
                using (Parking contextDB = new Parking(connection, false))
                {
                    contextDB.Database.CreateIfNotExists();
                }

                connection.Open();
                MySqlTransaction transaction = connection.BeginTransaction();

                try
                {
                    // DbConnection that is already opened
                    using (Parking context = new Parking(connection, false))
                    {

                        // Interception/SQL logging
                        context.Database.Log = (string message) => { Console.WriteLine(message); };

                        // Passing an existing transaction to the context
                        context.Database.UseTransaction(transaction);

                        // DbSet.AddRange
                        List<Car> cars = new List<Car>();

                        cars.Add(new Car { Manufacturer = "Nissan", Model = "370Z", Year = 2012 });
                        cars.Add(new Car { Manufacturer = "Ford", Model = "Mustang", Year = 2013 });
                        cars.Add(new Car { Manufacturer = "Chevrolet", Model = "Camaro", Year = 2012 });
                        cars.Add(new Car { Manufacturer = "Dodge", Model = "Charger", Year = 2013 });

                        context.Cars.AddRange(cars);

                        context.SaveChanges();
                    }
                }
            }
        }
    }
}

```

```
        transaction.Commit();  
    }  
    catch  
    {  
        transaction.Rollback();  
        throw;  
    }  
}  
}  
}  
}
```

4.8.2 Entity Framework Core Support

MySQL Connector/.NET integrates support for Entity Framework Core (EF Core). The requirements and configuration of EF Core depend on the version of Connector/.NET installed and the features that you require. Use the table that follows to evaluate the requirements.

Table 4.4 Supported versions of Entity Framework Core

Connector/.NET	EF Core 1.1	EF Core 2.0	EF Core 2.1
8.0.18	Not supported	Not supported	.NET Standard 2.0 or .NET Framework 4.6.1 (and later)
8.0.13	.NET Standard 1.6 or .NET Framework 4.5.2	Not supported	.NET Standard 2.0 or .NET Framework 4.6.1 (and later)
8.0.11 to 8.0.12	.NET Standard 1.6 or .NET Framework 4.5.2 (and later)	.NET Standard 2.0 only (.NET Framework is not supported) <i>Scaffolding is not supported</i>	Not supported
6.10.8	.NET Standard 1.3 or .NET Framework 4.5.2	.NET Standard 2.0 or .NET Framework 4.6.1 (and later)	Not supported
6.10.5 to 6.10.7	.NET Standard 1.3 or .NET Framework 4.5.2 (and later)	.NET Standard 2.0 only (.NET Framework is not supported) <i>Scaffolding is not supported</i>	Not supported
6.10.4	.NET Standard 1.3 or .NET Framework 4.5.2 (and later)	Not supported	Not supported

In this section:

- Minimum Requirements for EF Core Support
 - Configuration with MySQL
 - Limitations
 - Maximum String Length

Minimum Requirements for EF Core Support

- Connector/.NET 6.10 or 8.0 (see [Table 4.4, “Supported versions of Entity Framework Core”](#))
 - MySQL Server 5.7

- Entity Framework Core (see [Table 4.4, “Supported versions of Entity Framework Core”](#))
- .NET (see [Table 4.4, “Supported versions of Entity Framework Core”](#))
- .NET Core SDK
 - **Microsoft Windows:** <https://www.microsoft.com/net/core#windowscmd>
 - **Linux:** <https://www.microsoft.com/net/core#linuxredhat>
 - **macOS:** <https://www.microsoft.com/net/core#macos>
 - **Docker:** <https://www.microsoft.com/net/core#dockercmd>
- Optional: Microsoft Visual Studio 2015, 2017, or Code

Note

For EF Core 2.1, Visual Studio 2017 version 15.7 is the minimum.

Configuration with MySQL

To use Entity Framework Core with a MySQL database, do the following:

1. Install the [MySql.Data.EntityFrameworkCore](#) NuGet package.
For EF Core 1.1 only: If you plan to scaffold a database, install the [MySql.Data.EntityFrameworkCore.Design](#) NuGet package as well.

All packages will install the additional packages required to run your application. For instructions on adding a NuGet package, see the relevant [Microsoft documentation](#).

2. In the class that derives from the [DbContext](#) class, override the [OnConfiguring](#) method to set the MySQL data provider with [UseMySQL](#). The following example shows how to set the provider using a generic connection string in C#.

```
protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)
{
    #warning To protect potentially sensitive information in your connection string,
    // you should move it out of source code. See http://go.microsoft.com/fwlink/?LinkId=723263
    // for guidance on storing connection strings.

    optionsBuilder.UseMySQL("server=localhost;database=library;user=user;password=password");
}
```

Limitations

The Connector/.NET implementation of EF Core has the following limitations:

- Memory-Optimized Tables is not supported.

Maximum String Length

The following table shows the maximum length of string types supported by the Connector/.NET implementation of EF Core. Length values are in bytes for nonbinary and binary string types, depending on the character set used.

Table 4.5 Maximum Length of strings used with Entity Framework Core

Data Type	Maximum Length	.NET Type
CHAR	255	string
BINARY	255	byte[]
VARCHAR , VARBINARY	65,535	string , byte[]
TINYBLOB , TINYTEXT	255	byte[]

Data Type	Maximum Length	.NET Type
BLOB, TEXT	65,535	<code>byte[]</code>
MEDIUMBLOB, MEDIUMTEXT	16,777,215	<code>byte[]</code>
LONGBLOB, LONGTEXT	4,294,967,295	<code>byte[]</code>
ENUM	65,535	<code>string</code>
SET	65,535	<code>string</code>

For additional information about the storage requirements of the string types, see [String Type Storage Requirements](#).

4.8.2.1 Creating a Database with Code First in EF Core

The Code First approach enables you to define an entity model in code, create a database from the model, and then add data to the database. The data added by the application is also retrieved by the application using MySQL Connector/.NET.

The following example shows the process of creating a database from existing code. Although this example uses the C# language, you can execute it on Windows, macOS, or Linux.

1. Create a console application for this example.

- a. Initialize a valid .NET Core project and console application using the .NET Core command-line interface (CLI) and then switch to the newly created folder (`mysqlefcore`).

```
dotnet new console -o mysqlefcore
cd mysqlefcore
```

- b. Add the `MySql.Data.EntityFrameworkCore` package to the application using the CLI as follows:

```
dotnet add package MySql.Data.EntityFrameworkCore --version 6.10.8
```

Alternatively, you can use the **Package Manager Console** in Visual Studio to add the package.

```
Install-Package MySql.Data.EntityFrameworkCore -Version 6.10.8
```

Note

The version (for example, `6.10.8`) must match the actual Connector/.NET version you are using. For current version information, see [Table 4.4, “Supported versions of Entity Framework Core”](#).

- c. Restore dependencies and project-specific tools that are specified in the project file as follows:

```
dotnet restore
```

2. Create the model and run the application.

The model in this EF Core example will be used by the console application. It consists of two entities related to a book library, which will be configured in the `LibraryContext` class (or database context).

- a. Create a new file named `LibraryModel.cs` and then add the following `Book` and `Publisher` classes to the `mysqlefcore` namespace.

```
namespace mysqlefcore
{
    public class Book
    {
        public string ISBN { get; set; }
        public string Title { get; set; }
```

```

        public string Author { get; set; }
        public string Language { get; set; }
        public int Pages { get; set; }
        public virtual Publisher Publisher { get; set; }
    }

    public class Publisher
    {
        public int ID { get; set; }
        public string Name { get; set; }
        public virtual ICollection<Book> Books { get; set; }
    }
}

```

- b. Create a new file named `LibraryContext.cs` and add the code that follows. Replace the generic connection string with one that is appropriate for your MySQL server configuration.

The `LibraryContext` class contains the entities to use and it enables the configuration of specific attributes of the model, such as Key, required columns, references, and so on.

```

using Microsoft.EntityFrameworkCore;
using MySQL.Data.EntityFrameworkCore.Extensions;

namespace mysqlefcore
{
    public class LibraryContext : DbContext
    {
        public DbSet<Book> Book { get; set; }

        public DbSet<Publisher> Publisher { get; set; }

        protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)
        {
            optionsBuilder.UseMySQL("server=localhost;database=library;user=user;password=password");
        }

        protected override void OnModelCreating(ModelBuilder modelBuilder)
        {
            base.OnModelCreating(modelBuilder);

            modelBuilder.Entity<Publisher>(entity =>
            {
                entity.HasKey(e => e.ID);
                entity.Property(e => e.Name).IsRequired();
            });

            modelBuilder.Entity<Book>(entity =>
            {
                entity.HasKey(e => e.ISBN);
                entity.Property(e => e.Title).IsRequired();
                entity.HasOne(d => d.Publisher)
                    .WithMany(p => p.Books);
            });
        }
    }
}

```

- c. Insert the following code into the existing `Program.cs` file, replacing the default C# code.

```

using Microsoft.EntityFrameworkCore;
using System;
using System.Text;

namespace mysqlefcore
{
    class Program
    {
        static void Main(string[] args)
        {
            InsertData();
            PrintData();
        }
    }
}

```

```

        }

private static void InsertData()
{
    using(var context = new LibraryContext())
    {
        // Creates the database if not exists
        context.Database.EnsureCreated();

        // Adds a publisher
        var publisher = new Publisher
        {
            Name = "Mariner Books"
        };
        context.Publisher.Add(publisher);

        // Adds some books
        context.Book.Add(new Book
        {
            ISBN = "978-0544003415",
            Title = "The Lord of the Rings",
            Author = "J.R.R. Tolkien",
            Language = "English",
            Pages = 1216,
            Publisher = publisher
        });
        context.Book.Add(new Book
        {
            ISBN = "978-0547247762",
            Title = "The Sealed Letter",
            Author = "Emma Donoghue",
            Language = "English",
            Pages = 416,
            Publisher = publisher
        });
    }

    // Saves changes
    context.SaveChanges();
}
}

private static void PrintData()
{
    // Gets and prints all books in database
    using (var context = new LibraryContext())
    {
        var books = context.Book
            .Include(p => p.Publisher);
        foreach(var book in books)
        {
            var data = new StringBuilder();
            data.AppendLine($"ISBN: {book.ISBN}");
            data.AppendLine($"Title: {book.Title}");
            data.AppendLine($"Publisher: {book.Publisher.Name}");
            Console.WriteLine(data.ToString());
        }
    }
}
}

```

- d. Use the following CLI commands to restore the dependencies and then run the application.

```
dotnet restore
```

```
dotnet run
```

The output from running the application is represented by the following example:

```
ISBN: 978-0544003415
Title: The Lord of the Rings
Publisher: Mariner Books
```

ISBN: 978-0547247762
Title: The Sealed Letter
Publisher: Mariner Books

4.8.2.2 Scaffolding an Existing Database in EF Core

Scaffolding a database produces an Entity Framework model from an existing database. The resulting entities are created and mapped to the tables in the specified database. This feature was introduced in MySQL Connector/NET 6.10.2-beta and 8.0.8-dmr; however, scaffolding is not supported with all versions of Connector/NET (see [Table 4.4, “Supported versions of Entity Framework Core”](#)).

Note

The `Design` package for scaffolding a database is part of the main package in EF Core 2.0 (or later) and no longer separate. If you are upgrading from EF Core 1.1 to EF Core 2.0 or 2.1, you must remove the `MySql.Data.EntityFrameworkCore.Design` package manually.

The `MySql.Data.EntityFrameworkCore.Design` package remains available for EF Core 1.1 projects.

NuGet packages have the ability to select the best target for a project, which means that NuGet will install the libraries related to that specific framework version.

There are two different ways to scaffold an existing database:

- [Scaffolding a Database Using .NET Core CLI](#)
- [Scaffolding a Database Using Package Manager Console in Visual Studio](#)

This section shows how to scaffold the `sakila` database using both approaches.

Minimum Prerequisites

- .NET Core SDK 2.1 (see <https://www.microsoft.com/net/core>)
- Visual Studio 2017 version 15.7 (required for [Using Package Manager Console in Visual Studio](#))
- MySQL Server 5.7
- `sakila` database sample (see <https://dev.mysql.com/doc/sakila/en/>)

Note

Applications targeting previous versions of ASP.NET Core must upgrade to ASP.NET Core 2.1 to use EF Core 2.1.

Scaffolding a Database Using .NET Core CLI

1. Initialize a valid .NET Core project and console application using the .NET Core command-line interface (CLI) and then change to the newly created folder (`sakilaConsole`).

```
dotnet new console -o sakilaConsole
```

```
cd sakilaConsole
```

2. Add the MySQL NuGet package for EF Core using the CLI. For example, use the following command to add the `MySql.Data.EntityFrameworkCore v8.0.13` package:

```
dotnet add package MySql.Data.EntityFrameworkCore --version 8.0.13
```

Note

The version (for example, `--version 8.0.13`) must match the actual Connector/.NET version you are using. For current version information, see [Table 4.4, “Supported versions of Entity Framework Core”](#).

3. Add the following `Microsoft.EntityFrameworkCore.Design` NuGet package:

```
dotnet add package Microsoft.EntityFrameworkCore.Design
```

EF Core 1.1 only: Also add the `MySQL.Data.EntityFrameworkCore.Design` package.

4. Add a reference to `Microsoft.EntityFrameworkCore.Tools.DotNet` as a `DotNetCliToolReference` entry in the `sakilaConsole.csproj` file as follows:

EF Core 1.1

```
<ItemGroup>
  <DotNetCliToolReference Include="Microsoft.EntityFrameworkCore.Tools.DotNet" Version="1.1.6" />
</ItemGroup>
```

EF Core 2.0

```
<ItemGroup>
  <DotNetCliToolReference Include="Microsoft.EntityFrameworkCore.Tools.DotNet" Version="2.0.3" />
</ItemGroup>
```

Note

The .NET tools are included in the .NET Core 2.1 SDK and not required or supported for EF Core 2.1. If this is an upgrade, remove the following reference to that package from the `.csproj` file (version 2.0.3 in this example) :

```
<DotNetCliToolReference Include="Microsoft.EntityFrameworkCore.Tools.DotNet" Version="
```

5. Restore dependencies and project-specific tools that are specified in the project file as follows:

```
dotnet restore
```

6. Create the Entity Framework Core model by executing the following command (adjust the connection-string values to match your settings for the `user=` and `password=` options):

```
dotnet ef dbcontext scaffold "server=localhost;port=3306;user=root;password=mypass;database=sakila" MySQL
```

To validate that the model has been created, open the new `sakila` folder. You should see files corresponding to all tables mapped to entities. In addition, look for the `sakilaContext.cs` file, which contains the `DbContext` for this database.

Scaffolding a Database Using Package Manager Console in Visual Studio

1. Open Visual Studio and create a new **Console App (.NET Core)** for C#.
2. Add the MySQL NuGet package for EF Core using the **Package Manager Console**. For example, use the following command to add the `MySQL.Data.EntityFrameworkCore v8.0.13` package:

```
Install-Package MySql.Data.EntityFrameworkCore -Version 8.0.13
```

Note

The version (for example, `-Version 8.0.13`) must match the actual Connector/.NET version you are using. For current version information, see [Table 4.4, “Supported versions of Entity Framework Core”](#).

3. Install the following NuGet packages by selecting either **Package Manager Console** or **Manage NuGet Packages for Solution** from the **Tools** and then **NuGet Package Manager** menu:

- `Microsoft.EntityFrameworkCore.Design`

EF Core 1.1 only: Also add the `MySQL.Data.EntityFrameworkCore.Design` package.

- `Microsoft.EntityFrameworkCore.Tools` version 1.1.6 (for EF Core 1.1) and `Microsoft.EntityFrameworkCore.Tools` version 2.0.3 (for EF Core 2.0)

Note

The .NET tools are included in the .NET Core 2.1 SDK and not required or supported for EF Core 2.1. If this is an upgrade, remove the reference to that package from the `.csproj` file (version 2.0.3 in this example):

```
<DotNetCliToolReference Include="Microsoft.EntityFrameworkCore.Tools.DotNet" Version="2.0.3" />
```

4. Open **Package Manager Console** and enter the following command at the prompt to create the entities and DbContext for the `sakila` database (adjust the connection-string values to match your settings for the `user=` and `password=` options):

```
Scaffold-DbContext "server=localhost;port=3306;user=root;password=mypass;database=sakila" MySql.Data...
```

Visual Studio creates a new `sakila` folder inside the project, which contains all the tables mapped to entities and the `sakilaContext.cs` file.

Scaffolding a Database by Filtering Tables

It is possible to specify the exact tables in a schema to use when scaffolding database and to omit the rest. The command-line examples that follow show the parameters needed for filtering tables.

.NET Core CLI:

```
dotnet ef dbcontext scaffold "server=localhost;port=3306;user=root;password=mypass;database=sakila" MySql...
```

Package Manager Console in Visual Studio:

```
Scaffold-DbContext "server=localhost;port=3306;user=root;password=mypass;database=sakila" MySql.Data...
```

Scaffolding with Multiple Schemas

When scaffolding a database, you can use more than one schema or database. Note that the account used to connect to the MySQL server must have access to each schema to be included within the context. Multiple-schema functionality was introduced in Connector/NET 6.10.3-rc and 8.0.9-dmr releases.

The following command-line examples show how to incorporate the `sakila` and `world` schemas within a single context.

.NET Core CLI:

```
dotnet ef dbcontext scaffold "server=localhost;port=3306;user=root;password=mypass;database=sakila" MySql...
```

Package Manager Console in Visual Studio:

```
Scaffold-DbContext "server=localhost;port=3306;user=root;password=mypass;database=sakila" MySql.Data...
```

4.8.2.3 Configuring Character Sets and Collations in EF Core

This section describes how to change the character set, collation, or both at the entity and entity-property level in an Entity Framework (EF) Core model. Modifications made to the model affect the tables and columns generated from your code.

Starting with MySQL Connector/NET 6.10.4, you have two distinct approaches available for configuring character sets and collations in code-first scenarios. Data annotation enables you to apply attributes directly to your EF Core model. Alternatively, you can override the `OnModelCreating` method on your derived `DbContext` class and use the code-first fluent API to configure specific characteristics of the model. An example of each approach follows.

For more information about supported character sets and collations, see [Character Sets and Collations in MySQL](#).

Using Data Annotation

Before you can annotate an EF Core model with character set and collation attributes, add a reference to the following namespace in the file that contains your entity model:

```
using MySql.Data.EntityFrameworkCore.DataAnnotations;
```

Add one or more `[MySqlCharset]` attributes to store data using a variety of character sets and one or more `[MySqlCollation]` attributes to perform comparisons according to a variety of collations. In the following example, the `ComplexKey` class represents an entity (or table) and `Key1`, `Key2`, and `CollationColumn` represent entity properties (or columns).

```
[MySqlCharset("utf8")]
public class ComplexKey
{
    [MySqlCharset("latin1")]
    public string Key1 { get; set; }

    [MySqlCharset("latin1")]
    public string Key2 { get; set; }

    [MySqlCollation("latin1_spanish_ci")]
    public string CollationColumn { get; set; }
}
```

Using the Code-First Fluent API

Add the following directive to reference the methods related to character set and collation configuration:

```
using MySQL.Data.EntityFrameworkCore.Extensions;
```

When using the fluent API approach, the EF Core model remains unchanged. Fluent API overrides any rule set by an attribute.

```
public class ComplexKey
{
    public string Key1 { get; set; }

    public string Key2 { get; set; }

    public string CollationColumn { get; set; }
}
```

In this example, the entity and various entity properties are reconfigured, including the conventional mappings to character sets and collations. This approach uses the `ForMySQLHasCharset` and `ForMySQLHasCollation` methods.

```
public class MyContext : DbContext
{
    public DbSet<ComplexKey> ComplexKeys { get; set; }

    protected override void OnModelCreating(ModelBuilder modelBuilder)
    {
        modelBuilder.Entity<ComplexKey>(e =>
        {
            e.HasKey(p => new { p.Key1, p.Key2 });
            e.ForMySQLHasCollation("ascii_bin"); // defining collation at Entity level
            e.Property(p => p.Key1).ForMySQLHasCharset("latin1"); // defining charset in a property
            e.Property(p => p.CollationColumnFA).ForMySQLHasCollation("utf8_bin"); // defining collation in a property
        });
    }
}
```

```

    });
}
}
```

4.9 Connector/NET API Reference

This section contains a high-level reference to the MySQL Connector/NET ADO.NET and .NET Core components. The complete reference is automatically generated from the embedded documentation.

4.9.1 Microsoft.EntityFrameworkCore Namespace

Enables access to .NET Core command-line interface (CLI) tools.

Classes

Class	Description
MySQLOptionsExtensions	Represents the context-option extensions implemented for MySQL.

4.9.2 MySql.Data.Entity Namespace

Classes

Class	Description
BackoffAlgorithm	Represents the base class for backoff algorithms.
BackoffAlgorithmErr1040	Backoff algorithm customized for the MySQL error code 1040 - Too many connections.
BackoffAlgorithmErr1205	Backoff algorithm customized for the MySQL error code 1205 - Lock wait timeout exceeded; try restarting transaction.
BackoffAlgorithmErr1213	Backoff algorithm customized for MySQL error code 1213 - Deadlock found when trying to get lock; try restarting transaction.
BackoffAlgorithmErr1614	Backoff algorithm for the MySQL error code 1614 - Transaction branch was rolled back: deadlock was detected.
BackoffAlgorithmErr2006	Backoff algorithm customized for MySQL error code 2006 - MySQL server has gone away.
BackoffAlgorithmErr2013	Backoff algorithm customized for MySQL error code 2013 - Lost connection to MySQL server during query.
BackoffAlgorithmNdb	Backoff algorithm customized for MySQL Cluster (NDB) errors.
MySqlConnectionFactory	Used for creating connections in Code First 4.3.
MySqlDependencyResolver	Class used to resolve implementation of services.
MySqlEFConfiguration	Class used to define the MySQL services used in Entity Framework.
MySqlExecutionStrategy	Provided an execution strategy tailored for handling MySQL server transient errors.
MySqlHistoryContext	Class used by code first migrations to read and write migration history from the database.
MySqlLogger	Provides the logger class for use with Entity Framework.

Class	Description
MySqlManifestTokenResolver	Represents a service for getting a provider manifest token given a connection.
MySqlMigrationCodeGenerator	Class used to customized code generation to avoid the <code>dbo.</code> prefix added on table names.
MySqlMigrationSqlGenerator	Implements the MySQL SQL generator for EF 4.3 data migrations.
MySqlModelCacheKey	Represents a key value that uniquely identifies an Entity Framework model that has been loaded into memory.
MySqlProviderFactoryResolver	Represents a service for obtaining the correct MySQL <code>DbProviderFactory</code> from a connection.
MySqlProviderInvariantName	Defines the MySQL provider name.

Enumerations

Enumeration	Description
OpType	Represents a set of database operations.

4.9.3 MySql.Data.EntityFrameworkCore Namespace

Namespaces in this section:

- [MySql.Data.EntityFrameworkCore.DataAnnotations Namespace](#)
- [MySql.Data.EntityFrameworkCore.Extensions Namespace](#)
- [MySql.Data.EntityFrameworkCore.Infrastructure Namespace](#)

MySql.Data.EntityFrameworkCore.DataAnnotations Namespace

Classes

Class	Description
MySqlCharsetAttribute	Establishes the character set of an entity property.
MySqlCollationAttribute	Sets the collation in an entity property.

MySql.Data.EntityFrameworkCore.Extensions Namespace

Classes

Class	Description
MySQLPropertyBuilderExtensions	Represents the implementation of MySQL property-builder extensions used in Fluent API.
MySQLServiceCollectionExtensions	MySQL extension class for <code>IServiceCollection</code> .

MySql.Data.EntityFrameworkCore.Infrastructure Namespace

Classes

Class	Description
MySQLObContextOptionsBuilder	Represents the <code>RelationalDbContextOptionsBuilder</code> type implemented for MySQL.

Class	Description
MySQLOptionsExtension	Represents the RelationalOptionsExtension type implemented for MySQL.

4.9.4 MySql.Data.MySqlClient Namespace

Classes

Class	Description
AuthenticationPluginConfigurationElement	Retrieves the authentication plugin configuration from the configuration file.
BaseCommandInterceptor	Provides a means of enhancing or replacing SQL commands through the connection string rather than recompiling.
BaseTableCache	Provides a base class used for the table cache.
GenericConfigurationElementCollection	Retrieves an element collection from the configuration file.
InterceptorConfigurationElement	Class used in the configuration file to get configuration details for interceptors.
MySqlConnectionStringBuilder	Abstract class that provides common functionality for connection options that apply for all protocols.
MySqlBulkLoader	Load many rows into the database.
MySqlClientFactory	Represents the DBProviderFactory implementation for MySqlClient.
MySqlClientPermission	Derived from the .NET DBDataPermission class. For usage information, see Section 4.5.18, "Working with Partial Trust / Medium Trust" .
MySqlClientPermissionAttribute	Associates a security action with a custom security attribute.
MySqlCommand	Represents an SQL statement to execute against a MySQL database. This class cannot be inherited.
MySqlCommandBuilder	Automatically generates single-table commands used to reconcile changes made to a data set with the associated MySQL database. This class cannot be inherited.
MySqlConfiguration	Defines a configuration section that contains the information specific to MySQL.
MySqlConnection	Represents an open connection to a MySQL Server database. This class cannot be inherited.
MySqlConnectionStringBuilder	Defines all of the connection string options that can be used.
MySqlDataAdapter	Represents a set of data commands and a database connection that are used to fill a data set and update a MySQL database. This class cannot be inherited.
MySqlDataReader	Provides a means of reading a forward-only stream of rows from a MySQL database. This class cannot be inherited.

Class	Description
MySqlError	Collection of error codes that can be returned by the server
MySQLException	The exception that is thrown when MySQL returns an error. This class cannot be inherited.
 MySqlHelper	Helper class that makes it easier to work with the provider.
 MySqlInfoMessageEventArgs	Provides data for the InfoMessage event. This class cannot be inherited.
 MySqlParameter	Represents a parameter to a MySql.Data.MySqlClient.MySqlCommand , and optionally, its mapping to columns in a dataset. This class cannot be inherited.
 MySqlParameterCollection	Represents a collection of parameters relevant to a MySql.Data.MySqlClient.MySqlCommand as well as their respective mappings to columns in a dataset. This class cannot be inherited.
 MySqlProviderServices	The factory for building command definitions.
 MySqlRowUpdatedEventArgs	Provides data for the RowUpdated event. This class cannot be inherited.
 MySqlRowUpdatingEventArgs	Provides data for the RowUpdating event. This class cannot be inherited.
 MySqlSchemaCollection	Contains information about a schema.
 MySqlSchemaRow	Represents a row within a schema.
 MySqlScript	Provides a class capable of executing a SQL script containing multiple SQL statements including CREATE PROCEDURE statements that require changing the delimiter.
 MySqlScriptErrorEventArgs	Provides an error event argument used in MySqlScript.
 MySqlScriptEventArgs	Provides an event argument used in MySqlScript.
 MySqlScriptServices	Creates the script used to build an Entity Framework model.
 MySqlSecurityPermission	Creates permission sets.
 MySqlTrace	Logs events in a defined listener.
 MySqlTransaction	Represents an SQL transaction to be made in a MySQL database. This class cannot be inherited.
 ReplicationConfigurationElement	Defines a replication configuration element in the configuration file.
 ReplicationServerConfigurationElement	Defines a replication server in the configuration file.
 ReplicationServerGroupConfigurationElement	Defines a replication server group in the configuration file
 SchemaColumn	Represents a column object within a schema.

Delegates

Delegate	Description
<code>MySqlInfoMessageEventHandler</code>	Represents the method to handle the <code>InfoMessage</code> event of a <code>MySQLConnection</code> .
<code>MySqlRowUpdatedEventHandler</code>	Represents the method to handle the <code>RowUpdatedevent</code> of a <code>MySQLDataAdapter</code> .
<code>MySqlRowUpdatingEventHandler</code>	Represents the method to handle the <code>RowUpdATINGevent</code> of a <code>MySQLDataAdapter</code> .
<code>MySqlScriptErrorEventHandler</code>	Represents the method to handle an error in MySQLScript.
<code>MySqlStatementExecutedEventHandler</code>	Represents the method to be called after the execution of a statement in MySQLScript.

Enumerations

Enumeration	Description
<code>LockContention</code>	Defines waiting options that may be used with row locking options.
<code>MySqlAuthenticationMode</code>	Specifies the authentication mechanism that should be used.
<code>MySqlBulkLoaderConflictOption</code>	Defines the action to perform when a conflict is found.
<code>MySqlBulkLoaderPriority</code>	Defines the load priority.
<code>MySqlCertificateStoreLocation</code>	Defines the certificate store location.
<code>MySqlConnectionProtocol</code>	Specifies the type of connection to use.
<code>MySqlDbType</code>	Specifies the MySQL data type of a field or property for use in a <code>MySql.Data.MySqlClient.MySqlParameter</code> .
<code>MySqlDriverType</code>	Specifies the connection types that are supported.
<code>MySqlErrorCode</code>	Provides a reference to error codes returned by MySQL.
<code>MySqlSslMode</code>	Provides the SSL options for a connection.
<code>MySqlTraceEventType</code>	Defines the log event type in <code>MySQLTrace</code> .
<code>UsageAdvisorWarningFlags</code>	Defines the usage advisor warning type.

4.9.5 MySql.Data.MySqlClient.Authentication Namespace

Classes

Class	Description
<code>MySqlAuthenticationPlugin</code>	Abstract class used to define an authentication plugin.
<code>MySqlNativePasswordPlugin</code>	Implements the <code>mysql_native_password</code> authentication plugin.
<code>Sha256AuthenticationPlugin</code>	Implements the <code>sha256_password</code> authentication plugin.

Structures

Structure	Description
SecBuffer	Defines a security buffer.
SecHandle	Defines a security handler.
SecPkgContext_Sizes	Defines a security package context size.
SECURITY_HANDLE	Defines a security handler.
SECURITY_INTEGER	Defines a security integer value.

Enumerations

Enumeration	Description
SecBufferType	Defines a security buffer type.

4.9.6 MySql.Data.MySqlClient.Interceptors Namespace

Classes

Class	Description
BaseExceptionInterceptor	Represents the base class for all user-defined exception interceptors.

4.9.7 MySql.Data.MySqlClient.Memcached Namespace

The [MySql.Data.MySqlClient.Memcached](#) namespace contains members for binary and text memcached clients.

Classes

Class	Description
BinaryClient	Implements the memcached binary client protocol.
Client	Represents an abstract interface to the client memcached protocol.
MemcachedException	Provides the base class for all memcached exceptions.
TextClient	Implements the memcached text client protocol.

Enumerations

Enumeration	Description
MemcachedFlags	Represents a set of flags used for requesting new connections instances.

4.9.8 MySql.Data.MySqlClient.Replication Namespace

The [MySql.Data.MySqlClient.Replication](#) namespace contains members for replication and load-balancing components.

Classes

Class	Description
ReplicationRoundRobinServerGroup	Class that implements round-robin load balancing.

Class	Description
ReplicationServer	Represents a server in the replication environment.
ReplicationServerGroup	Base class used to implement load-balancing features.

4.9.9 MySql.Data.Types Namespace

The [MySql.Data.Types](#) namespace contains members for converting MySQL types.

Classes

Class	Description
MySqlConversionException	Represents exceptions returned during the conversion of MySQL types.

Structures

Structure	Description
MySqlDateTime	Defines operations that apply to MySqlDateTime objects.
MySqlDecimal	Defines operations that apply to MySqlDecimal objects.
MySqlGeometry	Defines operations that apply to MySqlGeometry objects.

4.9.10 MySql.Web Namespace

The [MySql.Web](#) namespace includes a set of subordinate namespaces that represent the features managed by various MySQL providers and available for use within ASP.NET applications.

Namespaces in this section:

- [MySql.Web.Common Namespace](#)
- [MySql.Web.Personalization Namespace](#)
- [MySql.Web.Profile Namespace](#)
- [MySql.Web.Security Namespace](#)
- [MySql.Web.SessionState Namespace](#)
- [MySql.Web.SiteMap Namespace](#)

MySql.Web.Common Namespace

Classes

Class	Description
SchemaManager	Manages schema-related operations.

MySql.Web.Personalization Namespace

Classes

Class	Description
MySqlPersonalizationProvider	Implements a personalization provider enabling the use of web parts at ASP.NET websites.

 MySql.Web.Profile Namespace**Classes**

Class	Description
MySQLProfileProvider	Implements a profile provider for the MySQL database.

 MySql.Web.Security Namespace**Classes**

Class	Description
MySQLMembershipProvider	Manages storage of membership information for an ASP.NET application in a MySQL database.
MySQLRoleProvider	Manages storage of role membership information for an ASP.NET application in a MySQL database.
MysqSimpleMembershipProvider	Provides support for website membership tasks, such as creating accounts, deleting accounts, and managing passwords.
MysqSimpleRoleProvider	Provides basic role-management functionality.
MySqlWebSecurity	Provides security and authentication features for ASP.NET Web Pages applications, including the ability to create user accounts, log users in and out, reset or change passwords, and perform related tasks.

 MySql.Web.SessionState Namespace**Classes**

Class	Description
MySqlSessionStateStore	Enables ASP.NET applications to store and manage session state information in a MySQL database. Expired session data is periodically deleted from the database.

 MySql.Web.SiteMap Namespace**Classes**

Class	Description
MySqlSiteMapProvider	Implements a site-map provider for the MySQL database.

4.10 Connector/.NET Support

The developers of MySQL Connector/NET greatly value the input of our users in the software development process. If you find Connector/NET lacking some feature important to you, or if you discover a bug and need to file a bug report, please use the instructions in [How to Report Bugs or Problems](#).

4.10.1 Connector/NET Community Support

- Community support for MySQL Connector/NET can be found through the forums at <http://forums.mysql.com>.
- Paid support is available from Oracle. Additional information is available at <http://dev.mysql.com/support/>.

4.10.2 How to Report Connector/NET Problems or Bugs

If you encounter difficulties or problems with MySQL Connector/NET, contact the Connector/NET community, as explained in [Section 4.10.1, “Connector/NET Community Support”](#).

First try to execute the same SQL statements and commands from the `mysql` client program. This helps you determine whether the error is in Connector/NET or MySQL.

If reporting a problem, ideally include the following information with the email:

- Operating system and version.
- Connector/NET version.
- MySQL server version.
- Copies of error messages or other unexpected output.
- Simple reproducible sample.

Remember that the more information you can supply to us, the more likely it is that we can fix the problem.

If you believe the problem to be a bug, then you must report the bug through <http://bugs.mysql.com/>.

Chapter 5 MySQL Connector/ODBC Developer Guide

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MySQL Connector/ODBC is the driver that enables ODBC applications to communicate with MySQL servers.

For notes detailing the changes in each release of Connector/ODBC, see [MySQL Connector/ODBC Release Notes](#).

For legal information, see the [Legal Notices](#).

For help with using MySQL, please visit the [MySQL Forums](#), where you can discuss your issues with other MySQL users.

Licensing information. This product may include third-party software, used under license. If you are using a *Commercial* release of MySQL Connector/ODBC, see [this document](#) for licensing information, including licensing information relating to third-party software that may be included in this Commercial release. If you are using a *Community* release of MySQL Connector/ODBC, see [this document](#) for licensing information, including licensing information relating to third-party software that may be included in this Community release.

5.1 Introduction to MySQL Connector/ODBC

The MySQL Connector/ODBC is the name for the family of MySQL ODBC drivers (previously called MyODBC drivers) that provide access to a MySQL database using the industry standard Open Database Connectivity (ODBC) API. This reference covers Connector/ODBC 8.0, which includes the functionality of the Unicode driver and the ANSI driver.

MySQL Connector/ODBC provides both driver-manager based and native interfaces to the MySQL database, with full support for MySQL functionality, including stored procedures, [transactions](#) and, with Connector/ODBC 5.1 and higher, full Unicode compliance.

For more information on the ODBC API standard and how to use it, refer to <http://support.microsoft.com/kb/110093>.

The application development section of the ODBC API reference assumes a good working knowledge of C, general DBMS, and a familiarity with MySQL. For more information about MySQL functionality and its syntax, refer to <https://dev.mysql.com/doc/>.

Typically, you need to install Connector/ODBC only on Windows machines. For Unix and macOS, you can use the native MySQL network or named pipes to communicate with your MySQL database. You may need Connector/ODBC for Unix or macOS if you have an application that requires an ODBC interface to communicate with the database. Applications that require ODBC to communicate with MySQL include ColdFusion, Microsoft Office, and Filemaker Pro.

For notes detailing the changes in each release of Connector/ODBC, see [MySQL Connector/ODBC Release Notes](#).

Key Connector/ODBC topics include:

- Installing Connector/ODBC: [Section 5.4, “Connector/ODBC Installation”](#).
- The configuration options: [Section 5.5.2, “Connector/ODBC Connection Parameters”](#).
- An example that connects to a MySQL database from a Windows host: [Section 5.6.2, “Step-by-step Guide to Connecting to a MySQL Database through Connector/ODBC”](#).
- An example that uses Microsoft Access as an interface to a MySQL database: [Section 5.6.4, “Using Connector/ODBC with Microsoft Access”](#).
- General tips and notes, including how to obtain the last auto-increment ID: [Section 5.8.1, “Connector/ODBC General Functionality”](#).
- Application-specific usage tips and notes: [Section 5.8.2, “Connector/ODBC Application-Specific Tips”](#).
- A FAQ (Frequently Asked Questions) list: [Section 5.8.4, “Connector/ODBC Errors and Resolutions \(FAQ\)”](#).
- Additional Connector/ODBC support options: [Section 5.9, “Connector/ODBC Support”](#).

5.2 Connector/ODBC Versions

These are the versions of Connector/ODBC that are currently available:

- Connector/ODBC 8.0: adds MySQL Server 8.0 support, including [caching_sha2_password](#) and the related [GET_SERVER_PUBLIC_KEY](#) connection attribute. For additional details, see the [Connector/ODBC 8.0 release notes](#).
- Connector/ODBC 5.3: is suitable for MySQL Server versions between 4.1 and 5.7. It does not work with 4.0 or earlier releases, and does not support all MySQL 8 features. It conforms to the ODBC 3.8 specification and contains key ODBC 3.8 features including self-identification as a ODBC 3.8 driver, streaming of output parameters (supported for binary types only), and support of the `SQL_ATTR_RESET_CONNECTION` connection attribute (for the Unicode driver only). Connector/ODBC 5.3 also introduces a GTK+-based setup library, providing GUI DSN setup dialog on some Unix-based systems. The library is currently included in the Oracle Linux 6 and Debian 6 binary packages. Other new features in the 5.3 series include file DSN and bookmark support; see the [release notes for the 5.3 series](#) for details.

Connector/ODBC 5.3.11 added [caching_sha2_password](#) support by adding the [GET_SERVER_PUBLIC_KEY](#) connection attribute.

- Connector/ODBC 5.2: upgrades the ANSI driver of Connector/ODBC 3.51 to the 5.x code base. It also includes new features, such as enabling server-side prepared statements by default. At installation time, you can choose the Unicode driver for the broadest compatibility with data sources using various character sets, or the ANSI driver for optimal performance with a more limited range of character sets. It works with MySQL versions 4.1.1 and higher.
- Connector/ODBC 5.1: is a partial rewrite of the 3.51 code base, and is designed to work with MySQL versions 4.1.1 and newer.

Connector/ODBC 5.1: also includes the following changes and improvements over the 3.51 release:

- Improved support on Windows 64-bit platforms.
- Full Unicode support at the driver level. This includes support for the `SQL_WCHAR` data type, and support for Unicode login, password and DSN configurations. For more information, see [Microsoft Knowledgebase Article #716246](#).
- Support for the `SQL_NUMERIC_STRUCT` data type, which provides easier access to the precise definition of numeric values. For more information, see [Microsoft Knowledgebase Article #714556](#).
- Native Windows setup library. This replaces the Qt library based interface for configuring DSN information within the ODBC Data Sources application.
- Support for the ODBC descriptor, which improves the handling and metadata of columns and parameter data. For more information, see [Microsoft Knowledgebase Article #716339](#).
- Connector/ODBC 3.51, also known as the MySQL ODBC 3.51 driver, is a 32-bit ODBC driver. Connector/ODBC 3.51 has support for ODBC 3.5x specification level 1 (complete core API + level 2 features) to continue to provide all functionality of ODBC for accessing MySQL.

The manual for versions of Connector/ODBC older than 5.3 can be located in the corresponding binary or source distribution.

Note

Versions of Connector/ODBC earlier than the 3.51 revision were not fully compliant with the ODBC specification.

Note

From this section onward, the primary focus of this guide is the Connector/ODBC 5.3 driver.

Note

Version numbers for MySQL products are formatted as X.X.X. However, Windows tools (Control Panel, properties display) may show the version numbers as XX.XX.XX. For example, the official MySQL formatted version number 5.0.9 may be displayed by Windows tools as 5.00.09. The two versions are the same; only the number display formats are different.

5.3 General Information About ODBC and Connector/ODBC

ODBC (Open Database Connectivity) provides a way for client programs to access a wide range of databases or data sources. ODBC is a standardized API that enables connections to SQL database servers. It was developed according to the specifications of the SQL Access Group and defines a set of function calls, error codes, and data types that can be used to develop database-independent applications. ODBC usually is used when database independence or simultaneous access to different data sources is required.

For more information about ODBC, refer to <http://support.microsoft.com/kb/110093>.

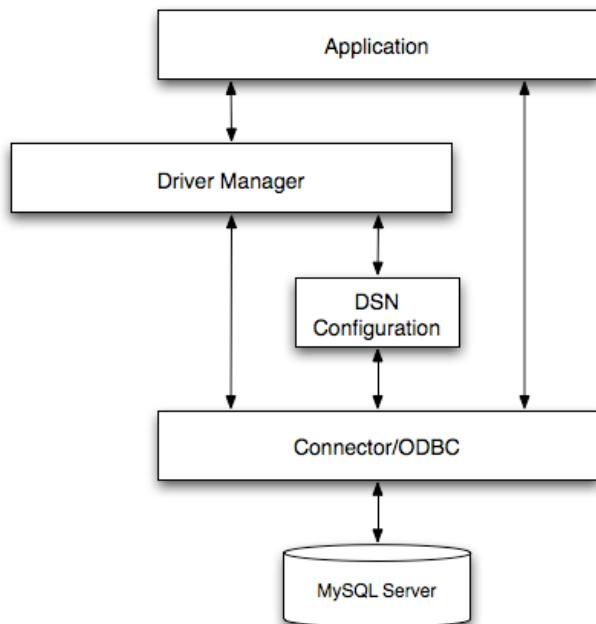
Open Database Connectivity (ODBC) is a widely accepted application-programming interface (API) for database access. It is based on the Call-Level Interface (CLI) specifications from X/Open and ISO/IEC for database APIs and uses Structured Query Language (SQL) as its database access language.

A survey of ODBC functions supported by Connector/ODBC is given at [Section 5.7.1, “Connector/ODBC API Reference”](#). For general information about ODBC, see <http://support.microsoft.com/kb/110093>.

5.3.1 Connector/ODBC Architecture

The Connector/ODBC architecture is based on five components, as shown in the following diagram:

Figure 5.1 Connector/ODBC Architecture Components



- **Application:**

The Application uses the ODBC API to access the data from the MySQL server. The ODBC API in turn communicates with the Driver Manager. The Application communicates with the Driver Manager using the standard ODBC calls. The Application does not care where the data is stored, how it is

stored, or even how the system is configured to access the data. It needs to know only the Data Source Name (DSN).

A number of tasks are common to all applications, no matter how they use ODBC. These tasks are:

- Selecting the MySQL server and connecting to it.
- Submitting SQL statements for execution.
- Retrieving results (if any).
- Processing errors.
- [Committing or rolling back](#) the [transaction](#) enclosing the SQL statement.
- Disconnecting from the MySQL server.

Because most data access work is done with SQL, the primary tasks for applications that use ODBC are submitting SQL statements and retrieving any results generated by those statements.

- **Driver manager:**

The Driver Manager is a library that manages communication between application and driver or drivers. It performs the following tasks:

- Resolves Data Source Names (DSN). The DSN is a configuration string that identifies a given database driver, database, database host and optionally authentication information that enables an ODBC application to connect to a database using a standardized reference.

Because the database connectivity information is identified by the DSN, any ODBC-compliant application can connect to the data source using the same DSN reference. This eliminates the need to separately configure each application that needs access to a given database; instead you instruct the application to use a pre-configured DSN.

- Loading and unloading of the driver required to access a specific database as defined within the DSN. For example, if you have configured a DSN that connects to a MySQL database then the driver manager will load the Connector/ODBC driver to enable the ODBC API to communicate with the MySQL host.
- Processes ODBC function calls or passes them to the driver for processing.

- **Connector/ODBC Driver:**

The Connector/ODBC driver is a library that implements the functions supported by the ODBC API. It processes ODBC function calls, submits SQL requests to MySQL server, and returns results back to the application. If necessary, the driver modifies an application's request so that the request conforms to syntax supported by MySQL.

- **DSN Configuration:**

The ODBC configuration file stores the driver and database information required to connect to the server. It is used by the Driver Manager to determine which driver to be loaded according to the definition in the DSN. The driver uses this to read connection parameters based on the DSN specified. For more information, [Section 5.5, “Configuring Connector/ODBC”](#).

- **MySQL Server:**

The MySQL database where the information is stored. The database is used as the source of the data (during queries) and the destination for data (during inserts and updates).

5.3.2 ODBC Driver Managers

An ODBC Driver Manager is a library that manages communication between the ODBC-aware application and any drivers. Its main functionality includes:

- Resolving Data Source Names (DSN).
- Driver loading and unloading.
- Processing ODBC function calls or passing them to the driver.

Most ODBC Driver Manager implementations also include an administration application that makes the configuration of DSN and drivers easier. Examples and information on ODBC Driver Managers for different operating systems are listed below:

- Windows: Microsoft Windows ODBC Driver Manager (`odbc32.dll`). It is included in the Windows operating system. See <http://support.microsoft.com/kb/110093> for more information.
- macOS: ODBC Administrator is a GUI application for macOS. It provides a simplified configuration mechanism for the iODBC Driver Manager. You can configure DSN and driver information either through ODBC Administrator or through the iODBC configuration files. This also means that you can test ODBC Administrator configurations using the `iodbctest` command. See <http://support.apple.com/kb/DL895> for more information.
- Unix:
 - `unixODBC` Driver Manager for Unix (`libodbc.so`). See <http://www.unixodbc.org>, for more information.
 - `iODBC` Driver Manager for Unix (`libiodbc.so`). See <http://www.iodb.org>, for more information.

5.4 Connector/ODBC Installation

This section explains where to download Connector/ODBC, and how to run the installer, copy the files manually, or build from source.

Where to Get Connector/ODBC

You can get a copy of the latest version of Connector/ODBC binaries and sources from our website at <https://dev.mysql.com/downloads/Connector/ODBC/>.

Choosing Binary or Source Installation Method

You can install the Connector/ODBC drivers using two different methods:

- The **binary installation** is the easiest and most straightforward method of installation. You receive all the necessary libraries and other files pre-built, with an installer program or batch script to perform all necessary copying and configuration.
- The **source installation** method is intended for platforms where a binary installation package is not available, or in situations where you want to customize or modify the installation process or Connector/ODBC drivers before installation.

If a binary distribution is not available for a particular platform, and you build the driver from the original source code.

Connector/ODBC binary distributions include an `INFO_BIN` file that describes the environment and configuration options used to build the distribution. If you installed Connector/ODBC from a binary distribution and experience build-related issues on a platform, it may help to check the settings that were used to build the distribution on that platform. Binary and source distributions include an `INFO_SRC` file that provides information about the product version and the source repository from which the distribution was produced. This information was added in Connector/ODBC 8.0.14.

Supported Platforms

Connector/ODBC can be used on all major platforms supported by MySQL according to <https://www.mysql.com/en/support/supportedplatforms/database.html>. This includes Windows, most Unix-like operation systems, and macOS.

Note

On all non-Windows platforms except macOS, the driver is built against `unixODBC` and is expecting a 2-byte `SQLWCHAR`, not 4 bytes as `iODBC` is using. For this reason, the binaries are **only** compatible with `unixODBC`; recompile the driver against `iODBC` to use them together. For further information, see [Section 5.3.2, “ODBC Driver Managers”](#).

For further instructions, consult the documentation corresponding to the platform where you are installing and whether you are running a binary installer or building from source:

Platform	Binary Installer	Build from Source
Windows	Installation Instructions	Build Instructions
Unix/Linux	Installation Instructions	Build Instructions
macOS	Installation Instructions	

Choosing Unicode or ANSI Driver

Connector/ODBC offers the flexibility to handle data using any character set through its **Unicode-enabled** driver, or the maximum raw speed for a more limited range of character sets through its **ANSI** driver. Both kinds of drivers are provided in the same download package, and are both installed onto your systems by the installation program or script that comes with the download package. Users who install Connector/ODBC and register it to the ODBC manager manually can choose to install and register either one or both of the drivers; the different drivers are identified by a `w` (for “wide characters”) for the Unicode driver and `a` for the ANSI driver at the end of the library names. For example, `myodbc8w.dll` versus `myodbc8a.dll`, or `libmyodbc8w.so` versus `libmyodbc8a.so`.

Note

Related: The previously described file names contain an “8”, such as `myodbc8a.dll`, which means they are for Connector/ODBC 8.x. File names with a “5”, such as `myodbc5a.dll`, are for Connector/ODBC 5.x.

5.4.1 Installing Connector/ODBC on Windows

Before installing the Connector/ODBC drivers on Windows:

- Make sure your Microsoft Data Access Components (MDAC) are up to date. You can obtain the latest version from the [Microsoft Data Access and Storage](#) website.
- Make sure the Visual C++ Redistributable for Visual Studio is installed.
 - Connector/ODBC 8.0.14 or higher: VC++ Runtime 2015 or VC++ Runtime 2017
 - Connector/ODBC 8.0.11 to 8.0.13: VC++ Runtime 2015
 - Connector/ODBC 5.3: VC++ Runtime 2013

Use the version of the package that matches the system type of your Connector/ODBC driver: use the 64-bit version (marked by “x64” in the package’s title and filename) if you are running a 64-bit driver, and use the 32-bit version (marked by “x86” in the package’s title and filename) if you are running a 32-bit driver.

- OpenSSL is a required dependency. The MSI package bundles OpenSSL libraries used by Connector/ODBC while the Zip Archive does not and requires that you install OpenSSL on the system.

There are different distribution types to use when installing for Windows. The software that is installed is identical in each case, only the installation method is different.

- **MySQL Installer (recommended):** The general MySQL Installer application for Windows can install, upgrade, configure, and manage most MySQL products, including Connector/ODBC. Download it from <http://dev.mysql.com/downloads/windows/installer/> and see the [MySQL Installer documentation](#) for additional details. This is not a Connector/ODBC specific installer.
- **MSI:** The Windows MSI Installer Package is an installation file wizard that installs Connector/ODBC. Download it from <https://dev.mysql.com/downloads/connector/odbc/>. See [Section 5.4.1.1, “Installing the Windows Connector/ODBC Driver Using an Installer”](#) for additional details.
- **Zip Archive:** Contains DLL files that must be manually installed. See [Section 5.4.1.2, “Installing the Windows Connector/ODBC Driver Using the Zipped DLL Package”](#) for additional details.

Note

An OLEDB/ODBC driver for Windows 64-bit is available from [Microsoft Downloads](#).

5.4.1.1 Installing the Windows Connector/ODBC Driver Using an Installer

The MSI installer package offers a very simple method for installing the Connector/ODBC drivers. Follow these steps to complete the installation:

1. Double-click the standalone installer that you extracted, or the MSI file you downloaded.
2. The MySQL Connector/ODBC Setup Wizard starts. Click the **Next** button to begin the installation process.

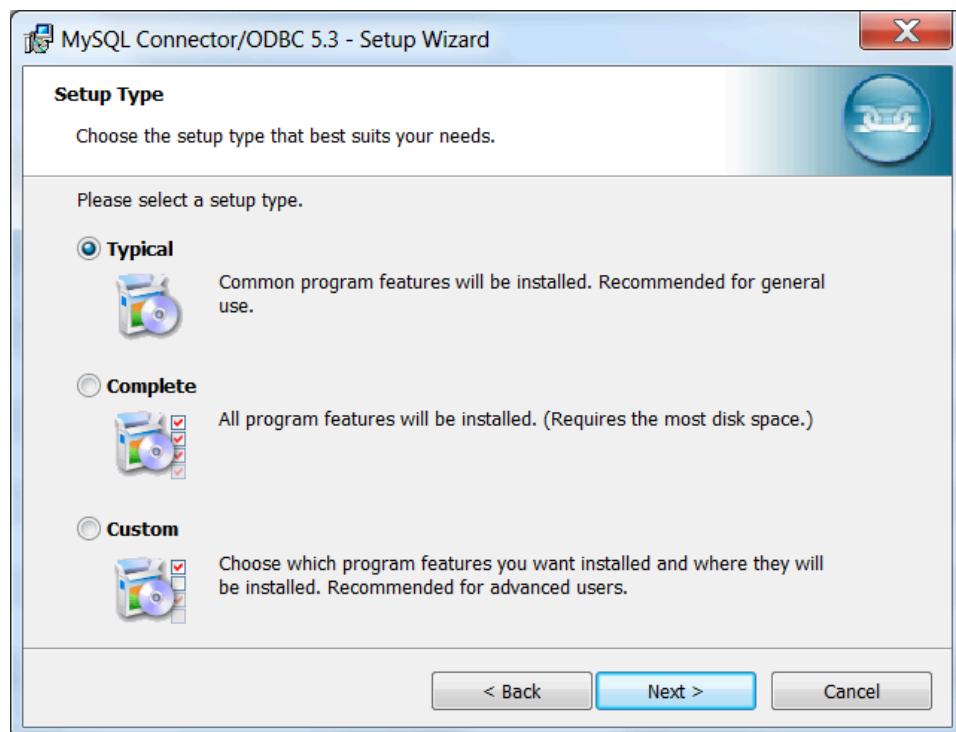
Figure 5.2 Connector/ODBC Windows Installer - Welcome



3. After accepting the licensing agreement, choose the installation type. The **Typical** installation provides the standard files needed to connect to a MySQL database using ODBC. The **Complete** option installs all the available files, including debug and utility components. Oracle recommends choosing one of these two options to complete the installation. If you choose one of these methods, click **Next**, then proceed to step 5.

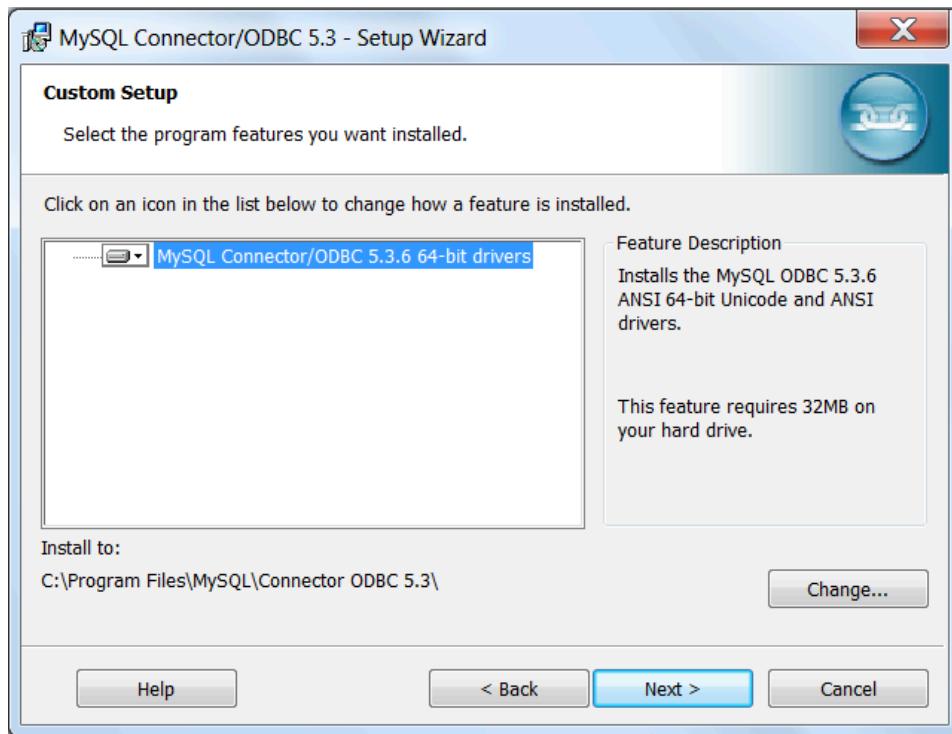
You can also choose a **Custom** installation, where you select the individual components to install. If you choose this method, click **Next**, then proceed to step 4.

Figure 5.3 Connector/ODBC Windows Installer - Choosing A Setup Type



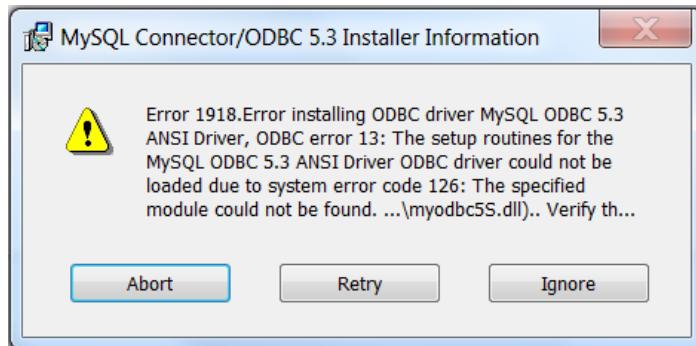
4. If you have chosen a custom installation, use the pop-ups to select which components to install, then click **Next** to install the necessary files.

Figure 5.4 Connector/ODBC Windows Installer - Custom Installation



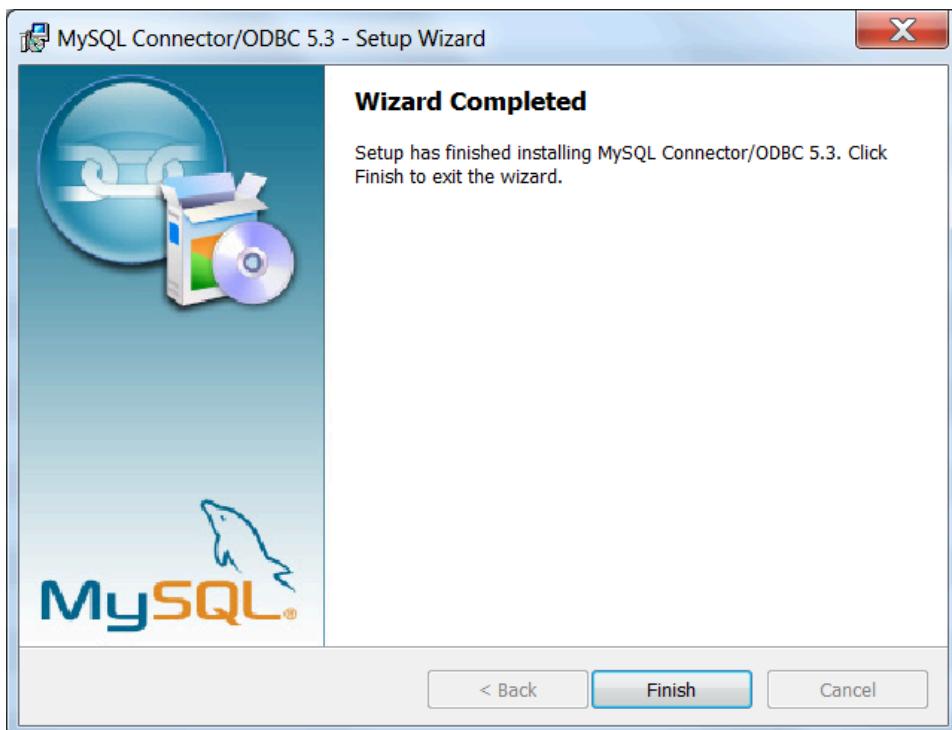
5. If you get an Error 1918 error message during the installation, it means you do not have the required Microsoft Visual C++ 2013 Redistributable Package installed. See [the discussion here](#) for details. Install the package before you click **Retry** and continue.

Figure 5.5 Connector/ODBC Windows Installer - Error 1918



- Once the files are copied to their final locations and the drivers registered with the Windows ODBC manager, the installation is complete. Click **Finish** to exit the installer.

Figure 5.6 Connector/ODBC Windows Installer - Completion



Now that the installation is complete, configure your ODBC connections using [Section 5.5, "Configuring Connector/ODBC"](#).

5.4.1.2 Installing the Windows Connector/ODBC Driver Using the Zipped DLL Package

If you have downloaded the zipped DLL package:

- Unzip the installation files.
- Run the included batch file to perform an installation to the default locations.
- Alternatively, install the individual files required for Connector/ODBC operation manually.

Note

The following instructions only work for 32-bit Windows systems. If you have a 64-bit Windows system, use the MSI installer, which installs both the 32-bit and 64-bit drivers to the correct locations.

To install using the **batch file**:

- Unzip the Connector/ODBC zipped DLL package.
- Open a command prompt.
- Change to the directory created when you unzipped the Connector/ODBC zipped DLL package.
- Run `Install.bat`:

```
C:\> Install.bat
```

This copies the necessary files into the default location, and then registers the Connector/ODBC driver with the Windows ODBC manager.

Note

Changing or adding a new DSN (data source name) may be accomplished using either the GUI, or from the command-line using `myodbc-installer.exe`.

Although Oracle recommends installing these files in the standard location, you can also copy the files by hand to an alternative location - for example, to run or test different versions of the Connector/ODBC driver on the same machine. To **copy the files** to a location of your choice, use the following steps:

1. Unzip the Connector/ODBC zipped DLL package.
2. Open a command prompt.
3. Change to the directory created when you unzipped the Connector/ODBC zipped DLL package.
4. Copy the library files to a suitable directory. The default location is the default Windows system directory `\Windows\System32`:

For Connector/ODBC 8.x:

```
C:\> copy lib\myodbc8S.dll \Windows\System32
C:\> copy lib\myodbc8S.lib \Windows\System32
If installing the Unicode-enabled driver:
C:\> copy lib\myodbc8w.dll \Windows\System32
C:\> copy lib\myodbc8w.lib \Windows\System32
If installing the ANSI driver:
C:\> copy lib\myodbc8a.dll \Windows\System32
C:\> copy lib\myodbc8a.lib \Windows\System32
```

For Connector/ODBC 5.x:

```
C:\> copy lib\myodbc5S.dll \Windows\System32
C:\> copy lib\myodbc5S.lib \Windows\System32
If installing the Unicode-enabled driver:
C:\> copy lib\myodbc5w.dll \Windows\System32
C:\> copy lib\myodbc5w.lib \Windows\System32
If installing the ANSI driver:
C:\> copy lib\myodbc5a.dll \Windows\System32
C:\> copy lib\myodbc5a.lib \Windows\System32
```

5. Copy the Connector/ODBC tools. These must be placed in a directory that is in the system `%PATH%`. The default is to install these into the Windows system directory `\Windows\System32`:

```
C:\> copy bin\myodbc-installer.exe \Windows\System32
```

6. Optionally, copy the help files. For these files to be accessible through the help system, they must be installed in the Windows system directory:

```
C:\> copy doc\*.hlp \Windows\System32
```

7. Finally, register the Connector/ODBC driver with the ODBC manager:

For Connector/ODBC 8.x:

```
For Unicode-enabled driver:
C:\> myodbc-installer -a -d -n "MySQL ODBC 8.0 Driver" \
  -t "DRIVER=myodbc8w.dll;SETUP=myodbc8S.dll"
For ANSI driver:
C:\> myodbc-installer -a -d -n "MySQL ODBC 8.0 Driver" \
  -t "DRIVER=myodbc8a.dll;SETUP=myodbc8S.dll"
```

For Connector/ODBC 5.3:

```
For Unicode-enabled driver:
C:\> myodbc-installer -a -d -n "MySQL ODBC 5.3 Driver" \
  -t "DRIVER=myodbc5w.dll;SETUP=myodbc5S.dll"
```

```
For ANSI driver:  
C:\> myodbc-installer -a -d -n "MySQL ODBC 5.3 Driver" \  
-t "DRIVER=myodbc5a.dll;SETUP=myodbc5S.dll"
```

If you installed these files into a non-default location, change the references to the DLL files and command location in the above statement

5.4.2 Installing Connector/ODBC on Unix-like Systems

There are three methods available for installing Connector/ODBC on a Unix-like system from a binary distribution. For most Unix environments, you will use the **tarball** distribution. For Linux systems, **RPM** distributions are available, through the [MySQL Yum repository](#) (for some platforms) or direct download.

Prerequisites

- unixODBC 2.2.12 or later.
- OpenSSL.

5.4.2.1 Installing Connector/ODBC Using the MySQL Yum Repository

The MySQL Yum repository for Oracle Linux, Red Hat Enterprise Linux, CentOS, and Fedora provides Connector/ODBC RPM packages using the [MySQL Yum repository](#). You must have the MySQL Yum repository on your system's repository list (see [Adding the MySQL Yum Repository](#) for details). Make sure your Yum repository setup is up-to-date by running:

```
shell> su root  
shell> yum update mysql-community-release
```

You can then install Connector/ODBC by the following command:

```
shell> yum install mysql-connector-odbc
```

See [Installing Additional MySQL Products and Components with Yum](#) for more details.

5.4.2.2 Installing Connector/ODBC from a Binary Tarball Distribution

To install the driver from a tarball distribution ([.tar.gz](#) file), download the latest version of the driver for your operating system and follow these steps, substituting the appropriate file and directory names based on the package you download (some of the steps below might require superuser privileges):

1. Extract the archive:

```
shell> gunzip mysql-connector-odbc-8.0.20-i686-pc-linux.tar.gz  
shell> tar xvf mysql-connector-odbc-8.0.20-i686-pc-linux.tar
```

2. The extra directory contains two subdirectories, `lib` and `bin`. Copy their contents to the proper locations on your system (we use `/usr/local/bin` and `/usr/local/lib` in this example; replace them with the destinations of your choice):

```
shell> cp bin/* /usr/local/bin  
shell> cp lib/* /usr/local/lib
```

The last command copies both the Connector/ODBC ANSI and the Unicode drivers from `lib` into `/usr/local/lib`; if you do not need both, you can just copy the one you want. See [Choosing Unicode or ANSI Driver](#) for details.

3. Finally, register the driver version of your choice (the ANSI version, the Unicode version, or both) with your system's ODBC manager (for example, iODBC or unixodbc) using the `myodbc-installer` tool that was included in the package under the `bin` subdirectory (and is now under the `/usr/local/bin` directory, if the last step was followed); for example, this registers the Unicode driver with the ODBC manager:

For Connector/ODBC 8.0:

```
// Registers the Unicode driver:  
shell> myodbc-installer -a -d -n "MySQL ODBC 8.0 Driver" -t "Driver=/usr/local/lib/libmyodbc8w.so"  
// Registers the ANSI driver  
shell> myodbc-installer -a -d -n "MySQL ODBC 8.0" -t "Driver=/usr/local/lib/libmyodbc8a.so"
```

For Connector/ODBC 5.3:

```
// Registers the Unicode driver:  
shell> myodbc-installer -a -d -n "MySQL ODBC 5.3 Driver" -t "Driver=/usr/local/lib/libmyodbc5w.so"  
// Registers the ANSI driver  
shell> myodbc-installer -a -d -n "MySQL ODBC 5.3" -t "Driver=/usr/local/lib/libmyodbc5a.so"
```

4. Verify that the driver is installed and registered using the ODBC manager, or the [myodbc-installer](#) utility:

```
shell> myodbc-installer -d -l
```

Next, see [Section 5.5.5, “Configuring a Connector/ODBC DSN on Unix”](#) on how to configure a DSN for Connector/ODBC.

5.4.2.3 Installing Connector/ODBC from an RPM Distribution

To install or upgrade Connector/ODBC from an RPM distribution on Linux, simply download the RPM distribution of the latest version of Connector/ODBC and follow the instructions below. Use [su root](#) to become [root](#), then install the RPM file.

If you are installing for the first time:

```
shell> su root  
shell> rpm -ivh mysql-connector-odbc-8.0.20.i686.rpm
```

If the driver exists, upgrade it like this:

```
shell> su root  
shell> rpm -Uvh mysql-connector-odbc-8.0.20.i686.rpm
```

If there is any dependency error for MySQL client library, [libmysqlclient](#), simply ignore it by supplying the [--nodeps](#) option, and then make sure the MySQL client shared library is in the path or set through [LD_LIBRARY_PATH](#).

This installs the driver libraries and related documents to [/usr/local/lib](#) and [/usr/share/doc/MyODBC](#), respectively. See [Section 5.5.5, “Configuring a Connector/ODBC DSN on Unix”](#) for the post-installation configuration steps.

To [uninstall](#) the driver, become [root](#) and execute an [rpm](#) command:

```
shell> su root  
shell> rpm -e mysql-connector-odbc
```

5.4.3 Installing Connector/ODBC on macOS

macOS is based on the FreeBSD operating system, and you can normally use the MySQL network port for connecting to MySQL servers on other hosts. Installing the Connector/ODBC driver lets you connect to MySQL databases on any platform through the ODBC interface. If your application requires an ODBC interface, install the Connector/ODBC driver. Applications that require or can use ODBC (and therefore the Connector/ODBC driver) include ColdFusion, Filemaker Pro, 4th Dimension and many other applications.

On macOS, the ODBC Administrator, based on the [iODBC](#) manager, provides easy administration of ODBC drivers and configuration, allowing the updates of the underlying [iODBC](#) configuration files

through a GUI tool. The tool is included in macOS v10.5 and earlier; users of later versions of macOS need to download it from <http://www.iodbc.org/dataspace/doc/iodbc/wiki/iodbcWiki/Downloads> and install it manually.

OpenSSL is a required dependency. The macOS installation binaries bundle OpenSSL, while the compressed tar archives do not and require that you install OpenSSL on your system before the installation process.

There are two ways to install Connector/ODBC on macOS. You can use either the package provided in a compressed tar archive that you manually install, or use a compressed disk image ([.dmg](#)) file, which includes an installer.

To install using the compressed tar archive (some of the steps below might require superuser privileges):

1. Download the compressed tar archive.
2. Extract the archive:

```
shell> tar xvzf mysql-connector-odbc-x.y.z-osx10.z-x86-(32|64)bit.tar.gz
```

3. The directory created contains two subdirectories, `lib` and `bin`. Copy these to a suitable location such as `/usr/local`:

```
shell> cp bin/* /usr/local/bin  
shell> cp lib/* /usr/local/lib
```

4. Finally, register the driver with iODBC using the `myodbc-installer` tool that was included in the package:

For Connector/ODBC 8.0:

```
shell> myodbc-installer -a -d -n "MySQL ODBC 8.0 Driver" -t "Driver=/usr/local/lib/libmyodbc8w.so"
```

For Connector/ODBC 5.3:

```
shell> myodbc-installer -a -d -n "MySQL ODBC 5.3 Driver" -t "Driver=/usr/local/lib/libmyodbc5w.so"
```

To install using the a compressed disk image ([.dmg](#)) file:

Important

For Connector/ODBC 5.3.7 and later, iODBC 3.52.12 or later must be installed on the macOS system before you can install Connector/ODBC using a compressed disk image. See [the discussion above on iODBC](#).

1. Download the disk image.
2. Double click the disk image to open it. You see the Connector/ODBC installer inside.
3. Double click the Connector/ODBC installer, and you will be guided through the rest of the installation process. You need superuser privileges to finish the installation.

To verify the installed drivers, either use the ODBC Administrator application or the `myodbc-installer` utility:

```
shell> myodbc-installer -d -l
```

5.4.4 Building Connector/ODBC from a Source Distribution on Windows

You only need to build Connector/ODBC from source on Windows to modify the source or installation location. If you are unsure whether to install from source, please use the binary installation detailed in [Section 5.4.1, “Installing Connector/ODBC on Windows”](#).

Building Connector/ODBC from source on Windows requires a number of different tools and packages:

- MDAC, Microsoft Data Access SDK from <http://support.microsoft.com/kb/110093>.
- A suitable C++ compiler, such as Microsoft Visual C++ or the C++ compiler included with Microsoft Visual Studio 2015 or later. Compiling Connector/ODBC 5.3 can use VS 2013.
- CMake.
- The MySQL client library and include files from MySQL 8.0 or higher for Connector/ODBC 8.0, or MySQL 5.7 for Connector/ODBC 5.3. This is required because Connector/ODBC uses calls and structures that do not exist in older versions of the library. To get the client library and include files, visit <https://dev.mysql.com/downloads/>.

Build Steps

Set the environment variables for the Visual Studio toolchain. Visual Studio includes a batch file to set these for you, and installs a **Start** menu shortcut that opens a command prompt with these variables set.

Set `MYSQL_DIR` to the MySQL server installation path, while using the short-style file names. For example:

```
C:\> set MYSQL_DIR=C:\PROGRA~1\MySQL\MYSQLS~1.0
```

Build Connector/ODBC using the `cmake` command-line tool by executing the following from the source root directory (in a command prompt window):

```
C:\> cmake -G "Visual Studio 12 2013"
```

This produces a project file that you can open with Visual Studio, or build from the command line with either of the following commands:

```
C:\> devenv.com MySQL_Connector_ODBC.sln /build Release
```

Since release 5.3.10, when building Connector/ODBC from sources, dynamic linking with the MySQL client library is selected by default—that is, the `MYSQLCLIENT_STATIC_LINKING` `cmake` option is `FALSE` by default (however, the binary distributions of Connector/ODBC from Oracle are linked statically to the client library). If you want to link statically to the MySQL client library, set the `MYSQLCLIENT_STATIC_LINKING` option to `TRUE`, and use the `MYSQLCLIENT_LIB_NAME` option to supply the client library's name for static linking:

```
C:\> cmake -G "Visual Studio 12 2013" -DMYSQLCLIENT_STATIC_LINKING:BOOL=TRUE \
  DMYSQLCLIENT_LIB_NAME=client_lib_name_with_extension
```

Also use the `MYSQLCLIENT_LIB_NAME` option to link dynamically to a MySQL client library other than `libmysql.dll`. `cmake` looks for the client library under the location specified by the `MYSQL_LIB_DIR` option; if the option is not specified, `cmake` looks under the default locations inside the folder specified by the `MYSQL_DIR` option.

Since Connector/ODBC 8.0.11, use `BUNDLE_DEPENDENCIES` to install external library runtime dependencies, such as OpenSSL, together with the connector. For dependencies inherited from the MySQL client library, this only works if these dependencies are bundled with the client library itself.

`INFO_SRC`: this file provides information about the product version and the source repository from which the distribution was produced. Was added in Connector/ODBC 8.0.14.

Since Connector/ODBC 5.3.9, you can link Connector/ODBC statically (equivalent to the `/MT` compiler option in Visual Studio) or dynamically (equivalent to the `/MD` compiler option in Visual Studio) to the Visual C++ runtime. The default option is to link dynamically; if you want to link statically, set the option `STATIC_MSVCRT:BOOL=TRUE`, that is:

```
C:\> cmake -G "Visual Studio 12 2013" -DSTATIC_MSVCRT:BOOL=TRUE
```

The `STATIC_MSVCRT` option and the `MYSQLCLIENT_STATIC_LINKING` option are independent of each other; that is, you can link Connector/ODBC dynamically to the Visual C++ runtime while linking statically to the MySQL client library, and vice versa. However, if you link Connector/ODBC dynamically to the Visual C++ runtime, you also need to link to a MySQL client library that is itself linked dynamically to the Visual C++ runtime; and similarly, linking Connector/ODBC statically to the Visual C++ runtime requires linking to a MySQL client library that is itself linked statically to the Visual C++ runtime.

To compile a debug build, set the `cmake` build type so that the correct versions of the MySQL client libraries are used; also, because the MySQL C client library built by Oracle is *not* built with the debug options, when linking to it while building Connector/ODBC in debug mode, use the `WITH_NODEFAULTLIB` option to tell `cmake` to ignore the default non-debug C++ runtime:

```
C:\> cmake -G "Visual Studio 14 2015" -DWITH_DEBUG=1 -DWITH_NODEFAULTLIB=libcmt
```

Create the debug build then with this command:

```
C:\> devenv.com MySQL_Connector_ODBC.sln /build Debug
```

Upon completion, the executables are in the `bin/` and `lib/` subdirectories.

See [Section 5.4.1.2, “Installing the Windows Connector/ODBC Driver Using the Zipped DLL Package”](#) on how to complete the installation by copying the binary files to the right locations and registering Connector/ODBC with the ODBC manager.

5.4.5 Building Connector/ODBC from a Source Distribution on Unix

You need the following tools to build MySQL from source on Unix:

- A working ANSI C++ compiler. GCC 4.2.1 or later, Sun Studio 12.1 or later, and many current vendor-supplied compilers are known to work.
- CMake.
- MySQL client libraries and include files. To get the client libraries and include files, visit <https://dev.mysql.com/downloads/>.
- A compatible ODBC manager must be installed. Connector/ODBC is known to work with the `iODBC` and `unixODBC` managers. See [Section 5.3.2, “ODBC Driver Managers”](#) for more information.
- If you are using a character set that is not compiled into the MySQL client library, install the MySQL character definitions from the `charsets` directory into `SHAREDIF` (by default, `/usr/local/mysql/share/mysql/charsets`). These should be in place if you have installed the MySQL server on the same machine. See [Character Sets, Collations, Unicode](#) for more information on character set support.

Once you have all the required files, unpack the source files to a separate directory, then run `cmake` with the following command:

```
shell> cmake -G "Unix Makefiles"
```

Typical `cmake` Parameters and Options

You might need to help `cmake` find the MySQL headers and libraries by setting the environment variables `MYSQL_INCLUDE_DIR`, `MYSQL_LIB_DIR`, and `MYSQL_DIR` to the appropriate locations; for example:

```
shell> export MYSQL_INCLUDE_DIR=/usr/local/mysql/include
shell> export MYSQL_LIB_DIR=/usr/local/mysql/lib
```

```
shell> export MYSQL_DIR=/usr/local/mysql
```

When you run `cmake`, you might add options to the command line. Here are some examples:

- `-DODBC_INCLUDES=dir_name`: Use when the ODBC include directory is not found within the system `$PATH`.
- `-DODBC_LIB_DIR=dir_name`: Use when the ODBC library directory is not found within the system `$PATH`.
- `-DWITH_UNIXODBC=1`: Enables unixODBC support. `iODBC` is the default ODBC library used when building Connector/ODBC from source on Linux platforms. Alternatively, `unixODBC` may be used by setting this option to "1".
- `-DMYSQLCLIENT_STATIC_LINKING=boolean`: Link statically to the MySQL client library. Since release 5.3.10, when building Connector/ODBC from sources, dynamic linking with the MySQL client library is selected by default—that is, the `MYSQLCLIENT_STATIC_LINKING` `cmake` option is `FALSE` by default (however, the binary distributions of Connector/ODBC from Oracle are linked statically to the client library). If you want to link statically to the MySQL client library, set the option to `TRUE`. See also the description for the `-DMYSQLCLIENT_LIB_NAME=client_lib_name_with_extension` option.
- `-DBUNDLE_DEPENDENCIES=boolean`: Enable to install external library runtime dependencies, such as OpenSSL, together with the connector. For dependencies inherited from the MySQL client library, this only works if these dependencies are bundled with the client library itself. Option added in v8.0.11.
- `-DMYSQLCLIENT_LIB_NAME=client_lib_name_with_extension`: Location of the MySQL client library. See the description for `MYSQLCLIENT_STATIC_LINKING`. For release 5.3.10 and later, if you want to link statically to the MySQL client library, use this option to supply the client library's name for static linking. Also use this option if you want to link dynamically to a MySQL client library other than `libmysqlclient.so`. `cmake` looks for the client library under the location specified by the environment variable `MYSQL_LIB_DIR`; if the variable is not specified, `cmake` looks under the default locations inside the folder specified by the environment variable `MYSQL_DIR`.
- `-DMYSQL_CONFIG_EXECUTABLE=/path/to/mysql_config`: Specifies location of the utility `mysql_config`, which is used to fetch values of the variables `MYSQL_INCLUDE_DIR`, `MYSQL_LIB_DIR`, `MYSQL_LINK_FLAGS`, and `MYSQL_CXXFLAGS`. Values fetched by `mysql_config` are overridden by values provided directly to `cmake` as parameters.
- `-DMYSQL_LINK_FLAGS=MySQL link flags`
- `-DMYSQL_CXXFLAGS=MySQL C++ linkage flags`
- `-DMYSQL_CXX_LINKAGE=1`: Enables C++ linkage to MySQL client library. By default, `MYSQL_CXX_LINKAGE` is enabled for MySQL 5.6.4 or later. For MySQL 5.6.3 and earlier, this option must be set explicitly to `1`.

Build Steps for Unix

To build the driver libraries, execute `make`:

```
shell> make
```

If any errors occur, correct them and continue with the build process. If you are not able to finish the build, see [Section 5.9.1, “Connector/ODBC Community Support”](#).

Installing Driver Libraries

To install the driver libraries, execute the following command:

```
shell> make install
```

For more information on build process, refer to the [BUILD](#) file that comes with the source distribution.

Testing Connector/ODBC on Unix

Some tests for Connector/ODBC are provided in the distribution with the libraries that you built. To run the tests:

1. Make sure you have an `odbc.ini` file in place, by which you can configure your DSN entries. A sample `odbc.ini` file is generated by the build process under the `test` folder. Set the environment variable `ODBCINI` to the location of your `odbc.ini` file.
2. Set up a test DSN in your `odbc.ini` file (see [Section 5.5.5, “Configuring a Connector/ODBC DSN on Unix”](#) for details). A sample DSN entry, which you can use for your tests, can be found in the sample `odbc.ini` file.
3. Set the environment variable `TEST_DSN` to the name of your test DSN.
4. Set the environment variable `TEST_UID` and perhaps also `TEST_PASSWORD` to the user name and password for the tests, if needed. By default, the tests use “root” as the user and do not enter a password; if you want the tests to use another user name or password, set `TEST_UID` and `TEST_PASSWORD` accordingly.
5. Make sure that your MySQL server is running.
6. Run the following command:

```
shell> make test
```

5.4.6 Building Connector/ODBC from a Source Distribution on macOS

To build Connector/ODBC from source on macOS, follow the same instructions given for [Section 5.4.5, “Building Connector/ODBC from a Source Distribution on Unix”](#). Notice that `iODBC` is the default ODBC library used when building Connector/ODBC on macOS from source. Alternatively, `unixODBC` may be used by setting the option `-DWITH_UNIXODBC=1`.

5.4.7 Installing Connector/ODBC from the Development Source Tree

Caution

This section is only for users who are interested in helping us test our new code. To just get MySQL Connector/ODBC up and running on your system, use a standard release distribution.

The Connector/ODBC code repository uses Git. To check out the latest source code, visit GitHub: <https://github.com/mysql/mysql-connector-odbc> To clone the Git repository to your machine, use this command

```
git clone https://github.com/mysql/mysql-connector-odbc.git
```

You should now have a copy of the entire Connector/ODBC source tree in the directory `mysql-connector-odbc`. To build and then install the driver libraries from this source tree on Unix or Linux, use the same steps outlined in [Section 5.4.5, “Building Connector/ODBC from a Source Distribution on Unix”](#).

On Windows, make use of Windows Makefiles `WIN-Makefile` and `WIN-Makefile_debug` in building the driver. For more information, see [Section 5.4.4, “Building Connector/ODBC from a Source Distribution on Windows”](#).

After the initial checkout operation to get the source tree, run `git pull` periodically to update your source according to the latest version.

5.5 Configuring Connector/ODBC

Before you connect to a MySQL database using the Connector/ODBC driver, you configure an ODBC Data Source Name (DSN). The DSN associates the various configuration parameters required to communicate with a database to a specific name. You use the DSN in an application to communicate with the database, rather than specifying individual parameters within the application itself. DSN information can be user-specific, system-specific, or provided in a special file. ODBC data source names are configured in different ways, depending on your platform and ODBC driver.

5.5.1 Overview of Connector/ODBC Data Source Names

A Data Source Name associates the configuration parameters for communicating with a specific database. Generally, a DSN consists of the following parameters:

- Name
- Host Name
- Database Name
- Login
- Password

In addition, different ODBC drivers, including Connector/ODBC, may accept additional driver-specific options and parameters.

There are three types of DSN:

- A *System DSN* is a global DSN definition that is available to any user and application on a particular system. A System DSN can normally only be configured by a systems administrator, or by a user who has specific permissions that let them create System DSNs.
- A *User DSN* is specific to an individual user, and can be used to store database connectivity information that the user regularly uses.
- A *File DSN* uses a simple file to define the DSN configuration. File DSNs can be shared between users and machines and are therefore more practical when installing or deploying DSN information as part of an application across many machines.

DSN information is stored in different locations depending on your platform and environment.

5.5.2 Connector/ODBC Connection Parameters

You can specify the parameters in the following tables for Connector/ODBC when configuring a DSN:

- [Table 5.1, “Connector/ODBC DSN Configuration Options”](#)
- [Table 5.3, “Connector/ODBC Option Parameters”](#)

Users on Windows can use the `ODBC Data Source Administrator` to set these parameters; see [Section 5.5.3, “Configuring a Connector/ODBC DSN on Windows”](#) on how to do that, and see [Table 5.1, “Connector/ODBC DSN Configuration Options”](#) for information on the options and the fields and check boxes they correspond to on the graphical user interface of the `ODBC Data Source Administrator`. On Unix and macOS, use the parameter name and value as the keyword/value pair in the DSN configuration. Alternatively, you can set these parameters within the `InConnectionString` argument in the `SQLDriverConnect()` call.

Table 5.1 Connector/ODBC DSN Configuration Options

Parameter	GUI Option	Default Value	Comment
<code>user</code>	User	ODBC	The user name used to connect to MySQL.
<code>uid</code>	User	ODBC	Synonymous with <code>user</code> . Added in 3.51.16.
<code>server</code>	TCP/IP Server	<code>localhost</code>	The host name of the MySQL server.
<code>database</code>	Database	-	The default database.
<code>option</code>	-	0	Options that specify how Connector/ODBC works. See “Connector/ODBC Option Parameters” and Table 5.2, “Connector/ODBC Option Values for Different Configurations”.
<code>port</code>	Port	3306	The TCP/IP port to use if <code>server</code> is not <code>localhost</code> .
<code>initstmt</code>	Initial Statement	-	Initial statement. A statement to execute when connecting. In MySQL version 3.51 the parameter is called <code>stmt</code> . The driver executes the statement being executed only at the time of the initial connection.
<code>password</code>	Password	-	The password for the <code>user</code> account on <code>server</code> .
<code>pwd</code>	Password	-	Synonymous with <code>password</code> . Added in 3.51.16.
<code>socket</code>	-	-	The Unix socket file or Windows named pipe to connect to <code>server</code> if it is not <code>localhost</code> .
<code>sslca</code>	SSL Certificate	-	The path to a file with a list of trust SSL CAs. Added in 3.51.16.
<code>sslcapath</code>	SSL CA Path	-	The path to a directory that contains trusted SSL CA certificates in PEM format. Added in 3.51.16.
<code>sslcert</code>	SSL Certificate	-	The name of the SSL certificate file to use for establishing the connection. Added in 3.51.16.
<code>sslcipher</code>	SSL Cipher	-	The list of permissible ciphers for SSL encryption. The value is in the same format as the <code>openssl ciphers</code> command.
<code>sslkey</code>	SSL Key	-	The name of the SSL key file to use for establishing the connection. Added in 3.51.16.
<code>rsakey</code>	RSA Public Key	-	The full-path name of the PEM file that contains the RSA public key to use for establishing the connection using the SHA256 authentication plugin of MySQL.
<code>sslverify</code>	Verify SSL	0	If set to 1, the SSL certificate will be verified when establishing the connection. If not set, then the default behavior is to skip verification.
charset	Character Set	-	The character set to use for the connection. Added in 3.51.16.
<code>readtimeout</code>	-	-	The timeout in seconds for attempts to read from the connection. The driver uses this timeout value and there are retries if necessary. The effective timeout value is three times the option value so that a lost connection can be detected earlier than the MySQL <code>Close_Wait_Timeout</code> value of 10 minutes. This option applies to MySQL connections, and only for TCP/IP connections, and only for Windows prior to MySQL 5.7.11. Corresponds to the <code>MYSQL_OPT_READ_TIMEOUT</code> option in the MySQL Client Library. Added in 3.51.27.
<code>writetimeout</code>	-	-	The timeout in seconds for attempts to write to the connection. The driver uses this timeout value and there are <code>net_retry_count</code> retries if necessary, so the total effective timeout value is <code>net_retry_count</code> times the option value. This option works only for TCP/IP connections.

Note

The option is deprecated since Connector/ODBC 5.3.7. It is preferable to use the `sslverify` parameter instead.

Parameter	GUI Option	Default Value	Comment
			and only for Windows prior to MySQL 5.1.12. Corresponds to the <code>MYSQL_OPT_WRITE_TIMEOUT</code> option of the MySQL Client API.
<code>interactive_timeout</code>	Interactive Client	0	If set to 1, the <code>CLIENT_INTERACTIVE</code> connection option is enabled. Added in 5.1.7.
<code>prefetch</code>	Prefetch from server by _ rows at a time	0	When set to a non-zero value <code>N</code> , causes all queries in the current statement to return <code>N</code> rows at a time rather than the entire result set. Use this option with caution against very large tables where it is not practical to retrieve the entire result set at once. You can scroll through the result set, <code>N</code> records at a time.
			This option works only with forward-only cursors. It does not work if the <code>cursor_type</code> option parameter <code>MULTI_STATEMENTS</code> is set. It can be combined with the option parameter <code>NO_CACHE</code> . Its behavior in ADs is undefined: the prefetching might or might not occur. Added in 5.1.7.
<code>no_ssps</code>	-	0	In Connector/ODBC 5.2 and after, by default, server-side prepared statements are used. When this option is set to a non-zero value, server-side prepared statements are emulated on the client side, which is the behavior in MySQL 5.1 and 3.51. Added in 5.2.0.
<code>can_handle_expired_password</code>	Can Handle Expired Password	0	Indicates that the application can deal with an expired password. This option is signalled by an SQL state of <code>08004</code> ("Server rejected the connection") and a native error code <code>ER_MUST_CHANGE_PASSWORD</code> . The connection is "sandboxed", and can do nothing other than issue a <code>SET PASSWORD</code> statement. To establish a connection in this mode, the application must either use the <code>initstmt</code> connection option to provide a password at the start, or issue a <code>SET PASSWORD</code> statement after connecting. Once the expired password is reset, the restrictions on the connection are lifted. See ALTER USER Statement for information about password expiration for MySQL server accounts. Added in 5.1.7.
<code>ENABLE_CLEARTEXT_IN</code>	Enable Cleartext IN Authentication	0	Set to 1 to enable cleartext authentication. Added in 5.1.7.
<code>ENABLE_LOCAL_INFILE</code>	Enable LOAD DATA operations	0	A connection string, DSN, and GUI option. Set <code>ENABLE_LOCAL_INFILE</code> to enable LOAD DATA operations. This toggles the <code>MYSQL_OPT_LOCAL_INFILE</code> mysql_options() option. This option overrides the DSN value if both are set. Added in 5.1.7.
<code>GET_SERVER_PUBLIC_KEY</code>	Get Server Public Key	0	When connecting to accounts that use <code>caching_sha2_password</code> authentication over non-secure connection (TLS disabled), the Connector/ODBC requests the RSA public key required to perform the handshake from the server. The option is ignored if the authentication plugin for the connection is different from <code>caching_sha2_password</code> . This corresponds to the <code>MYSQL_OPT_GET_SERVER_PUBLIC_KEY</code> mysql_options() C API function. The value is a boolean.
			The option is added in Connector/ODBC versions 8.0.11 and later. It requires Connector/ODBC built using OpenSSL-based MySQL client library. If MySQL client library used by Connector/ODBC was built with SSL disabled, this option is ignored. This is the case for GPL distributions of Connector/ODBC 5.1.7 and earlier. It is also not functional and is ignored.
<code>NO_TLS_1_0</code>	Disable TLS 1.0	0	Disallows the use of TLS 1.0 for connection encryption. TLS 1.1 and higher are allowed by default, and this option excludes version 1.0. Added in 5.3.7.
<code>NO_TLS_1_1</code>	Disable TLS 1.1	0	Disallows the use of TLS 1.1 for connection encryption. TLS 1.2 and higher are allowed by default, and this option excludes version 1.1. Added in 5.3.7.

Parameter	GUI Option	Default Value	Comment
<code>NO_TLS_1</code>	Disable TLS 1.2	0	Disallows the use of TLS 1.2 for connection encryption. SSL connections are allowed by default, and this option excludes version 1.2. Added in 5.3.7.
<code>SSL_ENFORCE</code>	Enforce SSL	0	Enforce the requirement to use SSL for connections. See Table 5.2, “Combined Effects of <code>SSL_ENFORCE</code> and <code>DISABLE_SSL_DEFAULT</code> ”. Added in 5.3.6.
<code>DISABLE_SSL_DEFAULT</code>	Disable default SSL	0	Disable the default requirement to use SSL for connection. When set to “0” [default], Connector/ODBC tries to establish an SSL connection first, and falls back to unencrypted connection if it is not possible. When set to “1,” Connector/ODBC attempts to establish an SSL connection first, and unencrypted connection is used, unless the <code>SSL_MODE</code> parameter is also set to “1.” See Table 5.2, “Combined Effects of <code>SSL_ENFORCE</code> and <code>DISABLE_SSL_DEFAULT</code> ”. Added in 5.3.6.
<code>SSLMODE</code>	SSL Mode	-	Sets the SSL mode of the server connection. The option can have one of the following values: <code>DISABLED</code> , <code>PREFERRED</code> , <code>REQUIRED</code> , or <code>VERIFY_IDENTITY</code> . See description for the <code>--ssl-mode</code> option in MySQL 5.7 Reference Manual for the meaning of each value. If <code>SSLMODE</code> is not explicitly set, use of the <code>sslca</code> or <code>sslcapath</code> options implies <code>SSLMODE=VERIFY_CA</code> . Added in 5.3.7. This option overrides the deprecated <code>SSL_ENFORCE</code> options.

Note

The SSL configuration parameters can also be automatically loaded from a `my.ini` or `my.cnf` file. See [Using Option Files](#).

Table 5.2 Combined Effects of `SSL_ENFORCE` and `DISABLE_SSL_DEFAULT`

	<code>DISABLE_SSL_DEFAULT = 0</code>	<code>DISABLE_SSL_DEFAULT = 1</code>
<code>SSL_ENFORCE = 0</code>	(Default) Connection with SSL is attempted first; if not possible, fall back to unencrypted connection.	Connection with SSL is not attempted; use unencrypted connection.
<code>SSL_ENFORCE = 1</code>	Connect with SSL; throw an error if an SSL connection cannot be established.	Connect with SSL; throw an error if an SSL connection cannot be established. <code>DISABLE_SSL_DEFAULT=1</code> is overridden.

The behavior of Connector/ODBC can be also modified by using special option parameters listed in [Table 5.3, “Connector/ODBC Option Parameters”](#), specified in the connection string or through the GUI dialog box. All of the connection parameters also have their own numeric constant values, which can be added up as a combined value for the `option` parameter for specifying those options. However, the numerical `option` value in the connection string can only enable, but not disable parameters enabled on the DSN, which can only be overridden by specifying the option parameters using their text names in the connection string.

Note

While the combined numerical value for the `option` parameter can be easily constructed by addition of the options' constant values, decomposing the value to verify if particular options are enabled can be difficult. We recommend using the options' parameter names instead in the connection string, because they are self-explanatory.

Table 5.3 Connector/ODBC Option Parameters

Parameter Name	GUI Option	Constant Value	Description
<code>FOUND_ROWS</code>	Return matched rows instead of affected rows	2	The client cannot get the true value of <code>FOUND_ROWS</code> . MySQL returns 0 if MySQL 3.22.2 or later, or have MySQL 3.23.0 or later.
<code>BIG_PACKETS</code>	Allow big result set	8	Do not set any parameters. With this binding will be treated as a normal result set.
<code>NO_PROMPT</code>	Don't prompt when connecting	16	Do not prompt for password if user like to prompt.
<code>DYNAMIC_CURSOR</code>	Enable Dynamic Cursors	32	Enable or disable dynamic cursors.
<code>NO_SCHEMA</code>	Ignore schema in column specifications	64	Ignore use of database schema. If <code>db_name.tbl_name</code> was removed in MySQL 4.1, use <code>NO_CATALOG</code> .
<code>NO_DEFAULT_CURSOR</code>	Disable driver-provided cursor support	128	Force use of ODBC cursor (experimental).
<code>NO_LOCALE</code>	Don't use <code>setlocale()</code>	256	Disable the use of locale (experimental).
<code>PAD_SPACE</code>	Pad CHAR to full length with space	512	Pad CHAR column to full length.
<code>FULL_COLUMN_NAMES</code>	Include table name in <code>SQLDescribeCol()</code>	1024	<code>SQLDescribeCol()</code> column names.
<code>COMPRESSED_PROTO</code>	Use compression	2048	Use the compressed protocol.
<code>IGNORE_SPACE</code>	Ignore space after function names	4096	Tell server to ignore space and before “(“ (makes all functions case-insensitive).
<code>NAMED_PIPE</code>	Named Pipe	8192	Connect with named pipe running on NT.
<code>NO_BIGINT</code>	Treat BIGINT columns as INT columns	16384	Change <code>BIGINT</code> to <code>INT</code> (some applications expect this).
<code>NO_CATALOG</code>	Disable catalog support	32768	Forces results from query as <code>SQLTables</code> , <code>SQLColumns</code> , etc., driver to report.

Parameter Name	GUI Option	Constant Value	Description
USE_MYCNF	Read options from <code>my.cnf</code>	65536	Read parameters from the [odbc] group in <code>my.cnf</code> .
SAFE	Enable safe options	131072	Add some extra safety.
NO_TRANSACTIONS	Disable transaction support	262144	Disable transactions.
LOG_QUERY	Log queries to %TEMP%\myodbc.sql	524288	Enable querying <code>%TEMP%\myodbc.sql</code> mode.)
NO_CACHE	Don't cache results of forward-only cursors	1048576	Do not cache results in the driver, instead (mysql_use_result) for forward-only cursors is important in applications that do not want to set.
FORWARD_CURSOR	Force use of forward-only cursors	2097152	Force the use of forward-only cases of applications using dynamic cursors to use noncursor-based forward-only cursors.
AUTO_RECONNECT	Enable automatic reconnect	4194304	Enables automatic reconnect. Use this option for reconnecting to a database that may cause connection errors in a client environment. See also in 3.51.13.
AUTO_IS_NULL	Enable SQL_AUTO_IS_NULL	8388608	When AUTO_IS_NULL is enabled, the driver changes the behavior of SQL_AUTO_IS_NULL so you get the MySQL default behavior. Thus, omitting this option and forcing SQL_AUTO_IS_NULL to 0 gets the MySQL behavior. See IS NULL in 3.51.13.
ZERO_DATE_TO_MIN	Return SQL_NULL_DATA for zero date	16777216	Translates zero date to minimum date (XXXX-01-01). Some statements returned an incompatible date.
MIN_DATE_TO_ZERO	Bind minimal date as zero date	33554432	Translates minimum date (XXXX-01-01) to zero date. This is supported by MySQL 5.1.3 and later. It resolves an issue where the date was not working correctly.

Parameter Name	GUI Option	Constant Value	Description
			minimum ODBC Added in 3.51.1
NO_DATE_OVERFLOW	Ignore data overflow error	0	Continue with the return error if the server will ignore result is the same in 5.3.8.
MULTI_STATEMENTS	Allow multiple statements	67108864	Enables support in 3.51.18.
COLUMN_SIZE_S32	Limit column size to signed 32-bit range	134217728	Limits the column size to prevent problems in applications that option is automatically with ADO applications.
NO_BINARY_RESULT	Always handle binary function results as character data	268435456	When set, this controls columns with an 3.51.26.
DFLT_BIGINT_BIND_STR	Bind BIGINT parameters as strings	536870912	Causes BIGINT strings. Microsoft a string on linked correctly, but both is used automatically Microsoft Access.
NO_INFORMATION_SCHEMA	Don't use INFORMATION_SCHEMA for metadata	1073741824	Tells catalog functions INFORMATION_SCHEMA legacy algorithm usually speed for INFORMATION_SCHEMA information obtained 5.1.7.

Table 5.4, “Recommended Connector/ODBC Option Values for Different Configurations” shows some recommended parameter settings and their corresponding `option` values for various configurations:

Table 5.4 Recommended Connector/ODBC Option Values for Different Configurations

Configuration Settings
Microsoft ROWS=1; Access, Visual Basic
Microsoft ROWS=1;DYNAMIC_CURSOR=1; Access (with improved DELETE queries)
Microsoft COLUMN_SIZE_S32=1; SQL Server
LargeCOMPRESSED_PROTO=1; tables with

```
Configuration  
Settings  
too  
many  
rows  
SyNQ=8SPACE=1;FLAG_SAFE=1;  
PowerBuilder  
QuERy=248E1;  
log  
generation  
(Debug  
mode)  
LangUAGe=1;FORWARD_CURSOR=1;  
tables  
with  
no-  
cache  
results  
ApPLICATiON=1  
that Applicable  
run  
full-  
table  
"SELECT  
*  
FROM ...  
"  
query,  
but  
read  
only  
a  
small  
number  
(N)  
of  
rows  
from  
the  
result
```

5.5.3 Configuring a Connector/ODBC DSN on Windows

To add or configure a Connector/ODBC 5.x or 8.x DSN on Windows, use either the [ODBC Data Source Administrator](#) GUI, or the command-line tool `myodbc-installer.exe` that comes with Connector/ODBC.

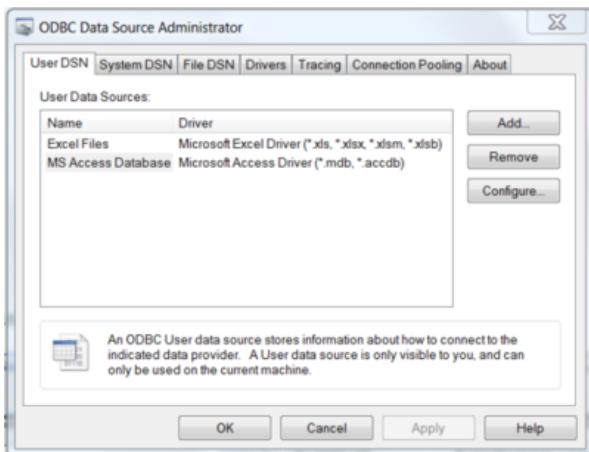
5.5.3.1 Configuring a Connector/ODBC DSN on Windows with the ODBC Data Source Administrator GUI

The [ODBC Data Source Administrator](#) on Windows lets you create DSNs, check driver installation, and configure ODBC functions such as tracing (used for debugging) and connection pooling. The following are steps for creating and configuring a DSN with the [ODBC Data Source Administrator](#):

1. Open the [ODBC Data Source Administrator](#).

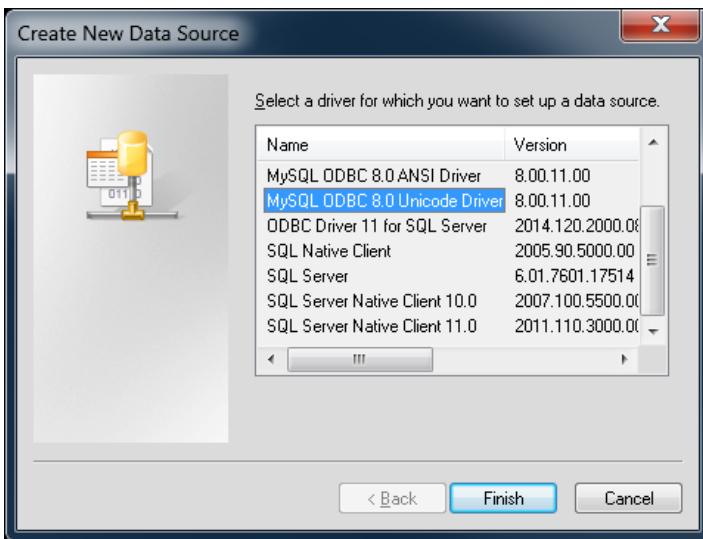
Different editions and versions of Windows store the [ODBC Data Source Administrator](#) in different locations. For instructions on opening the [ODBC Data Source Administrator](#), see the documentation for your Windows version; [these instructions](#) from Microsoft cover some popular Windows platforms. You should see a window similar to the following when you open the [ODBC Data Source Administrator](#):

Figure 5.7 ODBC Data Source Administrator Dialog



2. To create a System DSN (which will be available to all users), select the **System DSN** tab. To create a User DSN, which will be available only to the current user, click the **Add...** button to open the "Create New Data Source" dialog.
3. From the "Create New Data Source" dialog, select the MySQL ODBC 5.x ANSI or Unicode Driver, then click **Finish** to open its connection parameters dialog.

Figure 5.8 Create New Data Source Dialog: Choosing a MySQL ODBC Driver



4. You now need to configure the specific fields for the DSN you are creating through the [Connection Parameters](#) dialog.

Figure 5.9 Data Source Configuration Connection Parameters Dialog



In the **Data Source Name** box, enter the name of the data source to access. It can be any valid name that you choose.

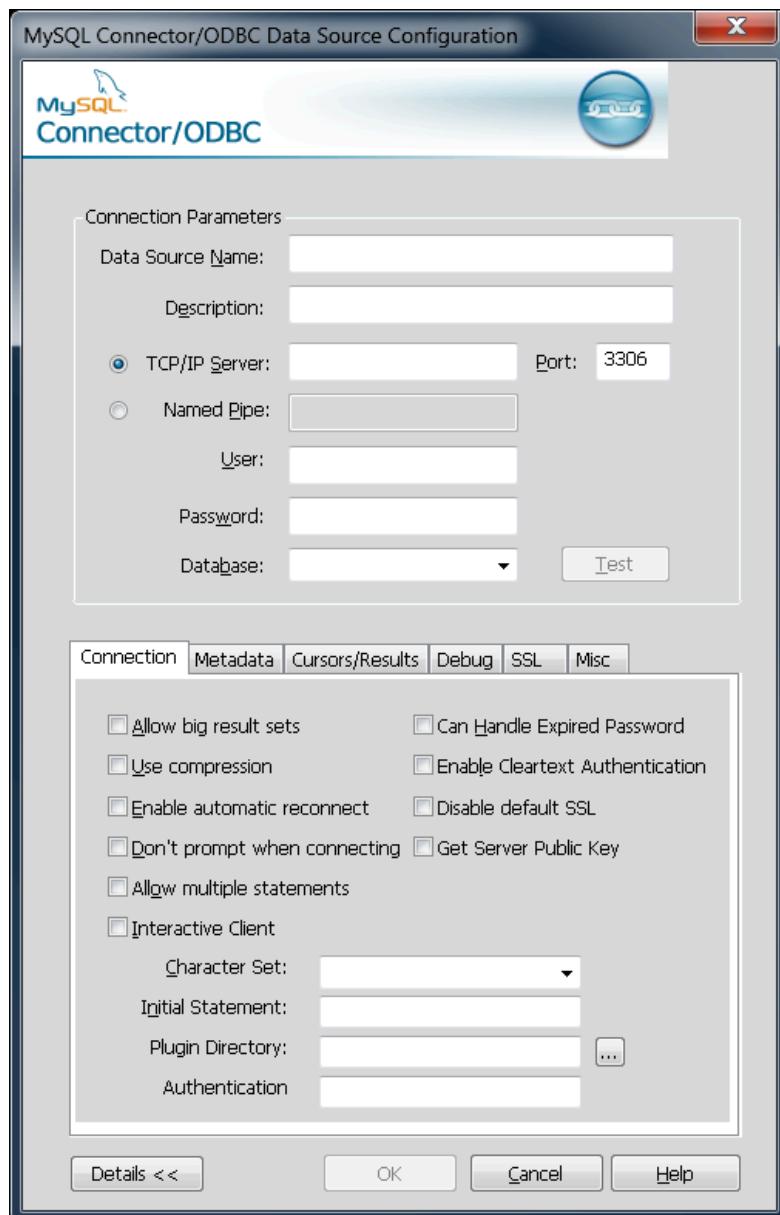
Tip

To identify whether a DSN was created using the 32-bit or the 64-bit driver, include the driver being used within the DSN identifier. This will help you to identify the right DSN to use with applications such as Excel that are only compatible with the 32-bit driver. For example, you might add [Using32bitODBC](#) to the DSN identifier for the 32-bit interface and [Using64bitODBC](#) for those using the 64-bit Connector/ODBC driver.

5. In the **Description** box, enter some text to help identify the connection.
6. In the **Server** field, enter the name of the MySQL server host to access. By default, it is [localhost](#).
7. In the **User** field, enter the user name to use for this connection.
8. In the **Password** field, enter the corresponding password for this connection.
9. The **Database** pop-up should be automatically populated with the list of databases that the user has permissions to access.
10. To communicate over a different TCP/IP port than the default (3306), change the value of the **Port**.
11. Click **OK** to save the DSN.

To verify the connection using the parameters you have entered, click the **Test** button. If the connection can be made successfully, you will be notified with a [Connection Successful](#) dialog; otherwise, you will be notified with a [Connection Failed](#) dialog.

You can configure a number of options for a specific DSN by clicking the **Details** button.

Figure 5.10 Connector/ODBC Connect Options Dialog

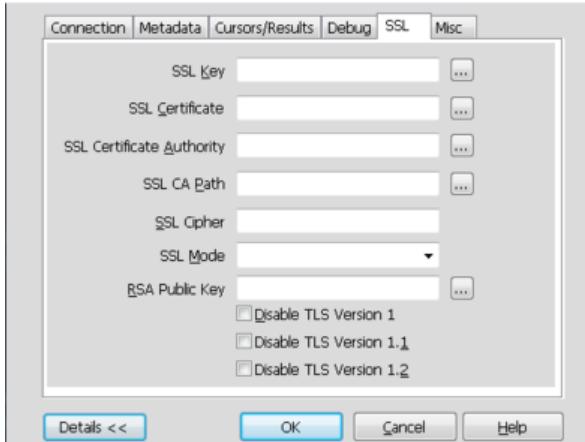
Toggling the **Details** button opens (or closes) an additional tabbed display where you set additional options that include the following:

- **Connections, Metadata, and Cursors/Results** enable you to select the additional flags for the DSN connection. For more information on these flags, see [Section 5.5.2, “Connector/ODBC Connection Parameters”](#).

Note

For the Unicode version of Connector/ODBC, due to its native Unicode support, you do not need to specify the initial character set to be used with your connection. However, for the ANSI version, if you want to use a multibyte character set such as UTF-16 or UTF-32 initially, specify it in **Character Set** box; however, that is not necessary for using UTF-8 or UTF-8-MB4 initially, because they do not contain \0 bytes in any characters, and therefore the ANSI driver will not truncate the strings by accident when finding \0 bytes.

- **Debug** lets you turn on ODBC debugging to record the queries you execute through the DSN to the `myodbc.sql` file. For more information, see [Section 5.5.8, “Getting an ODBC Trace File”](#).
- **SSL** configures the additional options required for using the Secure Sockets Layer (SSL) when communicating with MySQL server.

Figure 5.11 Connector/ODBC Connect Options Dialog: SSL Options

You must also enable and configure SSL on the MySQL server with suitable certificates to communicate using it using SSL.

5.5.3.2 Configuring a Connector/ODBC DSN on Windows, Using the Command Line

Use `myodbc-installer.exe` when configuring Connector/ODBC from the command-line.

Execute `myodbc-installer.exe` without arguments to view a list of available options.

5.5.3.3 Troubleshooting ODBC Connection Problems

This section answers Connector/ODBC connection-related questions.

- While configuring a Connector/ODBC DSN, a [Could Not Load Translator or Setup Library](#) error occurs

For more information, refer to [MS KnowledgeBase Article\(Q260558\)](#). Also, make sure you have the latest valid `ct13d32.dll` in your system directory.

- The Connector/ODBC .dll (Windows) and .so (Linux) file names depend on several factors:

Connector/ODBC Version: A digit in the file name indicates the major Connector/ODBC version number. For example, a file named `myodbc8w.dll` is for Connector/ODBC 8.x whereas `myodbc5w.dll` is for Connector/ODBC 5.x.

Driver Type: The Unicode driver adds the letter "w" to file names to indicate that wide characters are supported. For example, `myodbc8w.dll` is for the Unicode driver. The ANSI driver adds the letter "a" instead of a "w", like `myodbc8a.dll`.

GUI Setup module: The GUI setup module files add the letter "S" to file names.

- **Enabling Debug Mode:** typically debug mode is not enabled as it decreases performance. The driver must be compiled with debug mode enabled.

5.5.4 Configuring a Connector/ODBC DSN on macOS

To configure a DSN on macOS, you can either use the command-line utility (`myodbc-installer`), edit the `odbc.ini` file within the `Library/ODBC` directory of the user, or use the ODBC Administrator GUI.

Note

The ODBC Administrator is included in OS X v10.5 and earlier; users of later versions of OS X and macOS need to download and install it manually.

To create a DSN using the [myodbc-installer](#) utility, you only need to specify the DSN type and the DSN connection string. For example:

```
// With Connector/ODBC 8.0:  
shell> myodbc-installer -a -s -t"DSN=mydb;DRIVER=MySQL ODBC 8.0 Driver;SERVER=mysql;USER=username;PASSWORD=  
// With Connector/ODBC 5.3:  
shell> myodbc-installer -a -s -t"DSN=mydb;DRIVER=MySQL ODBC 5.3 Driver;SERVER=mysql;USER=username;PASSWORD=
```

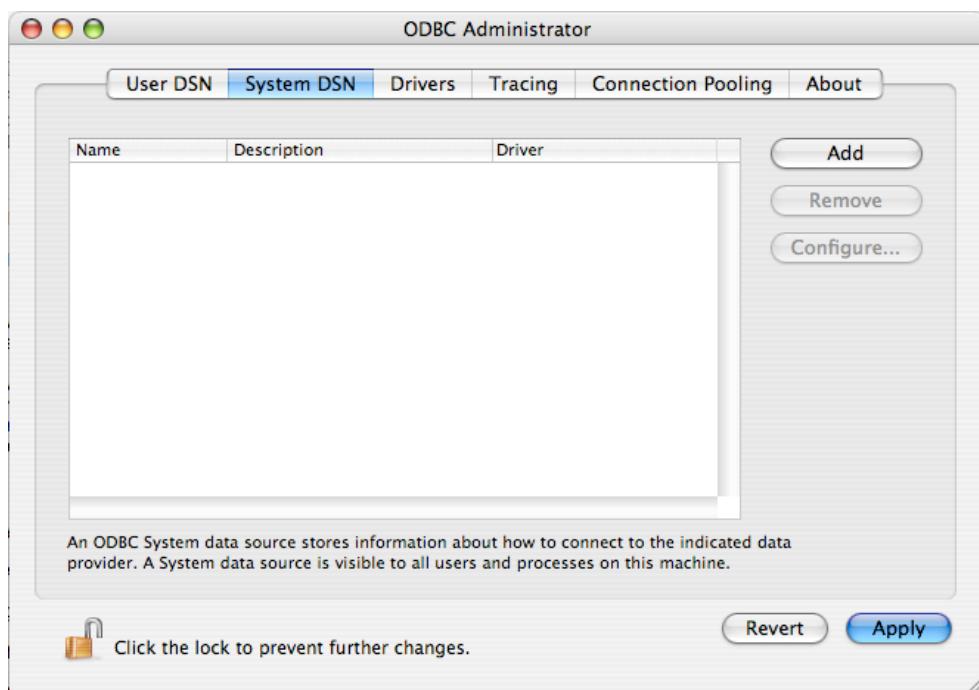
To use ODBC Administrator:

Warning

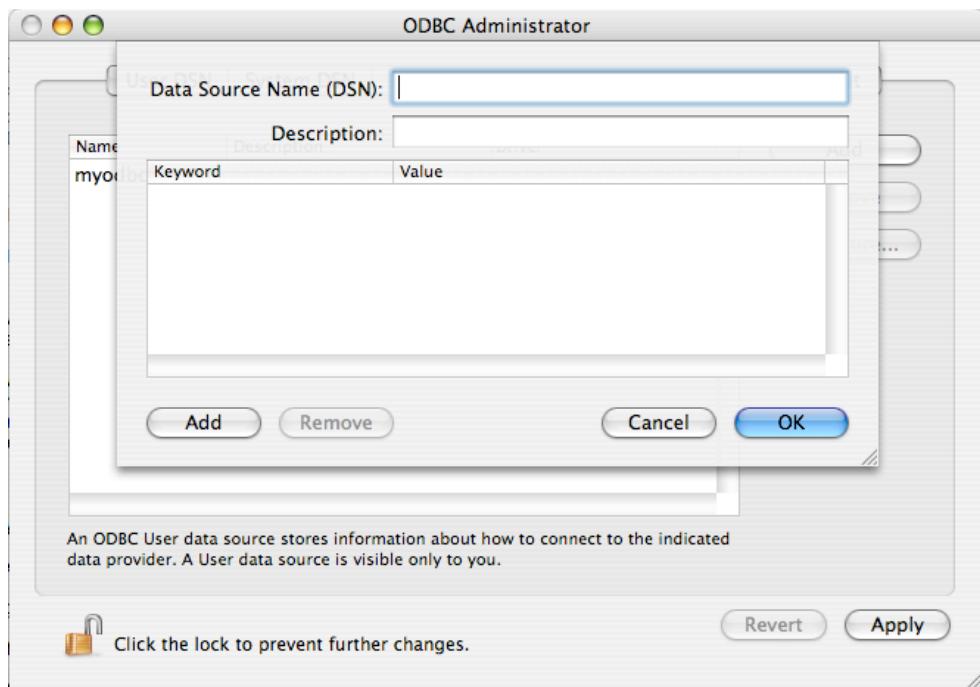
- For correct operation of ODBC Administrator, ensure that the [/Library/ODBC/odbc.ini](#) file used to set up ODBC connectivity and DSNs are writable by the [admin](#) group. If this file is not writable by this group, then the ODBC Administrator may fail, or may appear to work but not generate the correct entry.
- There are known issues with the macOS ODBC Administrator and Connector/ODBC that may prevent you from creating a DSN using this method. In that case, use the command line or edit the [odbc.ini](#) file directly. Existing DSNs or those that you created using the [myodbc-installer](#) tool can still be checked and edited using ODBC Administrator.

1. Open the ODBC Administrator from the [Utilities](#) folder in the [Applications](#) folder.

Figure 5.12 ODBC Administrator Dialog

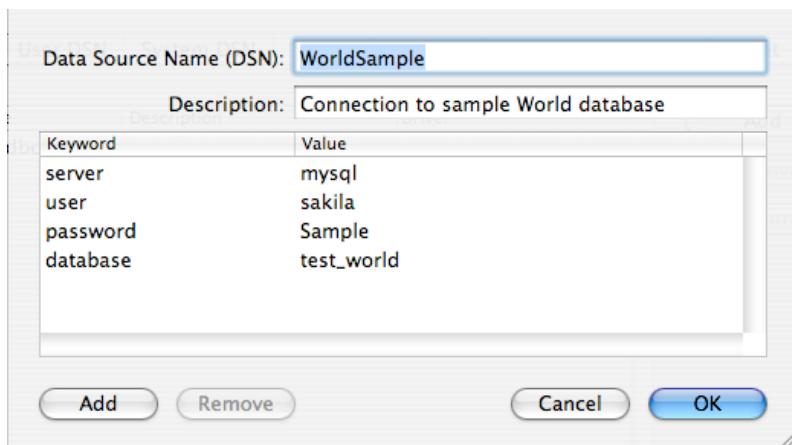


2. From the [ODBC Administrator](#) dialog, choose either the **User DSN** or **System DSN** tab and click **Add**.
3. Select the Connector/ODBC driver and click **OK**.
4. You will be presented with the [Data Source Name \(DSN\)](#) dialog. Enter the [Data Source Name](#) and an optional [Description](#) for the DSN.

Figure 5.13 ODBC Administrator Data Source Name Dialog

5. Click **Add** to add a new keyword/value pair to the panel. Configure at least four pairs to specify the `server`, `username`, `password` and `database` connection parameters. See [Section 5.5.2, “Connector/ODBC Connection Parameters”](#).
6. Click **OK** to add the DSN to the list of configured data source names.

A completed DSN configuration may look like this:

Figure 5.14 ODBC Administrator Sample DSN Dialog

You can configure other ODBC options in your DSN by adding further keyword/value pairs and setting the corresponding values. See [Section 5.5.2, “Connector/ODBC Connection Parameters”](#).

5.5.5 Configuring a Connector/ODBC DSN on Unix

On [Unix](#), you configure DSN entries directly in the `odbc.ini` file. Here is a typical `odbc.ini` file that configures `myodbc8w` (Unicode) and `myodbc8a` (ANSI) as DSN names for Connector/ODBC 8.0:

```
;;
; odbc.ini configuration for Connector/ODBC 8.0 driver
;;
```

```
[ODBC Data Sources]
myodbc8w      = MyODBC 8.0 UNICODE Driver DSN
myodbc8a      = MyODBC 8.0 ANSI Driver DSN
[myodbc8w]
Driver        = /usr/local/lib/libmyodbc8w.so
Description   = Connector/ODBC 8.0 UNICODE Driver DSN
SERVER        = localhost
PORT          =
USER          = root
Password      =
Database      = test
OPTION        = 3
SOCKET        =
[myodbc8a]
Driver        = /usr/local/lib/libmyodbc8a.so
Description   = Connector/ODBC 8.0 ANSI Driver DSN
SERVER        = localhost
PORT          =
USER          = root
Password      =
Database      = test
OPTION        = 3
SOCKET        =
```

Refer to the [Section 5.5.2, “Connector/ODBC Connection Parameters”](#), for the list of connection parameters that can be supplied.

Note

If you are using `unixODBC`, you can use the following tools to set up the DSN:

- `ODBCConfig` GUI tool ([HOWTO: ODBCConfig](#))
- `odbconfig`

In some cases when using `unixODBC`, you might get this error:

```
Data source name not found and no default driver specified
```

If this happens, make sure the `ODBCINI` and `ODBCSYSINI` environment variables are pointing to the right `odbc.ini` file. For example, if your `odbc.ini` file is located in `/usr/local/etc`, set the environment variables like this:

```
export ODBCINI=/usr/local/etc/odbc.ini
export ODBCSYSINI=/usr/local/etc
```

5.5.6 Connecting Without a Predefined DSN

You can connect to the MySQL server using `SQLDriverConnect`, by specifying the `DRIVER` name field. Here are the connection strings for Connector/ODBC using DSN-less connections:

For Connector/ODBC 8.0:

```
ConnectionString = "DRIVER={MySQL ODBC 8.0 Driver};\
                   SERVER=localhost; \
                   DATABASE=test; \
                   USER=venu; \
                   PASSWORD=venu; \
                   OPTION=3;"
```

Substitute “MySQL ODBC 8.0 Driver” with the name by which you have registered your Connector/ODBC driver with the ODBC driver manager, if it is different. If your programming language converts backslash followed by whitespace to a space, it is preferable to specify the connection string as a single long string, or to use a concatenation of multiple strings that does not add spaces in between. For example:

```
ConnectionString = "DRIVER={MySQL ODBC 8.0 Driver};"
                  "SERVER=localhost;"
                  "DATABASE=test;"
```

```
"USER=venu;"  
"PASSWORD=venu;"  
"OPTION=3;"
```

Note. On macOS, you might need to specify the full path to the Connector/ODBC driver library.

Refer to [Section 5.5.2, “Connector/ODBC Connection Parameters”](#) for the list of connection parameters that can be supplied.

5.5.7 ODBC Connection Pooling

Connection pooling enables the ODBC driver to re-use existing connections to a given database from a pool of connections, instead of opening a new connection each time the database is accessed. By enabling connection pooling you can improve the overall performance of your application by lowering the time taken to open a connection to a database in the connection pool.

For more information about connection pooling: <http://support.microsoft.com/default.aspx?scid=kb;EN-US;q169470>.

5.5.8 Getting an ODBC Trace File

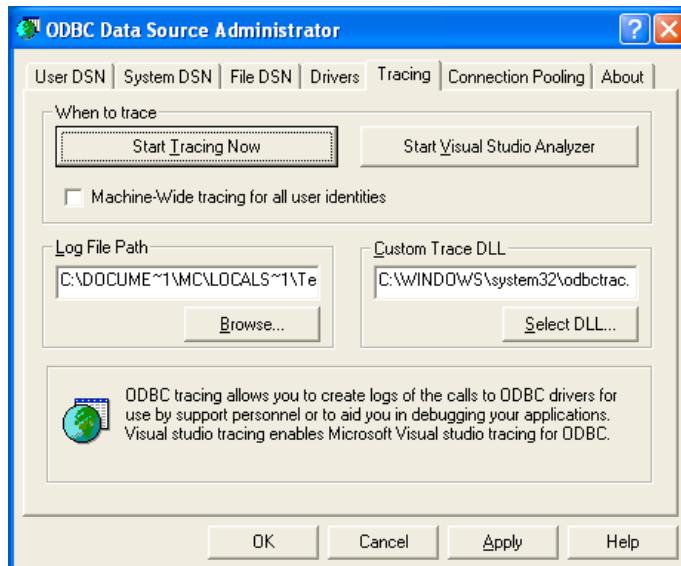
If you encounter difficulties or problems with Connector/ODBC, start by making a log file from the [ODBC Manager](#) and Connector/ODBC. This is called *tracing*, and is enabled through the ODBC Manager. The procedure for this differs for Windows, macOS and Unix.

5.5.8.1 Enabling ODBC Tracing on Windows

To enable the trace option on Windows:

1. The [Tracing](#) tab of the ODBC Data Source Administrator dialog box lets you configure the way ODBC function calls are traced.

Figure 5.15 ODBC Data Source Administrator Tracing Dialog



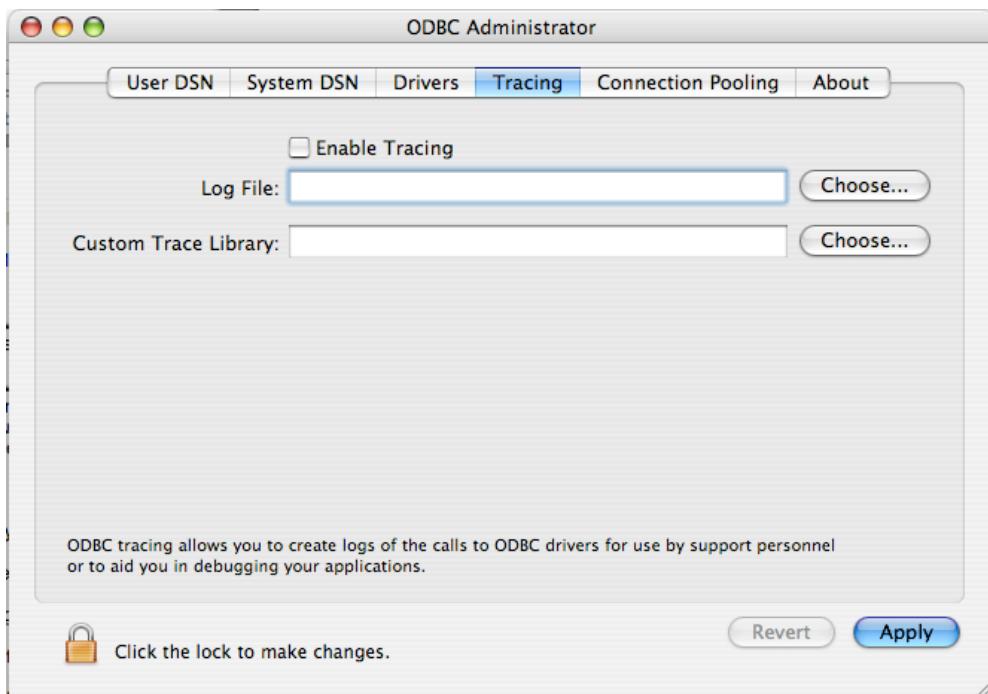
2. When you activate tracing from the [Tracing](#) tab, the [Driver Manager](#) logs all ODBC function calls for all subsequently run applications.
3. ODBC function calls from applications running before tracing is activated are not logged. ODBC function calls are recorded in a log file you specify.
4. Tracing ceases only after you click [Stop Tracing Now](#). Remember that while tracing is on, the log file continues to increase in size and that tracing affects the performance of all your ODBC applications.

5.5.8.2 Enabling ODBC Tracing on macOS

To enable the trace option on macOS, use the [Tracing](#) tab within ODBC Administrator .

1. Open the ODBC Administrator.
2. Select the [Tracing](#) tab.

Figure 5.16 ODBC Administrator Tracing Dialog



3. Select the [Enable Tracing](#) check box.
4. Enter the location to save the Tracing log. To append information to an existing log file, click the [Choose...](#) button.

5.5.8.3 Enabling ODBC Tracing on Unix

To enable the trace option on OS X 10.2 (or earlier) or Unix, add the [trace](#) option to the ODBC configuration:

1. On Unix, explicitly set the [Trace](#) option in the [ODBC.INI](#) file.

Set the tracing [ON](#) or [OFF](#) by using [TraceFile](#) and [Trace](#) parameters in [odbc.ini](#) as shown below:

```
TraceFile  = /tmp/odbc.trace
Trace      = 1
```

[TraceFile](#) specifies the name and full path of the trace file and [Trace](#) is set to [ON](#) or [OFF](#). You can also use [1](#) or [YES](#) for [ON](#) and [0](#) or [NO](#) for [OFF](#). If you are using [ODBCConfig](#) from [unixODBC](#), then follow the instructions for tracing [unixODBC](#) calls at [HOWTO-ODBCConfig](#).

5.5.8.4 Enabling a Connector/ODBC Log

To generate a Connector/ODBC log, do the following:

1. Within Windows, enable the [Trace Connector/ODBC](#) option flag in the Connector/ODBC connect/configure screen. The log is written to file [C:\myodbc.log](#). If the trace option is not

remembered when you are going back to the above screen, it means that you are not using the `myodbc.dll` driver, see [Section 5.5.3.3, “Troubleshooting ODBC Connection Problems”](#).

On macOS, Unix, or if you are using a DSN-less connection, either supply `OPTION=4` in the connection string, or set the corresponding keyword/value pair in the DSN.

2. Start your application and try to get it to fail. Then check the Connector/ODBC trace file to find out what could be wrong.

If you need help determining what is wrong, see [Section 5.9.1, “Connector/ODBC Community Support”](#).

5.6 Connector/ODBC Examples

Once you have configured a DSN to provide access to a database, how you access and use that connection is dependent on the application or programming language. As ODBC is a standardized interface, any application or language that supports ODBC can use the DSN and connect to the configured database.

5.6.1 Basic Connector/ODBC Application Steps

Interacting with a MySQL server from an applications using the Connector/ODBC typically involves the following operations:

- Configure the Connector/ODBC DSN.
- Connect to MySQL server.

This might include: allocate environment handle, set ODBC version, allocate connection handle, connect to MySQL Server, and set optional connection attributes.

- Initialization statements.

This might include: allocate statement handle and set optional statement attributes.

- Execute SQL statements.

This might include: prepare the SQL statement and execute the SQL statement, or execute it directly without prepare.

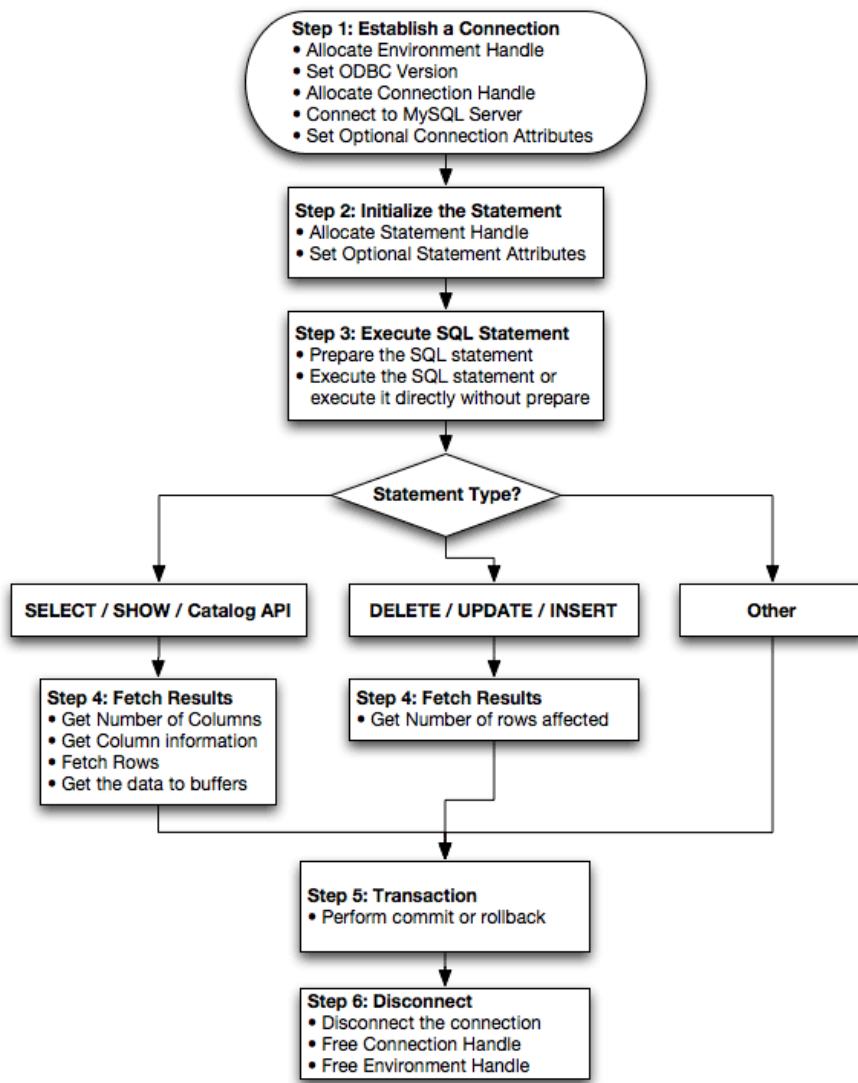
- Retrieve results, depending on the statement type.

For SELECT / SHOW / Catalog API the results might include: get number of columns, get column information, fetch rows, and get the data to buffers. For Delete / Update / Insert the results might include the number of rows affected.

- Perform [transactions](#); perform commit or rollback.
- Disconnect from the server.

This might include: disconnect the connection and free the connection and environment handles.

Most applications use some variation of these steps. The basic application steps are also shown in the following diagram:

Figure 5.17 Connector/ODBC Programming Flowchart

5.6.2 Step-by-step Guide to Connecting to a MySQL Database through Connector/ODBC

A typical situation where you would install Connector/ODBC is to access a database on a Linux or Unix host from a Windows machine.

As an example of the process required to set up access between two machines, the steps below take you through the basic steps. These instructions assume that you connect to system ALPHA from system BETA with a user name and password of `myuser` and `mypassword`.

On system ALPHA (the MySQL server) follow these steps:

1. Start the MySQL server.
2. Use `GRANT` to set up an account with a user name of `myuser` that can connect from system BETA using a password of `myuser` to the database `test`:

```
GRANT ALL ON test.* to 'myuser'@'BETA' IDENTIFIED BY 'mypassword';
```

For more information about MySQL privileges, refer to [Access Control and Account Management](#).

On system BETA (the Connector/ODBC client), follow these steps:

1. Configure a Connector/ODBC DSN using parameters that match the server, database and authentication information that you have just configured on system ALPHA.

Parameter	Value	Comment
DSN	remote_test	A name to identify the connection.
SERVER	ALPHA	The address of the remote server.
DATABASE	test	The name of the default database.
USER	myuser	The user name configured for access to this database.
PASSWORD	mypassword	The password for myuser .

2. Using an ODBC-capable application, such as Microsoft Office, connect to the MySQL server using the DSN you have just created. If the connection fails, use tracing to examine the connection process. See [Section 5.5.8, "Getting an ODBC Trace File"](#), for more information.

5.6.3 Connector/ODBC and Third-Party ODBC Tools

Once you have configured your Connector/ODBC DSN, you can access your MySQL database through any application that supports the ODBC interface, including programming languages and third-party applications. This section contains guides and help on using Connector/ODBC with various ODBC-compatible tools and applications, including Microsoft Word, Microsoft Excel and Adobe/Macromedia ColdFusion.

Connector/ODBC has been tested with the following applications:

Publisher	Application	Notes
Adobe	ColdFusion	Formerly Macromedia ColdFusion
Borland	C++ Builder	
	Builder 4	
	Delphi	
Business Objects	Crystal Reports	
Claris	Filemaker Pro	
Corel	Paradox	
Computer Associates	Visual Objects	Also known as CAVO
	AllFusion ERwin Data Modeler	
Gupta	Team Developer	Previously known as Centura Team Developer; Gupta SQL/Windows
Gensym	G2-ODBC Bridge	
Inline	iHTML	
Lotus	Notes	Versions 4.5 and 4.6
Microsoft	Access	
	Excel	
	Visio Enterprise	
	Visual C++	
	Visual Basic	
	ODBC.NET	Using C#, Visual Basic, C++
	FoxPro	
	Visual Interdev	

Publisher	Application	Notes
OpenOffice.org	OpenOffice.org	
Perl	DBD::ODBC	
Pervasive Software	DataJunction	
Sambar Technologies	Sambar Server	
SPSS	SPSS	
SoftVelocity	Clarion	
SQLExpress	SQLExpress for Xbase+ +	
Sun	StarOffice	
SunSystems	Vision	
Sybase	PowerBuilder	
	PowerDesigner	
theKompany.com	Data Architect	

5.6.4 Using Connector/ODBC with Microsoft Access

You can use a MySQL database with Microsoft Access using Connector/ODBC. The MySQL database can be used as an import source, an export source, or as a linked table for direct use within an Access application, so you can use Access as the front-end interface to a MySQL database.

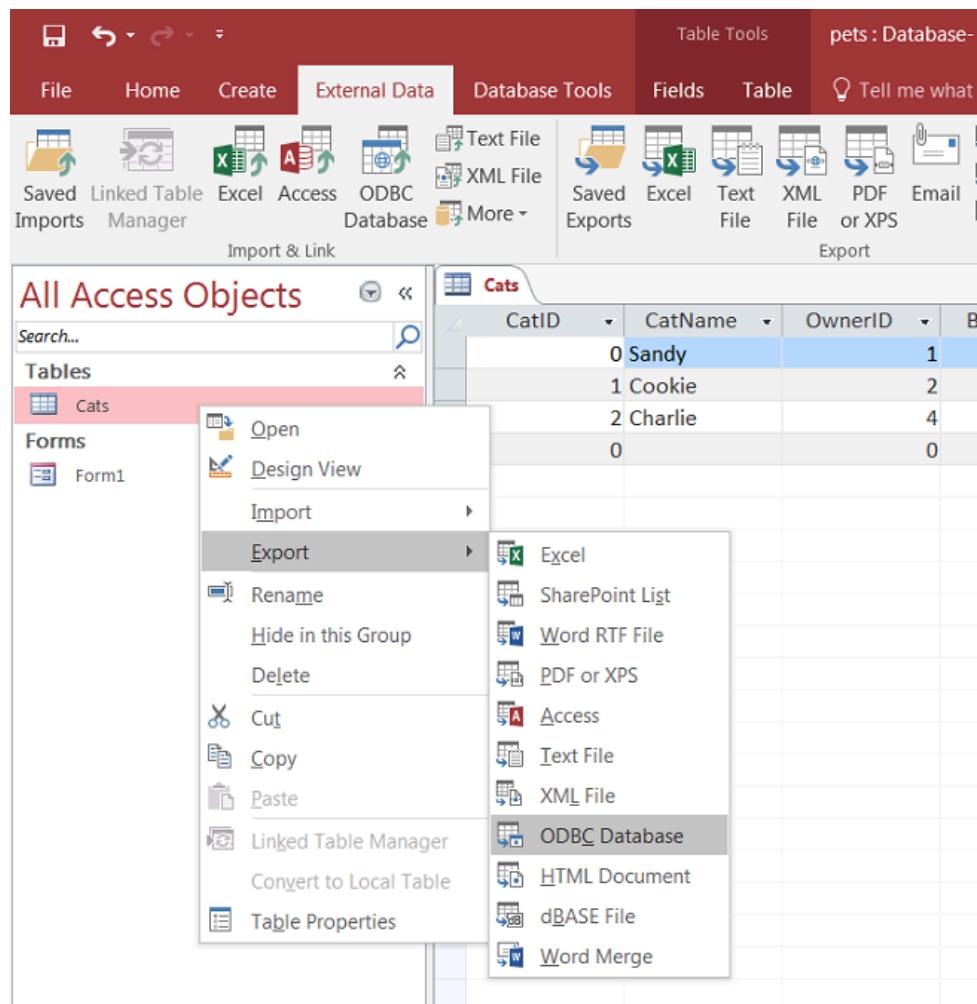
5.6.4.1 Exporting Access Data to MySQL

Important

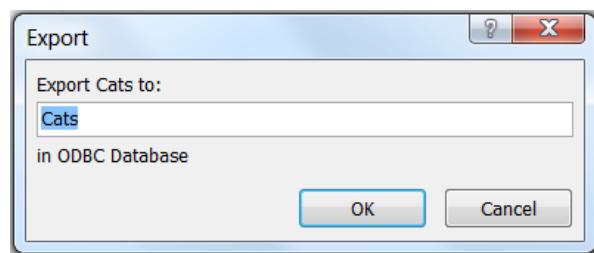
Make sure that the information that you are exporting to the MySQL table is valid for the corresponding MySQL data types. Values that are valid within Access but are outside of the supported ranges of the MySQL data types may trigger an “overflow” error during the export.

To export a table of data from an Access database to MySQL, follow these instructions:

1. With an Access database opened, the navigation plane on the right should display, among other things, all the tables in the database that are available for export (if that is not the case, adjust the navigation plane's display settings). Right click on the table you want to export, and in the menu that appears, choose **Export , ODBC Database**.

Figure 5.18 Access: Export ODBC Database Menu Selected

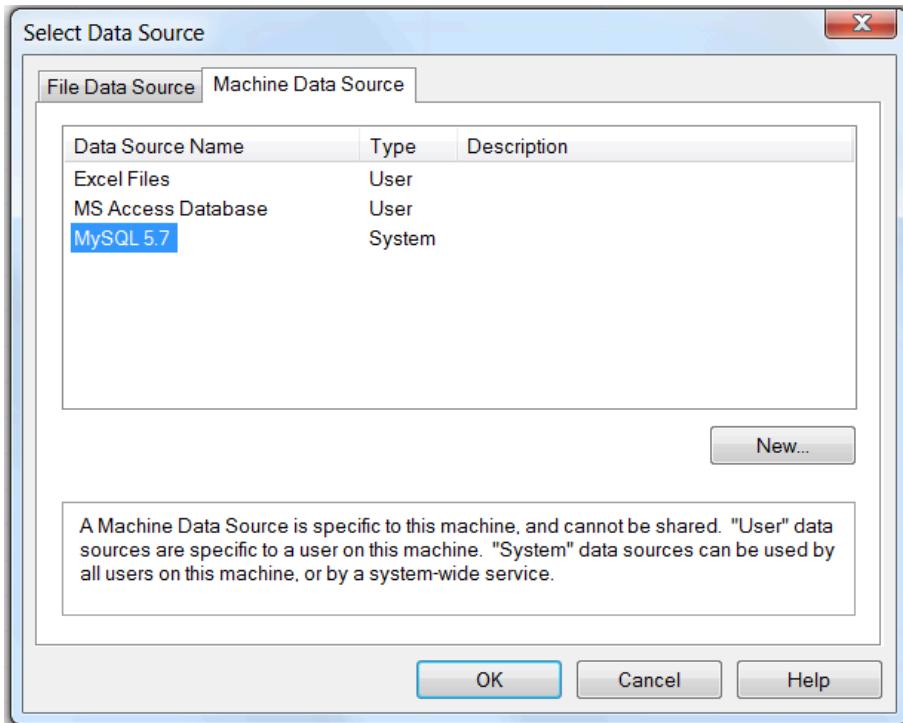
2. The **Export** dialog box appears. Enter the desired name for the table after its import into the MySQL server, and click **OK**.

Figure 5.19 Entering Name For Table To Be Exported

3. The **Select Data Source** dialog box appears; it lists the defined data sources for any ODBC drivers installed on your computer. Click either the **File Data Source** or **Machine Data Source** tab, and then double-click the Connector/ODBC DSN to which you want to export your table. To define a new DSN for Connector/ODBC instead, click **New** and follow the instructions in [Section 5.5.3](#),

["Configuring a Connector/ODBC DSN on Windows"](#); double click the new DSN after it has been created.

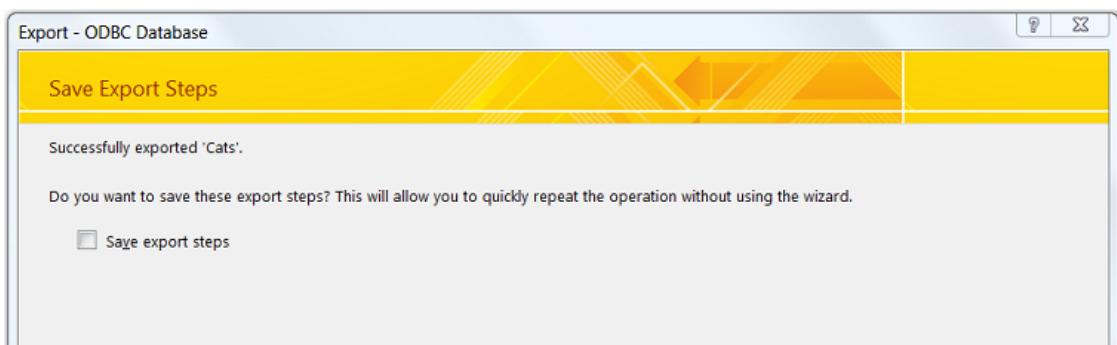
Figure 5.20 Selecting An ODBC Database



If the ODBC data source that you selected requires you to log in, enter your login ID and password (additional information might also be required), and then click **OK**.

4. A dialog box appears with a success message if the export is successful. In the dialog box, you can choose to save the export steps for easy repetitions in the future.

Figure 5.21 Save Export Success Message

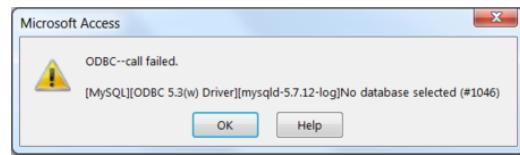


Note

If you see the following error message instead when you try to export to the Connector/ODBC DSN, it means you did not choose the **Database** to connect to when you defined or logged in to the DSN. Reconfigure the DSN and specify the **Database** to connect to (see [Section 5.5.3, "Configuring](#)

a Connector/ODBC DSN on Windows" for details), or choose a **Database** when you log in to the DSN .

Figure 5.22 Error Message Dialog: Database Not Selected

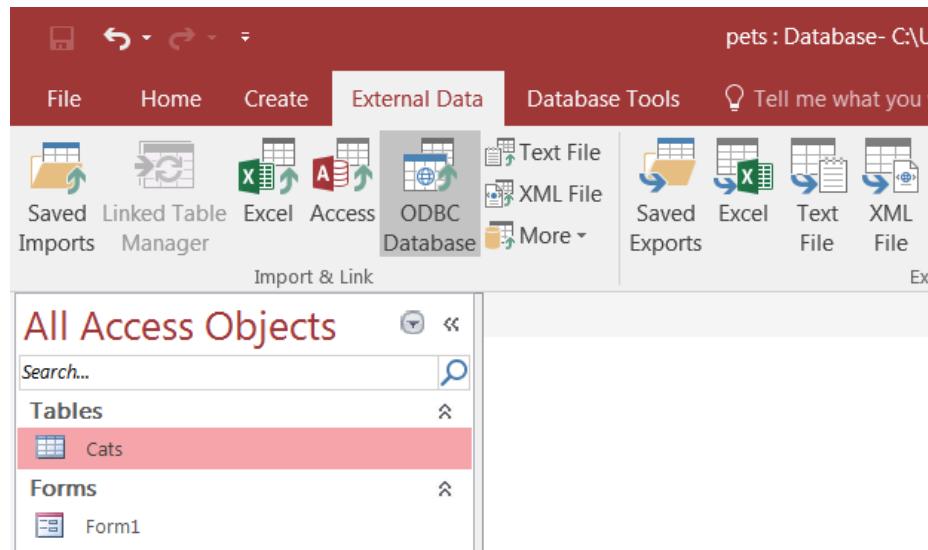


5.6.4.2 Importing MySQL Data to Access

To import tables from MySQL to Access, follow these instructions:

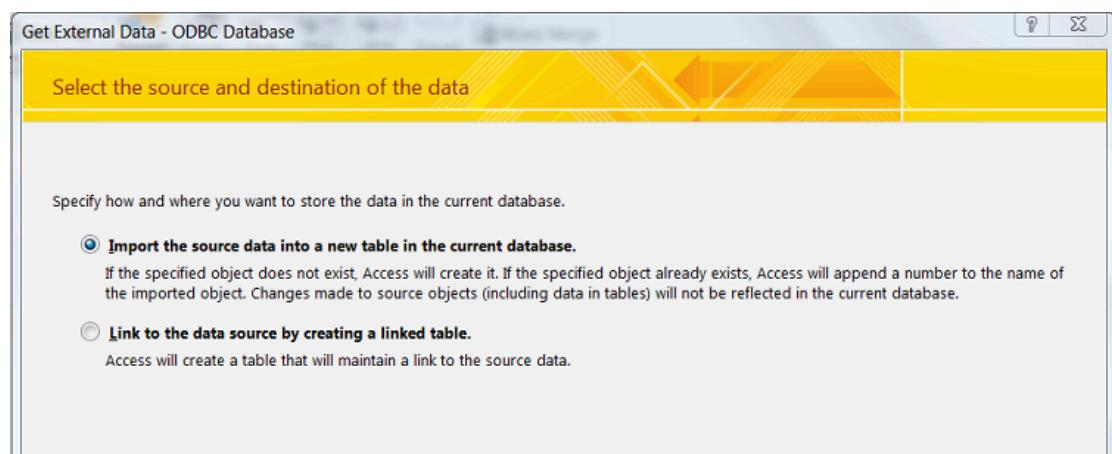
1. Open the Access database into which that you want to import MySQL data.
2. On the **External Data** tab, choose **ODBC Database**.

Figure 5.23 External Data: ODBC Database



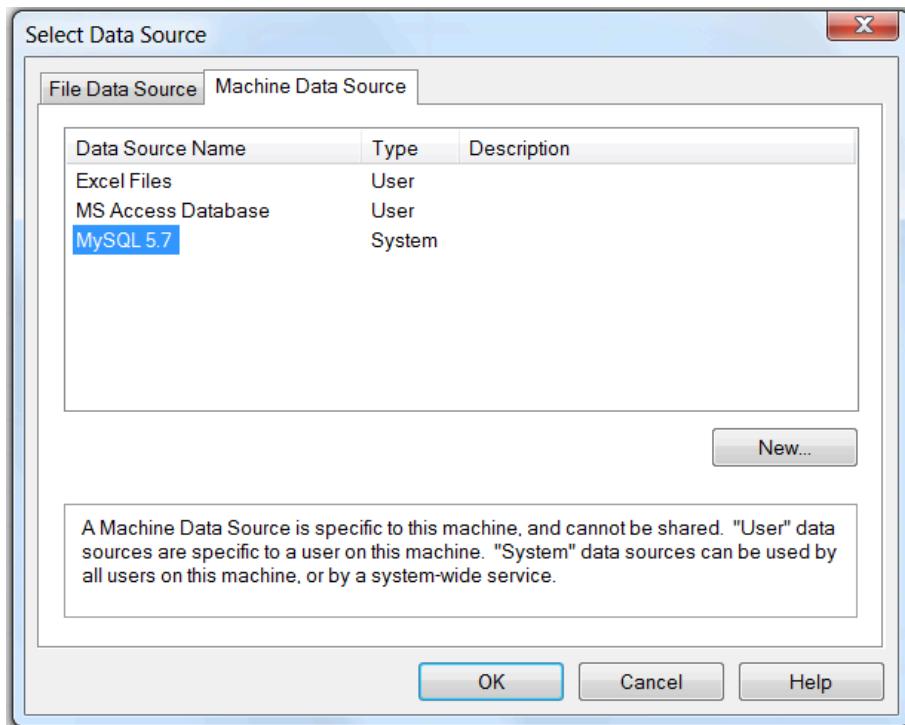
3. In the **Get External Data** dialog box that appears, choose **Import the source data into a new table in the current database** and click **OK**.

Figure 5.24 Get External Data: ODBC Database



- The **Select Data Source** dialog box appears. It lists the defined data sources for any ODBC drivers installed on your computer. Click either the **File Data Source** or **Machine Data Source** tab, and then double-click the Connector/ODBC DSN from which you want to import your table. To define a new DSN for Connector/ODBC instead, click **New** and follow the instructions in [Section 5.5.3, "Configuring a Connector/ODBC DSN on Windows"](#); double click the new DSN after it has been created.

Figure 5.25 Select Data Source Dialog: Selecting an ODBC Database



If the ODBC data source that you selected requires you to log in, enter your login ID and password (additional information might also be required), and then click **OK**.

- Microsoft Access connects to the MySQL server and displays the list of tables (objects) that you can import. Select the tables you want to import from this Import Objects dialog (or click **Select All**), and then click **OK**.

Figure 5.26 Import Objects Dialog: Selecting Tables To Import

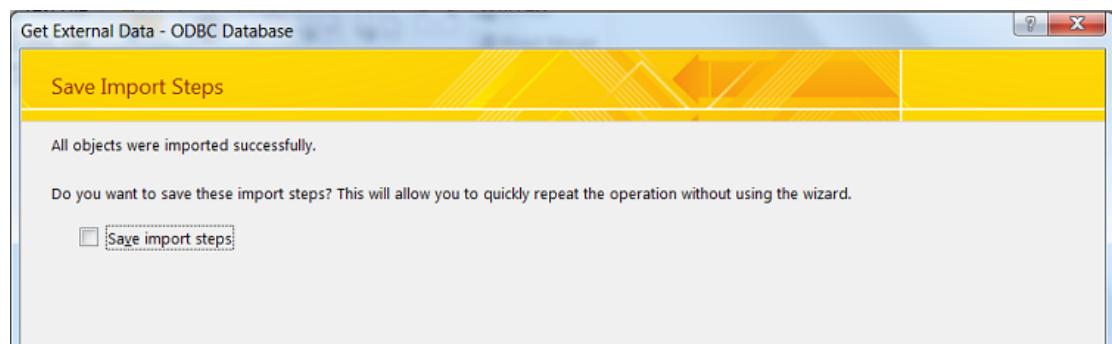


Notes

- If no tables show up for you to select, it might be because you did not choose the **Database** to connect to when you defined or logged in to the

- DSN. Reconfigure the DSN and specify the **Database** to connect to (see [Section 5.5.3, “Configuring a Connector/ODBC DSN on Windows”](#) for details), or choose a **Database** when you log in to the DSN .
- If your Access database already has a table with the same name as the one you are importing, Access will append a number to the name of the imported table.
6. A dialog box appears with a success message if the import is successful. In the dialog box, you can choose to save the import steps for easy repetitions in the future.

Figure 5.27 Get External Data: Save Import Steps Dialog



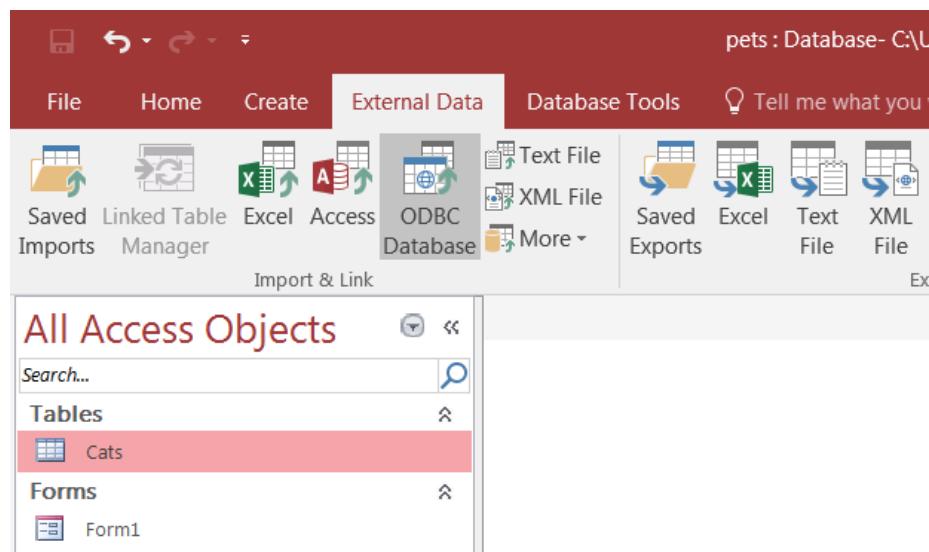
5.6.4.3 Using Microsoft Access as a Front-end to MySQL

You can use Microsoft Access as a front end to MySQL by linking tables within your Microsoft Access database to tables that exist within your MySQL database. When a query is requested on a table within Access, ODBC is used to execute the queries on the MySQL database.

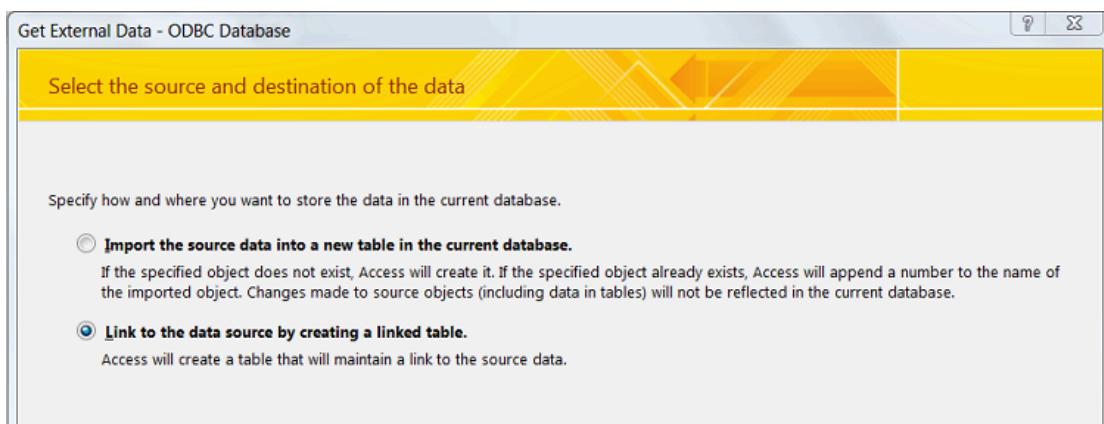
To create a linked table:

1. Open the Access database that you want to link to MySQL.
2. On the **External Data** tab, choose **ODBC Database**.

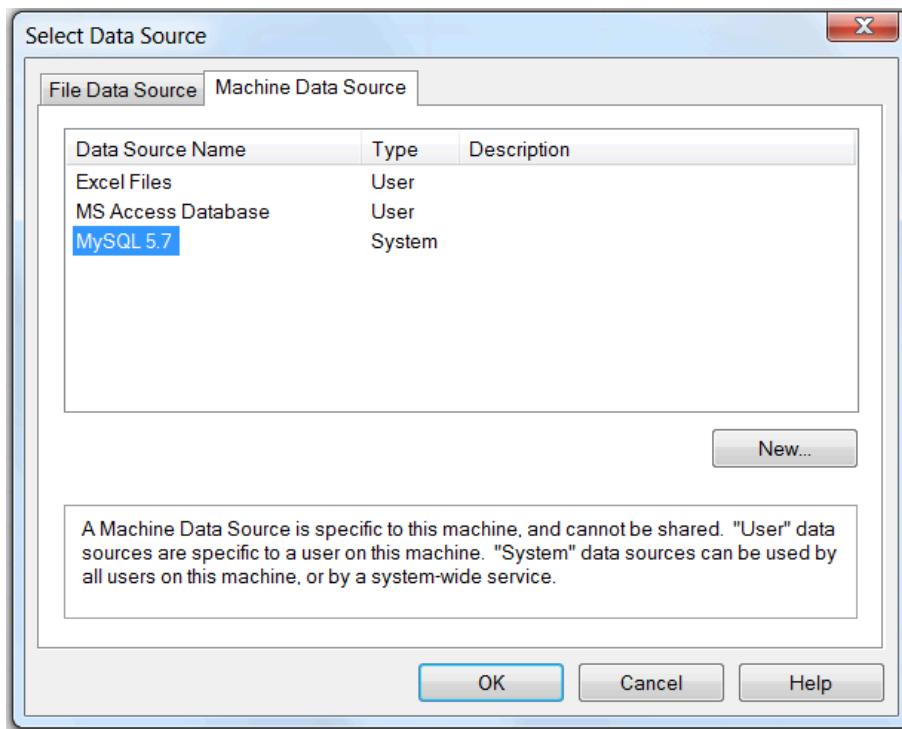
Figure 5.28 External Data: ODBC Database



3. In the [Get External Data](#) dialog box that appears, choose **Link to the data source by creating a linked table** and click **OK**.

Figure 5.29 Get External Data: Link To ODBC Database Option Chosen

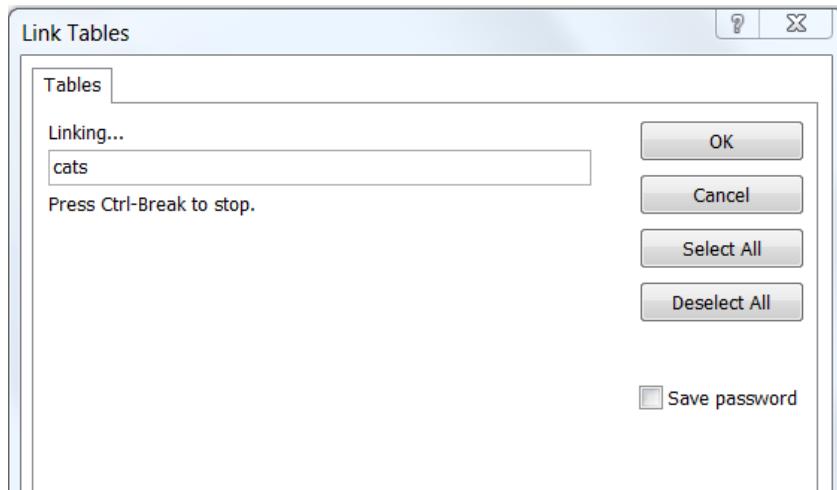
4. The **Select Data Source** dialog box appears; it lists the defined data sources for any ODBC drivers installed on your computer. Click either the **File Data Source** or **Machine Data Source** tab, and then double-click the Connector/ODBC DSN you want to link your table to. To define a new DSN for Connector/ODBC instead, click **New** and follow the instructions in [Section 5.5.3, “Configuring a Connector/ODBC DSN on Windows”](#); double click the new DSN after it has been created.

Figure 5.30 Selecting An ODBC Database

If the ODBC data source that you selected requires you to log in, enter your login ID and password (additional information might also be required), and then click **OK**.

5. Microsoft Access connects to the MySQL server and displays the list of tables that you can link to. Choose the tables you want to link to (or click **Select All**), and then click **OK**.

Figure 5.31 Link Tables Dialog: Selecting Tables to Link

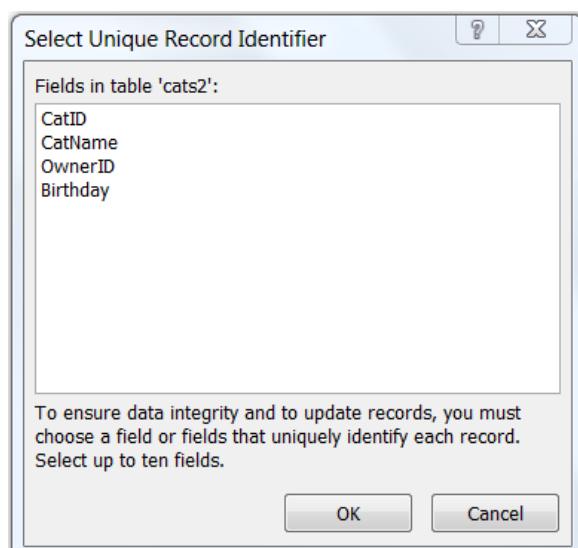


Notes

- If no tables show up for you to select, it might be because you did not choose the **Database** to connect to when you defined or logged in to the DSN. Reconfigure the DSN and specify the **Database** to connect to (see [Section 5.5.3, “Configuring a Connector/ODBC DSN on Windows”](#) for details), or choose a **Database** when you log in to the DSN.
- If your database on Access already has a table with the same name as the one you are linking to, Access will append a number to the name of the new linked table.

6. If Microsoft Access is unable to determine the unique record identifier for a table automatically, it will ask you to choose a column (or a combination of columns) to be used to uniquely identify each row from the source table. Select the column[s] to use and click **OK**.

Figure 5.32 Linking Microsoft Access Tables To MySQL Tables, Choosing Unique Record Identifier



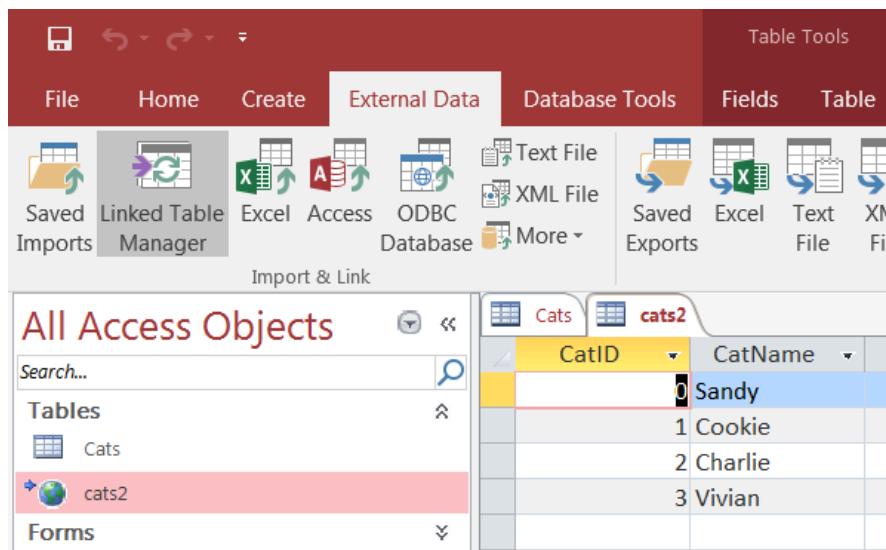
Once the process has been completed, you can build interfaces and queries to the linked tables just as you would for any Access database.

Use the following procedure to view links or to refresh them when the structures of the linked tables have changed.

To view or refresh links:

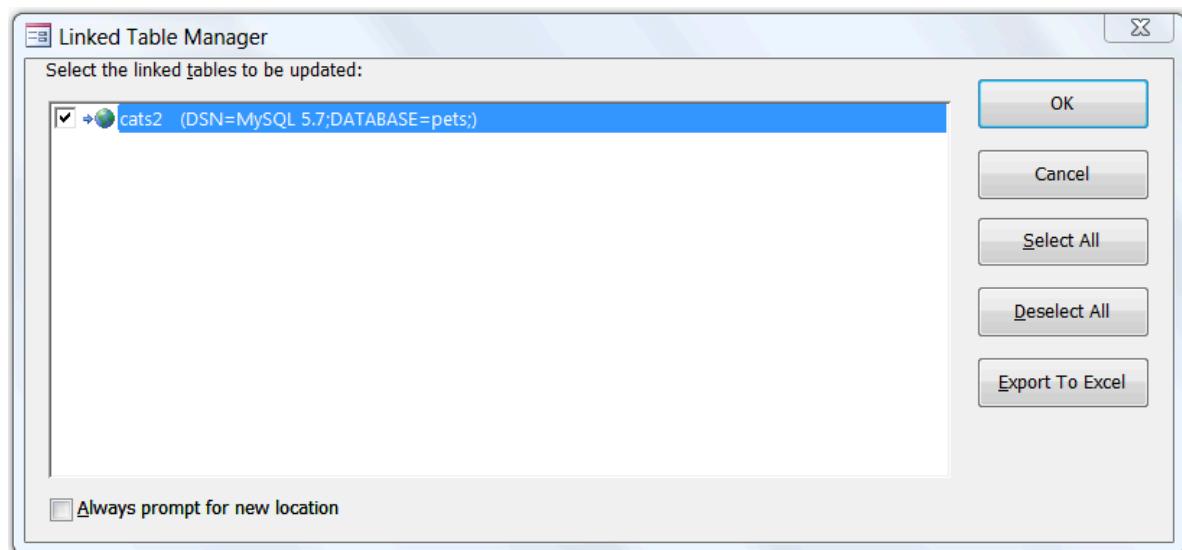
1. Open the database that contains links to MySQL tables.
2. On the **External Data** tab, choose **Linked Table Manager**.

Figure 5.33 External Data: Linked Table Manager



3. The Linked Table Manager appears. Select the check box for the tables whose links you want to refresh. Click **OK** to refresh the links.

Figure 5.34 External Data: Linked Table Manager Dialog



If the ODBC data source requires you to log in, enter your login ID and password (additional information might also be required), and then click **OK**.

Microsoft Access confirms a successful refresh or, if the tables are not found, returns an error message, in which case you should update the links with the steps below.

To change the path for a set of linked tables (for pictures of the GUI dialog boxes involved, see the instructions above for linking tables and refreshing links) :

1. Open the database that contains the linked tables.
2. On the **External Data** tab, choose **Linked Table Manager**.
3. In the **Linked Table Manager** that appears, select the **Always Prompt For A New Location** check box.
4. Select the check box for the tables whose links you want to change, and then click **OK**.
5. The **Select Data Source** dialog box appears. Select the new DSN and database with it.

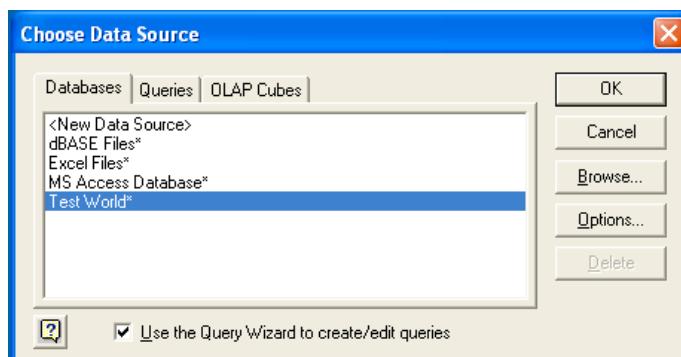
5.6.5 Using Connector/ODBC with Microsoft Word or Excel

You can use Microsoft Word and Microsoft Excel to access information from a MySQL database using Connector/ODBC. Within Microsoft Word, this facility is most useful when importing data for mailmerge, or for tables and data to be included in reports. Within Microsoft Excel, you can execute queries on your MySQL server and import the data directly into an Excel Worksheet, presenting the data as a series of rows and columns.

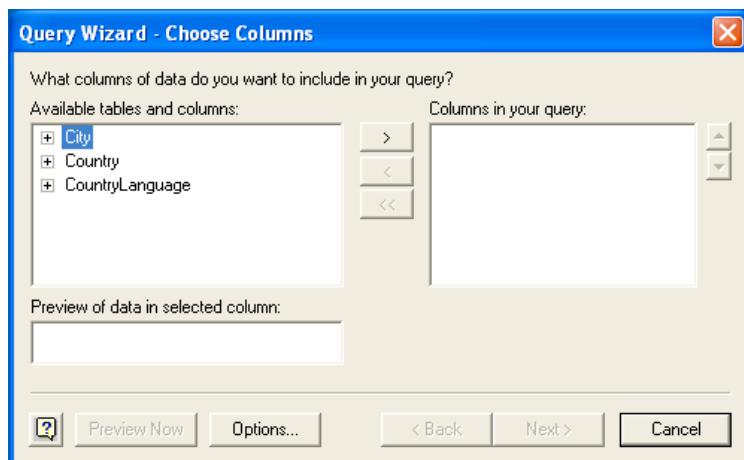
With both applications, data is accessed and imported into the application using Microsoft Query, which lets you execute a query through an ODBC source. You use Microsoft Query to build the SQL statement to be executed, selecting the tables, fields, selection criteria and sort order. For example, to insert information from a table in the World test database into an Excel spreadsheet, using the DSN samples shown in [Section 5.5, “Configuring Connector/ODBC”](#):

1. Create a new Worksheet.
2. From the **Data** menu, choose **Import External Data**, and then select **New Database Query**.
3. Microsoft Query will start. First, you need to choose the data source, by selecting an existing Data Source Name.

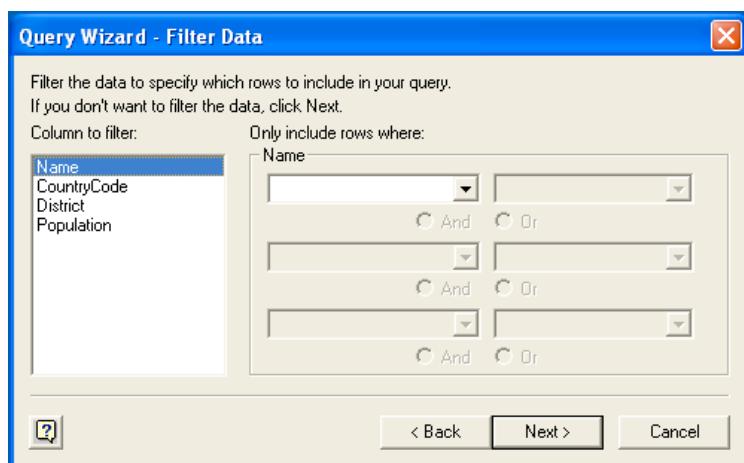
Figure 5.35 Microsoft Query Wizard: Choose Data Source Dialog



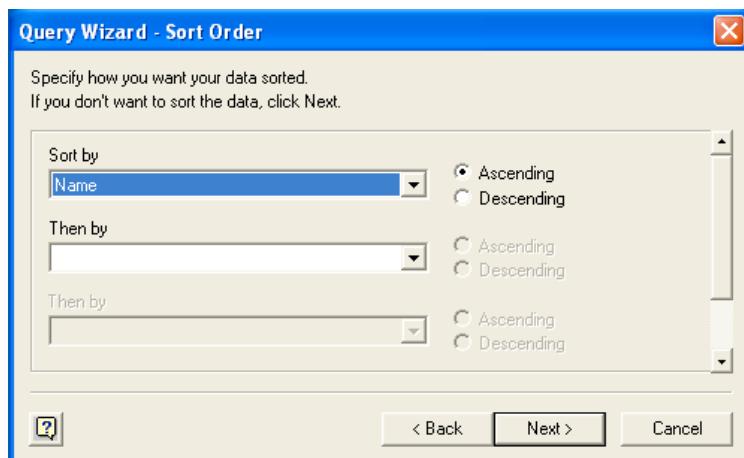
4. Within the **Query Wizard**, choose the columns to import. The list of tables available to the user configured through the DSN is shown on the left, the columns that will be added to your query are shown on the right. The columns you choose are equivalent to those in the first section of a **SELECT** query. Click **Next** to continue.

Figure 5.36 Microsoft Query Wizard: Choose Columns

5. You can filter rows from the query (the equivalent of a `WHERE` clause) using the `Filter Data` dialog. Click **Next** to continue.

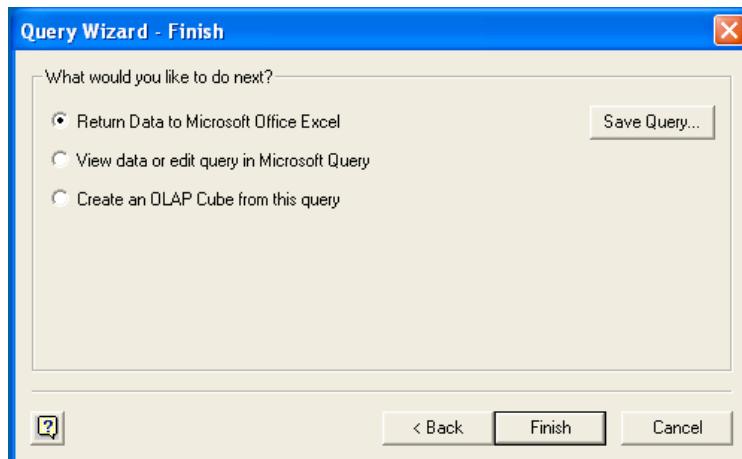
Figure 5.37 Microsoft Query Wizard: Filter Data

6. Select an (optional) sort order for the data. This is equivalent to using a `ORDER BY` clause in your SQL query. You can select up to three fields for sorting the information returned by the query. Click **Next** to continue.

Figure 5.38 Microsoft Query Wizard: Sort Order

7. Select the destination for your query. You can select to return the data Microsoft Excel, where you can choose a worksheet and cell where the data will be inserted; you can continue to view the query and results within Microsoft Query, where you can edit the SQL query and further filter and sort the information returned; or you can create an OLAP Cube from the query, which can then be used directly within Microsoft Excel. Click **Finish**.

Figure 5.39 Microsoft Query Wizard: Selecting A Destination



The same process can be used to import data into a Word document, where the data will be inserted as a table. This can be used for mail merge purposes (where the field data is read from a Word table), or where you want to include data and reports within a report or other document.

5.6.6 Using Connector/ODBC with Crystal Reports

Crystal Reports can use an ODBC DSN to connect to a database from which you extract data and information for reporting purposes.

Note

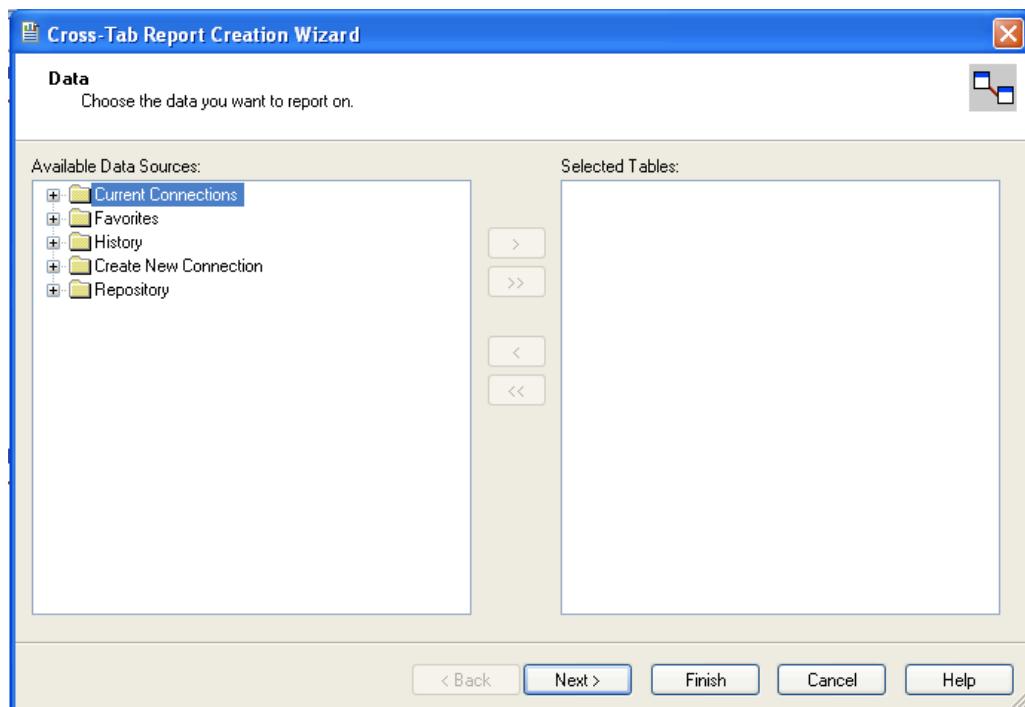
There is a known issue with certain versions of Crystal Reports where the application is unable to open and browse tables and fields through an ODBC connection. Before using Crystal Reports with MySQL, please ensure that you have update to the latest version, including any outstanding service packs and hotfixes. For more information on this issue, see the [Business Objects Knowledgebase](#) for more information.

For example, to create a simple crosstab report within Crystal Reports XI, follow these steps:

1. Create a DSN using the [Data Sources \(ODBC\)](#) tool. You can either specify a complete database, including user name and password, or you can build a basic DSN and use Crystal Reports to set the user name and password.

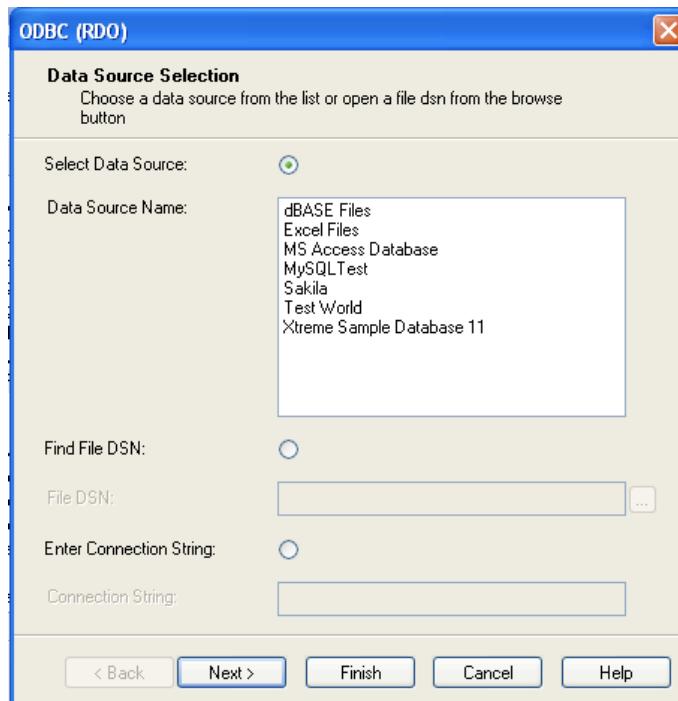
For the purposes of this example, a DSN that provides a connection to an instance of the MySQL Sakila sample database has been created.
2. Open Crystal Reports and create a new project, or open an existing reporting project into which you want to insert data from your MySQL data source.
3. Start the Cross-Tab Report Wizard, either by clicking the option on the Start Page. Expand the **Create New Connection** folder, then expand the **ODBC (RDO)** folder to obtain a list of ODBC data sources.

You will be asked to select a data source.

Figure 5.40 Cross-Tab Report Creation Wizard

- When you first expand the **ODBC (RDO)** folder you will be presented the Data Source Selection screen. From here you can select either a pre-configured DSN, open a file-based DSN or enter and manual connection string. For this example, the pre-configured **Sakila** DSN will be used.

If the DSN contains a user name/password combination, or you want to use different authentication credentials, click **Next** to enter the user name and password that you want to use. Otherwise, click **Finish** to continue the data source selection wizard.

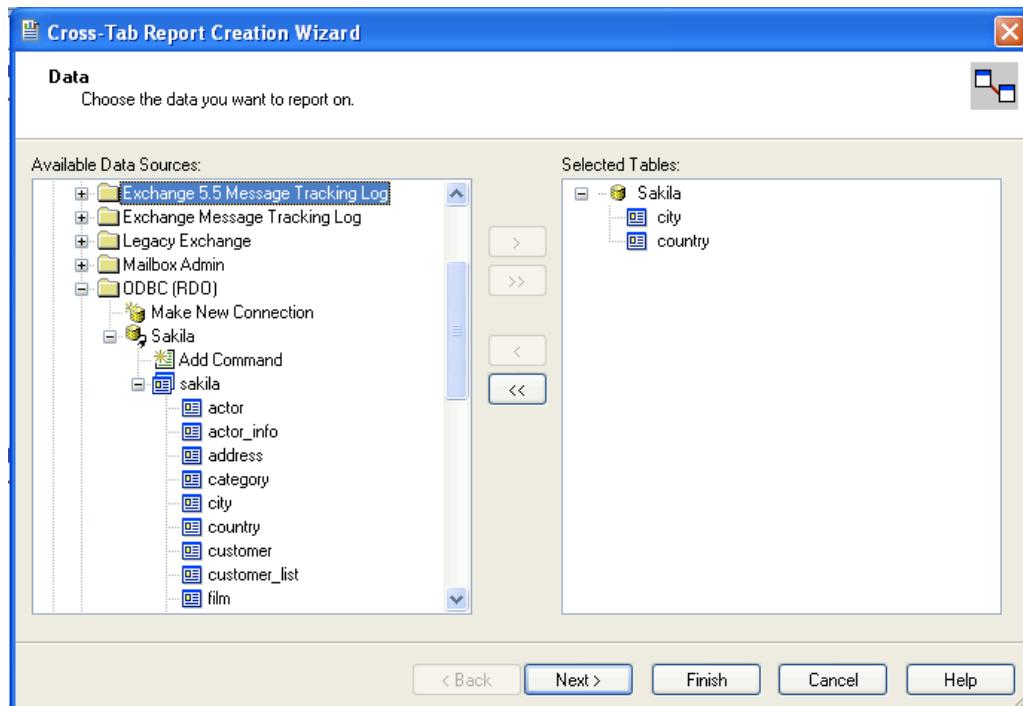
Figure 5.41 ODBC (RDO) Data Source Selection Wizard

5. You will be returned the Cross-Tab Report Creation Wizard. You now need to select the database and tables that you want to include in your report. For our example, we will expand the selected Sakila database. Click the `city` table and use the `>` button to add the table to the report. Then repeat the action with the `country` table. Alternatively you can select multiple tables and add them to the report.

Finally, you can select the parent **Sakila** resource and add of the tables to the report.

Once you have selected the tables you want to include, click **Next** to continue.

Figure 5.42 Cross-Tab Report Creation Wizard with Example ODBC (RDO) Data

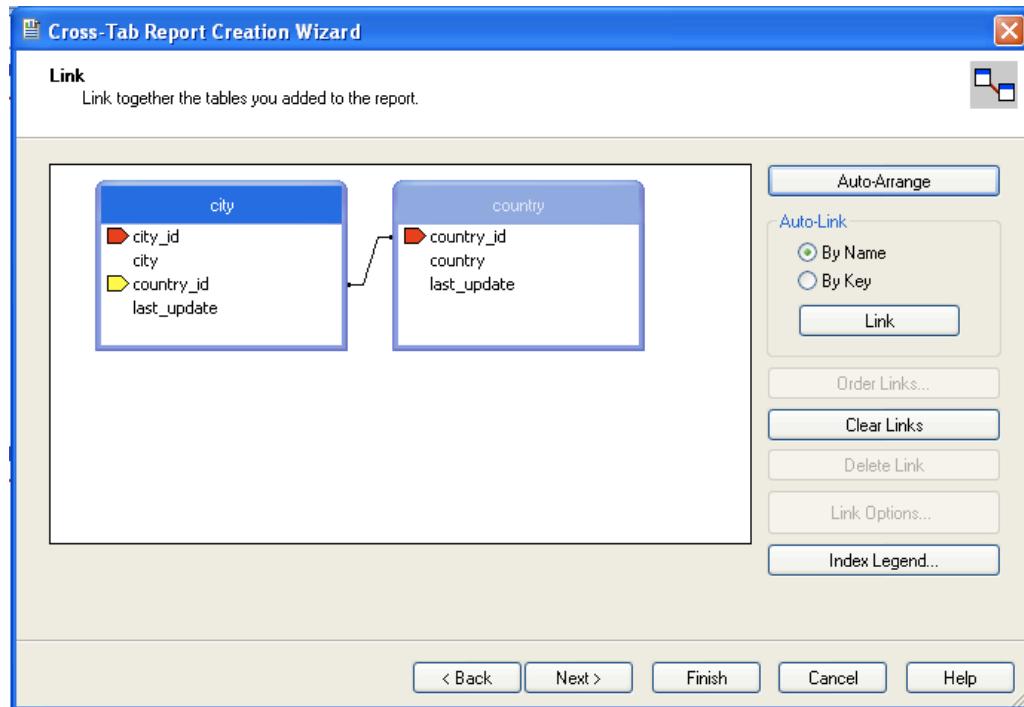


6. Crystal Reports will now read the table definitions and automatically identify the links between the tables. The identification of links between tables enables Crystal Reports to automatically lookup and summarize information based on all the tables in the database according to your query. If

Crystal Reports is unable to perform the linking itself, you can manually create the links between fields in the tables you have selected.

Click **Next** to continue the process.

Figure 5.43 Cross-Tab Report Creation Wizard: Table Links

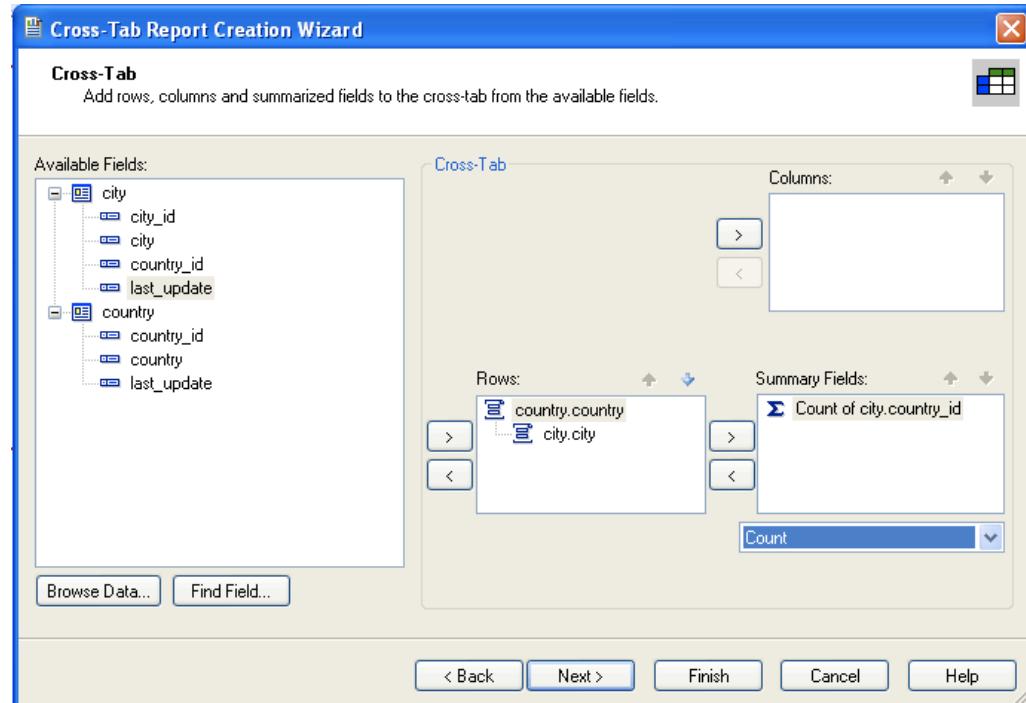


7. You can now select the columns and rows that to include within the Cross-Tab report. Drag and drop or use the > buttons to add fields to each area of the report. In the example shown, we will

report on cities, organized by country, incorporating a count of the number of cities within each country. If you want to browse the data, select a field and click the **Browse Data...** button.

Click **Next** to create a graph of the results. Since we are not creating a graph from this data, click **Finish** to generate the report.

Figure 5.44 Cross-Tab Report Creation Wizard: Cross-Tab Selection Dialog



8. The finished report will be shown, a sample of the output from the Sakila sample database is shown below.

Figure 5.45 Cross-Tab Report Creation Wizard: Final Report

		Total
Total		600
Afghanistan	Total	1
	Kabul	1
Algeria	Total	3
	Batna	1
	Bchar	1
	Skikda	1
American Samoa	Total	1
	Tafuna	1
Angola	Total	2
	Benguela	1
	Namibe	1
Anguilla	Total	1
	South Hill	1
Argentina	Total	13
	Almirante Brow	1

Once the ODBC connection has been opened within Crystal Reports, you can browse and add any fields within the available tables into your reports.

5.6.7 Connector/ODBC Programming

With a suitable ODBC Manager and the Connector/ODBC driver installed, any programming language or environment that can support ODBC can connect to a MySQL database through Connector/ODBC.

This includes, but is not limited to, Microsoft support languages (including Visual Basic, C# and interfaces such as ODBC.NET), Perl (through the DBI module, and the DBD::ODBC driver).

5.6.7.1 Using Connector/ODBC with Visual Basic Using ADO, DAO and RDO

This section contains simple examples of the use of Connector/ODBC with ADO, DAO and RDO.

ADO: `rs.addNew`, `rs.delete`, and `rs.update`

The following ADO (ActiveX Data Objects) example creates a table `my_ado` and demonstrates the use of `rs.addNew`, `rs.delete`, and `rs.update`.

```
Private Sub myodbc_ado_Click()
Dim conn As ADODB.Connection
Dim rs As ADODB.Recordset
Dim fld As ADODB.Field
Dim sql As String
'connect to MySQL server using Connector/ODBC
Set conn = New ADODB.Connection
conn.ConnectionString = "DRIVER={MySQL ODBC 3.51 Driver};"_
& "SERVER=localhost;"_
& "DATABASE=test;"_
& "UID=venu;PWD=venu; OPTION=3"
conn.Open
'create table
```

```

conn.Execute "DROP TABLE IF EXISTS my_ado"
conn.Execute "CREATE TABLE my_ado(id int not null primary key, name varchar(20), " _
& "txt text, dt date, tm time, ts timestamp)"
'direct insert
conn.Execute "INSERT INTO my_ado(id,name,txt) values(1,100,'venu')"
conn.Execute "INSERT INTO my_ado(id,name,txt) values(2,200,'MySQL')"
conn.Execute "INSERT INTO my_ado(id,name,txt) values(3,300,'Delete')"
Set rs = New ADODB.Recordset
rs.CursorLocation = adUseServer
'fetch the initial table ..
rs.Open "SELECT * FROM my_ado", conn
Debug.Print rs.RecordCount
rs.MoveFirst
Debug.Print String(50, "-") & "Initial my_ado Result Set " & String(50, "-")
For Each fld In rs.Fields
Debug.Print fld.Name,
Next
Debug.Print
Do Until rs.EOF
For Each fld In rs.Fields
Debug.Print fld.Value,
Next
rs.MoveNext
Debug.Print
Loop
rs.Close
'rs insert
rs.Open "select * from my_ado", conn, adOpenDynamic, adLockOptimistic
rs.AddNew
rs!ID = 8
rs!Name = "Mandy"
rs!txt = "Insert row"
rs.Update
rs.Close
'rs update
rs.Open "SELECT * FROM my_ado"
rs!Name = "update"
rs!txt = "updated-row"
rs.Update
rs.Close
'rs update second time..
rs.Open "SELECT * FROM my_ado"
rs!Name = "update"
rs!txt = "updated-second-time"
rs.Update
rs.Close
'rs delete
rs.Open "SELECT * FROM my_ado"
rs.MoveNext
rs.MoveNext
rs.Delete
rs.Close
'fetch the updated table ..
rs.Open "SELECT * FROM my_ado", conn
Debug.Print rs.RecordCount
rs.MoveFirst
Debug.Print String(50, "-") & "Updated my_ado Result Set " & String(50, "-")
For Each fld In rs.Fields
Debug.Print fld.Name,
Next
Debug.Print
Do Until rs.EOF
For Each fld In rs.Fields
Debug.Print fld.Value,
Next
rs.MoveNext
Debug.Print
Loop
rs.Close
conn.Close
End Sub

```

DAO: `rs.addNew`, `rs.update`, and Scrolling

The following DAO (Data Access Objects) example creates a table `my_dao` and demonstrates the use of `rs.addNew`, `rs.update`, and result set scrolling.

```

Private Sub myodbc_dao_Click()
Dim ws As Workspace
Dim conn As Connection
Dim queryDef As queryDef
Dim str As String
'connect to MySQL using MySQL ODBC 3.51 Driver
Set ws = DBEngine.CreateWorkspace("", "venu", "venu", dbUseODBC)
str = "odbc;DRIVER={MySQL ODBC 3.51 Driver};"
& "SERVER=localhost;_
& " DATABASE=test;_
& "UID=venu;PWD=venu; OPTION=3"
Set conn = ws.OpenConnection("test", dbDriverNoPrompt, False, str)
'Create table my_dao
Set queryDef = conn.CreateQueryDef("", "drop table if exists my_dao")
queryDef.Execute
Set queryDef = conn.CreateQueryDef("", "create table my_dao(Id INT AUTO_INCREMENT PRIMARY KEY, "
& "Ts TIMESTAMP(14) NOT NULL, Name varchar(20), Id2 INT)")
queryDef.Execute
'Insert new records using rs.addNew
Set rs = conn.OpenRecordset("my_dao")
Dim i As Integer
For i = 10 To 15
rs.AddNew
rs!Name = "insert record" & i
rs!Id2 = i
rs.Update
Next i
rs.Close
'rs update..
Set rs = conn.OpenRecordset("my_dao")
rs.Edit
rs!Name = "updated-string"
rs.Update
rs.Close
'fetch the table back...
Set rs = conn.OpenRecordset("my_dao", dbOpenDynamic)
str = "Results:"
rs.MoveFirst
While Not rs.EOF
str = " " & rs!Id & " , " & rs!Name & " , " & rs!Ts & " , " & rs!Id2
Debug.Print "DATA:" & str
rs.MoveNext
Wend
'rs Scrolling
rs.MoveFirst
str = " FIRST ROW: " & rs!Id & " , " & rs!Name & " , " & rs!Ts & " , " & rs!Id2
Debug.Print str
rs.MoveLast
str = " LAST ROW: " & rs!Id & " , " & rs!Name & " , " & rs!Ts & " , " & rs!Id2
Debug.Print str
rs.MovePrevious
str = " LAST-1 ROW: " & rs!Id & " , " & rs!Name & " , " & rs!Ts & " , " & rs!Id2
Debug.Print str
'free all resources
rs.Close
queryDef.Close
conn.Close
ws.Close
End Sub

```

RDO: `rs.addNew` and `rs.update`

The following RDO (Remote Data Objects) example creates a table `my_rdo` and demonstrates the use of `rs.addNew` and `rs.update`.

```
Dim rs As rdoResultset
```

```

Dim cn As New rdoConnection
Dim cl As rdoColumn
Dim SQL As String
'cn.Connect = "DSN=test;"
cn.Connect = "DRIVER={MySQL ODBC 3.51 Driver};"_
& "SERVER=localhost;"_
& "DATABASE=test;"_
& "UID=venu;PWD=venu; OPTION=3"
cn.CursorDriver = rdUseOdbc
cn.EstablishConnection rdDriverPrompt
'drop table my_rdo
SQL = "drop table if exists my_rdo"
cn.Execute SQL, rdExecDirect
'create table my_rdo
SQL = "create table my_rdo(id int, name varchar(20))"
cn.Execute SQL, rdExecDirect
'insert - direct
SQL = "insert into my_rdo values (100,'venu')"
cn.Execute SQL, rdExecDirect
SQL = "insert into my_rdo values (200,'MySQL')"
cn.Execute SQL, rdExecDirect
'rs insert
SQL = "select * from my_rdo"
Set rs = cn.OpenResultset(SQL, rdOpenStatic, rdConcurRowVer, rdExecDirect)
rs.AddNew
rs!id = 300
rs!Name = "Insert1"
rs.Update
rs.Close
'rs insert
SQL = "select * from my_rdo"
Set rs = cn.OpenResultset(SQL, rdOpenStatic, rdConcurRowVer, rdExecDirect)
rs.AddNew
rs!id = 400
rs!Name = "Insert 2"
rs.Update
rs.Close
'rs update
SQL = "select * from my_rdo"
Set rs = cn.OpenResultset(SQL, rdOpenStatic, rdConcurRowVer, rdExecDirect)
rs.Edit
rs!id = 999
rs!Name = "updated"
rs.Update
rs.Close
'fetch back...
SQL = "select * from my_rdo"
Set rs = cn.OpenResultset(SQL, rdOpenStatic, rdConcurRowVer, rdExecDirect)
Do Until rs.EOF
For Each cl In rs.rdoColumns
Debug.Print cl.Value,
Next
rs.MoveNext
Debug.Print
Loop
Debug.Print "Row count="; rs.RowCount
'close
rs.Close
cn.Close
End Sub

```

5.6.7.2 Using Connector/ODBC with .NET

This section contains simple examples that demonstrate the use of Connector/ODBC drivers with ODBC.NET.

Using Connector/ODBC with ODBC.NET and C# (C sharp)

The following sample creates a table `my_odbc_net` and demonstrates its use in C#.

```
/**
```

```
* @sample      : mycon.cs
* @purpose    : Demo sample for ODBC.NET using Connector/ODBC
*
*/
/* build command
*
*csc /t:exe
*/      /out:mycon.exe mycon.cs
*/      /r:Microsoft.Data.Odbc.dll
*/
using Console = System.Console;
using Microsoft.Data.Odbc;
namespace myodbc3
{
    class mycon
    {
        static void Main(string[] args)
        {
            try
            {
                //Connection string for Connector/ODBC 3.51
                string MyConString = "DRIVER={MySQL ODBC 3.51 Driver};" +
                    "SERVER=localhost;" +
                    "DATABASE=test;" +
                    "UID=venu;" +
                    "PASSWORD=venu;" +
                    "OPTION=3";
                //Connect to MySQL using Connector/ODBC
                OdbcConnection MyConnection = new OdbcConnection(MyConString);
                MyConnection.Open();
                Console.WriteLine("\n !!! success, connected successfully !!!\n");
                //Display connection information
                Console.WriteLine("Connection Information:");
                Console.WriteLine("\tConnection String:" +
                    MyConnection.ConnectionString);
                Console.WriteLine("\tConnection Timeout:" +
                    MyConnection.ConnectionTimeout);
                Console.WriteLine("\tDatabase:" +
                    MyConnection.Database);
                Console.WriteLine("\tDataSource:" +
                    MyConnection.DataSource);
                Console.WriteLine("\tDriver:" +
                    MyConnection.Driver);
                Console.WriteLine("\tServerVersion:" +
                    MyConnection.ServerVersion);
                //Create a sample table
                OdbcCommand MyCommand =
                    new OdbcCommand("DROP TABLE IF EXISTS my_odbc_net",
                        MyConnection);
                MyCommand.ExecuteNonQuery();
                MyCommand.CommandText =
                    "CREATE TABLE my_odbc_net(id int, name varchar(20), idb bigint)";
                MyCommand.ExecuteNonQuery();
                //Insert
                MyCommand.CommandText =
                    "INSERT INTO my_odbc_net VALUES(10,'venu', 300)";
                Console.WriteLine("INSERT, Total rows affected:" +
                    MyCommand.ExecuteNonQuery());
                //Insert
                MyCommand.CommandText =
                    "INSERT INTO my_odbc_net VALUES(20,'mysql',400)";
                Console.WriteLine("INSERT, Total rows affected:" +
                    MyCommand.ExecuteNonQuery());
                //Insert
                MyCommand.CommandText =
                    "INSERT INTO my_odbc_net VALUES(20,'mysql',500)";
                Console.WriteLine("INSERT, Total rows affected:" +
                    MyCommand.ExecuteNonQuery());
                //Update
                MyCommand.CommandText =
                    "UPDATE my_odbc_net SET id=999 WHERE id=20";
                Console.WriteLine("Update, Total rows affected:" +
```

```

        MyCommand.ExecuteNonQuery());
//COUNT(*)
MyCommand.CommandText =
    "SELECT COUNT(*) as TRows FROM my_odbc_net";
Console.WriteLine("Total Rows:" +
    MyCommand.ExecuteScalar());
//Fetch
MyCommand.CommandText = "SELECT * FROM my_odbc_net";
OdbcDataReader MyDataReader;
MyDataReader = MyCommand.ExecuteReader();
while (MyDataReader.Read())
{
    if(string.Compare(MyConnection.Driver, "myodbc3.dll") == 0) {
        //Supported only by Connector/ODBC 3.51
        Console.WriteLine("Data:" + MyDataReader.GetInt32(0) + " " +
            MyDataReader.GetString(1) + " " +
            MyDataReader.GetInt64(2));
    }
    else {
        //BIGINTs not supported by Connector/ODBC
        Console.WriteLine("Data:" + MyDataReader.GetInt32(0) + " " +
            MyDataReader.GetString(1) + " " +
            MyDataReader.GetInt32(2));
    }
}
//Close all resources
MyDataReader.Close();
MyConnection.Close();
}
catch (OdbcException MyOdbcException) //Catch any ODBC exception ..
{
    for (int i=0; i < MyOdbcException.Errors.Count; i++)
    {
        Console.Write("ERROR #" + i + "\n" +
            "Message: " +
            MyOdbcException.Errors[i].Message + "\n" +
            "Native: " +
            MyOdbcException.Errors[i].NativeError.ToString() + "\n" +
            "Source: " +
            MyOdbcException.Errors[i].Source + "\n" +
            "SQL: " +
            MyOdbcException.Errors[i].SQLState + "\n");
    }
}

```

Using Connector/ODBC with ODBC.NET and Visual Basic

The following sample creates a table `my vb net` and demonstrates the use in VB.

```
' @sample      : myvb.vb
' @purpose    : Demo sample for ODBC.NET using Connector/ODBC
'
'
' build command
'
'
' vbc /target:exe
'   /out:myvb.exe
'   /r:Microsoft.Data.Odbc.dll
'   /r:System.dll
'   /r:System.Data.dll
'
Imports Microsoft.Data.Odbc
Imports System
Module myvb
    Sub Main()
        Try
            'Connector/ODBC 3.51 connection string
            Dim MyConString As String = "DRIVER={MySQL ODBC 3.51 Driver}; & _
            "SERVER=localhost;" &
```

```

"DATABASE=test;" & _
"UID=venu;" & _
"PASSWORD=venu;" & _
"OPTION=3;"
'Connection
Dim MyConnection As New OdbcConnection(MyConString)
MyConnection.Open()
Console.WriteLine("Connection State:::" & MyConnection.State.ToString())
'Drop
Console.WriteLine("Dropping table")
Dim MyCommand As New OdbcCommand()
MyCommand.Connection = MyConnection
MyCommand.CommandText = "DROP TABLE IF EXISTS my_vb_net"
MyCommand.ExecuteNonQuery()
'Create
Console.WriteLine("Creating....")
MyCommand.CommandText = "CREATE TABLE my_vb_net(id int, name varchar(30))"
MyCommand.ExecuteNonQuery()
'Insert
MyCommand.CommandText = "INSERT INTO my_vb_net VALUES(10,'venu')"
Console.WriteLine("INSERT, Total rows affected:" & _
MyCommand.ExecuteNonQuery())
'Insert
MyCommand.CommandText = "INSERT INTO my_vb_net VALUES(20,'mysql')"
Console.WriteLine("INSERT, Total rows affected:" & _
MyCommand.ExecuteNonQuery())
'Insert
MyCommand.CommandText = "INSERT INTO my_vb_net VALUES(20,'mysql')"
Console.WriteLine("INSERT, Total rows affected:" & _
MyCommand.ExecuteNonQuery())
'Insert
MyCommand.CommandText = "INSERT INTO my_vb_net(id) VALUES(30)"
Console.WriteLine("INSERT, Total rows affected:" & _
MyCommand.ExecuteNonQuery())
'Update
MyCommand.CommandText = "UPDATE my_vb_net SET id=999 WHERE id=20"
Console.WriteLine("Update, Total rows affected:" & _
MyCommand.ExecuteNonQuery())
'COUNT(*)
MyCommand.CommandText = "SELECT COUNT(*) as TRows FROM my_vb_net"
Console.WriteLine("Total Rows:" & MyCommand.ExecuteScalar())
'Select
Console.WriteLine("Select * FROM my_vb_net")
MyCommand.CommandText = "SELECT * FROM my_vb_net"
Dim MyDataReader As OdbcDataReader
MyDataReader = MyCommand.ExecuteReader
While MyDataReader.Read
    If MyDataReader("name") Is DBNull.Value Then
        Console.WriteLine("id = " & _
CStr(MyDataReader("id")) & " name = " & _
"NULL")
    Else
        Console.WriteLine("id = " & _
CStr(MyDataReader("id")) & " name = " & _
CStr(MyDataReader("name")))
    End If
End While
'Catch ODBC Exception
Catch MyOdbcException As OdbcException
    Dim i As Integer
    Console.WriteLine(MyOdbcException.ToString())
    'Catch program exception
Catch MyException As Exception
    Console.WriteLine(MyException.ToString())
End Try
End Sub

```

5.7 Connector/ODBC Reference

This section provides reference material for the Connector/ODBC API, showing supported functions and methods, supported MySQL column types and the corresponding native type in Connector/ODBC, and the error codes returned by Connector/ODBC when a fault occurs.

5.7.1 Connector/ODBC API Reference

This section summarizes ODBC routines, categorized by functionality.

For the complete ODBC API reference, please refer to the ODBC Programmer's Reference at <http://msdn.microsoft.com/en-us/library/ms714177.aspx>.

An application can call `SQLGetInfo` function to obtain conformance information about Connector/ODBC. To obtain information about support for a specific function in the driver, an application can call `SQLGetFunctions`.

Note

For backward compatibility, the Connector/ODBC driver supports all deprecated functions.

The following tables list Connector/ODBC API calls grouped by task:

Table 5.5 ODBC API Calls for Connecting to a Data Source

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLAllocHandle</code>	Yes	ISO 92	Obtains an environment, connection, statement, or descriptor handle.
<code>SQLConnect</code>	Yes	ISO 92	Connects to a specific driver by data source name, user ID, and password.
<code>SQLDriverConnect</code>	Yes	ODBC	Connects to a specific driver by connection string or requests that the Driver Manager and driver display connection dialog boxes for the user.
<code>SQLAllocEnv</code>	Yes	Deprecated	Obtains an environment handle allocated from driver.
<code>SQLAllocConnect</code>	Yes	Deprecated	Obtains a connection handle

Table 5.6 ODBC API Calls for Obtaining Information about a Driver and Data Source

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLDataSources</code>	No	ISO 92	Returns the list of available data sources, handled by the Driver Manager
<code>SQLDrivers</code>	No	ODBC	Returns the list of installed drivers and their attributes, handles by Driver Manager
<code>SQLGetInfo</code>	Yes	ISO 92	Returns information about a specific driver and data source.
<code>SQLGetFunctions</code>	Yes	ISO 92	Returns supported driver functions.
<code>SQLGetTypeInfo</code>	Yes	ISO 92	Returns information about supported data types.

Table 5.7 ODBC API Calls for Setting and Retrieving Driver Attributes

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLSetConnectAttr</code>	Yes	ISO 92	Sets a connection attribute.
<code>SQLGetConnectAttr</code>	Yes	ISO 92	Returns the value of a connection attribute.
<code>SQLSetConnectOption</code>	Yes	Deprecated	Sets a connection option
<code>SQLGetConnectOption</code>	Yes	Deprecated	Returns the value of a connection option
<code>SQLSetEnvAttr</code>	Yes	ISO 92	Sets an environment attribute.
<code>SQLGetEnvAttr</code>	Yes	ISO 92	Returns the value of an environment attribute.
<code>SQLSetStmtAttr</code>	Yes	ISO 92	Sets a statement attribute.
<code>SQLGetStmtAttr</code>	Yes	ISO 92	Returns the value of a statement attribute.
<code>SQLSetStmtOption</code>	Yes	Deprecated	Sets a statement option
<code>SQLGetStmtOption</code>	Yes	Deprecated	Returns the value of a statement option

Table 5.8 ODBC API Calls for Preparing SQL Requests

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLAllocStmt</code>	Yes	Deprecated	Allocates a statement handle
<code>SQLPrepare</code>	Yes	ISO 92	Prepares an SQL statement for later execution.
<code>SQLBindParameter</code>	Yes	ODBC	Assigns storage for a parameter in an SQL statement. Connector/ODBC 5.2 adds support for “out” and “inout” parameters, through the <code>SQL_PARAM_OUTPUT</code> or <code>SQL_PARAM_INPUT_OUTPUT</code> type specifiers. (“Out” and “inout” parameters are not supported for <code>LONGTEXT</code> and <code>LONGBLOB</code> columns.)
<code>SQLGetCursorName</code>	Yes	ISO 92	Returns the cursor name associated with a statement handle.
<code>SQLSetCursorName</code>	Yes	ISO 92	Specifies a cursor name.
<code>SQLSetScrollOptions</code>	Yes	ODBC	Sets options that control cursor behavior.

Table 5.9 ODBC API Calls for Submitting Requests

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLExecute</code>	Yes	ISO 92	Executes a prepared statement.
<code>SQLExecDirect</code>	Yes	ISO 92	Executes a statement
<code>SQLNativeSql</code>	Yes	ODBC	Returns the text of an SQL statement as translated by the driver.
<code>SQLDescribeParam</code>	No	ODBC	Returns the description for a specific parameter in a statement. Not supported by Connector/ODBC—the returned results should not be trusted.
<code>SQLNumParams</code>	Yes	ISO 92	Returns the number of parameters in a statement.
<code>SQLParamData</code>	Yes	ISO 92	Used in conjunction with <code>SQLPutData</code> to supply parameter data at execution time. (Useful for long data values.)

Function Name	Connector/ ODBC Supports?	Standard	Purpose
SQLPutData	Yes	ISO 92	Sends part or all of a data value for a parameter. (Useful for long data values.)

Table 5.10 ODBC API Calls for Retrieving Results and Information about Results

Function Name	Connector/ ODBC Supports?	Standard	Purpose
SQLRowCount	Yes	ISO 92	Returns the number of rows affected by an insert, update, or delete request.
SQLNumResultCols	Yes	ISO 92	Returns the number of columns in the result set.
SQLDescribeCol	Yes	ISO 92	Describes a column in the result set.
SQLColAttribute	Yes	ISO 92	Describes attributes of a column in the result set.
SQLColAttributes	Yes	Deprecated	Describes attributes of a column in the result set.
SQLFetch	Yes	ISO 92	Returns multiple result rows.
SQLFetchScroll	Yes	ISO 92	Returns scrollable result rows.
SQLExtendedFetch	Yes	Deprecated	Returns scrollable result rows.
SQLSetPos	Yes	ODBC	Positions a cursor within a fetched block of data and enables an application to refresh data in the rowset or to update or delete data in the result set.
SQLBulkOperations	Yes	ODBC	Performs bulk insertions and bulk bookmark operations, including update, delete, and fetch by bookmark.

Table 5.11 ODBC API Calls for Retrieving Error or Diagnostic Information

Function Name	Connector/ ODBC Supports?	Standard	Purpose
SQLError	Yes	Deprecated	Returns additional error or status information
SQLGetDiagField	Yes	ISO 92	Returns additional diagnostic information (a single field of the diagnostic data structure).
SQLGetDiagRec	Yes	ISO 92	Returns additional diagnostic information (multiple fields of the diagnostic data structure).

Table 5.12 ODBC API Calls for Obtaining Information about the Data Source's System Tables (Catalog Functions) Item

Function Name	Connector/ ODBC Supports?	Standard	Purpose
SQLColumnPrivileges	Yes	ODBC	Returns a list of columns and associated privileges for one or more tables.
SQLColumns	Yes	X/Open	Returns the list of column names in specified tables.
SQLForeignKeys	Yes	ODBC	Returns a list of column names that make up foreign keys, if they exist for a specified table.

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLPrimaryKeys</code>	Yes	ODBC	Returns the list of column names that make up the primary key for a table.
<code>SQLSpecialColumns</code>	Yes	X/Open	Returns information about the optimal set of columns that uniquely identifies a row in a specified table, or the columns that are automatically updated when any value in the row is updated by a transaction.
<code>SQLStatistics</code>	Yes	ISO 92	Returns statistics about a single table and the list of indexes associated with the table.
<code>SQLTablePrivileges</code>	Yes	ODBC	Returns a list of tables and the privileges associated with each table.
<code>SQLTables</code>	Yes	X/Open	Returns the list of table names stored in a specific data source.

Table 5.13 ODBC API Calls for Performing Transactions

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLTransact</code>	Yes	Deprecated	Commits or rolls back a transaction
<code>SQLEndTran</code>	Yes	ISO 92	Commits or rolls back a transaction.

Table 5.14 ODBC API Calls for Terminating a Statement

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLFreeStmt</code>	Yes	ISO 92	Ends statement processing, discards pending results, and, optionally, frees all resources associated with the statement handle.
<code>SQLCloseCursor</code>	Yes	ISO 92	Closes a cursor that has been opened on a statement handle.
<code>SQLCancel</code>	Yes	ISO 92	Cancels an SQL statement.

Table 5.15 ODBC API Calls for Terminating a Connection

Function Name	Connector/ ODBC Supports?	Standard	Purpose
<code>SQLDisconnect</code>	Yes	ISO 92	Closes the connection.
<code>SQLFreeHandle</code>	Yes	ISO 92	Releases an environment, connection, statement, or descriptor handle.
<code>SQLFreeConnect</code>	Yes	Deprecated	Releases connection handle.
<code>SQLFreeEnv</code>	Yes	Deprecated	Releases an environment handle.

5.7.2 Connector/ODBC Data Types

The following table illustrates how Connector/ODBC maps the server data types to default SQL and C data types.

Table 5.16 How Connector/ODBC Maps MySQL Data Types to SQL and C Data Types

Native Value	SQL Type	C Type
<code>bigint unsigned</code>	<code>SQL_BIGINT</code>	<code>SQL_C_UBIGINT</code>
<code>bigint</code>	<code>SQL_BIGINT</code>	<code>SQL_C_SBIGINT</code>
<code>bit</code>	<code>SQL_BIT</code>	<code>SQL_C_BIT</code>
<code>bit</code>	<code>SQL_CHAR</code>	<code>SQL_C_CHAR</code>
<code>blob</code>	<code>SQL_LONGVARBINARY</code>	<code>SQL_C_BINARY</code>
<code>bool</code>	<code>SQL_CHAR</code>	<code>SQL_C_CHAR</code>
<code>char</code>	<code>SQL_CHAR</code>	<code>SQL_C_CHAR</code>
<code>date</code>	<code>SQL_DATE</code>	<code>SQL_C_DATE</code>
<code>datetime</code>	<code>SQL_TIMESTAMP</code>	<code>SQL_C_TIMESTAMP</code>
<code>decimal</code>	<code>SQL_DECIMAL</code>	<code>SQL_C_CHAR</code>
<code>double precision</code>	<code>SQL_DOUBLE</code>	<code>SQL_C_DOUBLE</code>
<code>double</code>	<code>SQL_FLOAT</code>	<code>SQL_C_DOUBLE</code>
<code>enum</code>	<code>SQL_VARCHAR</code>	<code>SQL_C_CHAR</code>
<code>float</code>	<code>SQL_REAL</code>	<code>SQL_C_FLOAT</code>
<code>int unsigned</code>	<code>SQL_INTEGER</code>	<code>SQL_C ULONG</code>
<code>int</code>	<code>SQL_INTEGER</code>	<code>SQL_C_SLONG</code>
<code>integer unsigned</code>	<code>SQL_INTEGER</code>	<code>SQL_C ULONG</code>
<code>integer</code>	<code>SQL_INTEGER</code>	<code>SQL_C_SLONG</code>
<code>long varbinary</code>	<code>SQL_LONGVARBINARY</code>	<code>SQL_C_BINARY</code>
<code>long varchar</code>	<code>SQL_LONGVARCHAR</code>	<code>SQL_C_CHAR</code>
<code>longblob</code>	<code>SQL_LONGVARBINARY</code>	<code>SQL_C_BINARY</code>
<code>longtext</code>	<code>SQL_LONGVARCHAR</code>	<code>SQL_C_CHAR</code>
<code>mediumblob</code>	<code>SQL_LONGVARBINARY</code>	<code>SQL_C_BINARY</code>
<code>mediumint unsigned</code>	<code>SQL_INTEGER</code>	<code>SQL_C ULONG</code>
<code>mediumint</code>	<code>SQL_INTEGER</code>	<code>SQL_C_SLONG</code>
<code>mediumtext</code>	<code>SQL_LONGVARCHAR</code>	<code>SQL_C_CHAR</code>
<code>numeric</code>	<code>SQL_NUMERIC</code>	<code>SQL_C_CHAR</code>
<code>real</code>	<code>SQL_FLOAT</code>	<code>SQL_C_DOUBLE</code>
<code>set</code>	<code>SQL_VARCHAR</code>	<code>SQL_C_CHAR</code>
<code>smallint unsigned</code>	<code>SQL_SMALLINT</code>	<code>SQL_C USHORT</code>
<code>smallint</code>	<code>SQL_SMALLINT</code>	<code>SQL_C SSHORT</code>
<code>text</code>	<code>SQL_LONGVARCHAR</code>	<code>SQL_C_CHAR</code>
<code>time</code>	<code>SQL_TIME</code>	<code>SQL_C_TIME</code>
<code>timestamp</code>	<code>SQL_TIMESTAMP</code>	<code>SQL_C_TIMESTAMP</code>
<code>tinyblob</code>	<code>SQL_LONGVARBINARY</code>	<code>SQL_C_BINARY</code>
<code>tinyint unsigned</code>	<code>SQL_TINYINT</code>	<code>SQL_C_UTINYINT</code>
<code>tinyint</code>	<code>SQL_TINYINT</code>	<code>SQL_C_STINYINT</code>
<code>tinytext</code>	<code>SQL_LONGVARCHAR</code>	<code>SQL_C_CHAR</code>
<code>varchar</code>	<code>SQL_VARCHAR</code>	<code>SQL_C_CHAR</code>
<code>year</code>	<code>SQL_SMALLINT</code>	<code>SQL_C_SHORT</code>

5.7.3 Connector/ODBC Error Codes

The following tables lists the error codes returned by Connector/ODBC apart from the server errors.

Table 5.17 Special Error Codes Returned by Connector/ODBC

Native Code	SQLSTATE 2	SQLSTATE 3	Error Message
500	01000	01000	General warning
501	01004	01004	String data, right truncated
502	01S02	01S02	Option value changed
503	01S03	01S03	No rows updated/deleted
504	01S04	01S04	More than one row updated/deleted
505	01S06	01S06	Attempt to fetch before the result set returned the first row set
506	07001	07002	<code>SQLBindParameter</code> not used for all parameters
507	07005	07005	Prepared statement not a cursor-specification
508	07009	07009	Invalid descriptor index
509	08002	08002	Connection name in use
510	08003	08003	Connection does not exist
511	24000	24000	Invalid cursor state
512	25000	25000	Invalid transaction state
513	25S01	25S01	Transaction state unknown
514	34000	34000	Invalid cursor name
515	S1000	HY000	General driver defined error
516	S1001	HY001	Memory allocation error
517	S1002	HY002	Invalid column number
518	S1003	HY003	Invalid application buffer type
519	S1004	HY004	Invalid SQL data type
520	S1009	HY009	Invalid use of null pointer
521	S1010	HY010	Function sequence error
522	S1011	HY011	Attribute can not be set now
523	S1012	HY012	Invalid transaction operation code
524	S1013	HY013	Memory management error
525	S1015	HY015	No cursor name available
526	S1024	HY024	Invalid attribute value
527	S1090	HY090	Invalid string or buffer length
528	S1091	HY091	Invalid descriptor field identifier
529	S1092	HY092	Invalid attribute option identifier
530	S1093	HY093	Invalid parameter number
531	S1095	HY095	Function type out of range
532	S1106	HY106	Fetch type out of range
533	S1117	HY117	Row value out of range
534	S1109	HY109	Invalid cursor position
535	S1C00	HYC00	Optional feature not implemented

Native Code	SQLSTATE 2	SQLSTATE 3	Error Message
0	21S01	21S01	Column count does not match value count
0	23000	23000	Integrity constraint violation
0	42000	42000	Syntax error or access violation
0	42S02	42S02	Base table or view not found
0	42S12	42S12	Index not found
0	42S21	42S21	Column already exists
0	42S22	42S22	Column not found
0	08S01	08S01	Communication link failure

5.8 Connector/ODBC Notes and Tips

Here are some common notes and tips for using Connector/ODBC within different environments, applications and tools. The notes provided here are based on the experiences of Connector/ODBC developers and users.

5.8.1 Connector/ODBC General Functionality

This section provides help with common queries and areas of functionality in MySQL and how to use them with Connector/ODBC.

5.8.1.1 Obtaining Auto-Increment Values

Obtaining the value of column that uses `AUTO_INCREMENT` after an `INSERT` statement can be achieved in a number of different ways. To obtain the value immediately after an `INSERT`, use a `SELECT` query with the `LAST_INSERT_ID()` function.

For example, using Connector/ODBC you would execute two separate statements, the `INSERT` statement and the `SELECT` query to obtain the auto-increment value.

```
INSERT INTO tbl (auto,text) VALUES(NULL,'text');
SELECT LAST_INSERT_ID();
```

If you do not require the value within your application, but do require the value as part of another `INSERT`, the entire process can be handled by executing the following statements:

```
INSERT INTO tbl (auto,text) VALUES(NULL,'text');
INSERT INTO tbl2 (id,text) VALUES(LAST_INSERT_ID(),'text');
```

Certain ODBC applications (including Delphi and Access) may have trouble obtaining the auto-increment value using the previous examples. In this case, try the following statement as an alternative:

```
SELECT * FROM tbl WHERE auto IS NULL;
```

This alternative method requires that `sql_auto_is_null` variable is not set to 0. See [Server System Variables](#).

See also [How to Get the Unique ID for the Last Inserted Row](#).

5.8.1.2 Dynamic Cursor Support

Support for the `dynamic cursor` is provided in Connector/ODBC 3.51, but dynamic cursors are not enabled by default. You can enable this function within Windows by selecting the `Enable Dynamic Cursor` check box within the ODBC Data Source Administrator.

On other platforms, you can enable the dynamic cursor by adding `32` to the `OPTION` value when creating the DSN.

5.8.1.3 Connector/ODBC Performance

The Connector/ODBC driver has been optimized to provide very fast performance. If you experience problems with the performance of Connector/ODBC, or notice a large amount of disk activity for simple queries, there are a number of aspects to check:

- Ensure that [ODBC Tracing](#) is not enabled. With tracing enabled, a lot of information is recorded in the tracing file by the ODBC Manager. You can check, and disable, tracing within Windows using the **Tracing** panel of the ODBC Data Source Administrator. Within macOS, check the **Tracing** panel of ODBC Administrator. See [Section 5.5.8, “Getting an ODBC Trace File”](#).
- Make sure you are using the standard version of the driver, and not the debug version. The debug version includes additional checks and reporting measures.
- Disable the Connector/ODBC driver trace and query logs. These options are enabled for each DSN, so make sure to examine only the DSN that you are using in your application. Within Windows, you can disable the Connector/ODBC and query logs by modifying the DSN configuration. Within macOS and Unix, ensure that the driver trace (option value 4) and query logging (option value 524288) are not enabled.

5.8.1.4 Setting ODBC Query Timeout in Windows

For more information on how to set the query timeout on Microsoft Windows when executing queries through an ODBC connection, read the Microsoft knowledgebase document at <http://support.microsoft.com/default.aspx?scid=kb%3Ben-us%3B153756>.

5.8.2 Connector/ODBC Application-Specific Tips

Most programs should work with Connector/ODBC, but for each of those listed here, there are specific notes and tips to improve or enhance the way you work with Connector/ODBC and these applications.

With all applications, ensure that you are using the latest Connector/ODBC drivers, ODBC Manager and any supporting libraries and interfaces used by your application. For example, on Windows, using the latest version of Microsoft Data Access Components (MDAC) will improve the compatibility with ODBC in general, and with the Connector/ODBC driver.

5.8.2.1 Using Connector/ODBC with Microsoft Applications

The majority of Microsoft applications have been tested with Connector/ODBC, including Microsoft Office, Microsoft Access and the various programming languages supported within ASP and Microsoft Visual Studio.

Microsoft Access

To improve the integration between Microsoft Access and MySQL through Connector/ODBC:

- For all versions of Access, enable the Connector/ODBC [Return matching rows](#) option. For Access 2.0, also enable the [Simulate ODBC 1.0](#) option.
- Include a [TIMESTAMP](#) column in all tables that you want to be able to update. For maximum portability, do not use a length specification in the column declaration (which is unsupported within MySQL in versions earlier than 4.1).
- Include a [primary key](#) in each MySQL table you want to use with Access. If not, new or updated rows may show up as [#DELETED#](#).
- Use only [DOUBLE](#) float fields. Access fails when comparing with single-precision floats. The symptom usually is that new or updated rows may show up as [#DELETED#](#) or that you cannot find or update rows.
- If you are using Connector/ODBC to link to a table that has a [BIGINT](#) column, the results are displayed as [#DELETED#](#). The work around solution is:

- Have one more dummy column with `TIMESTAMP` as the data type.
- Select the `Change BIGINT columns to INT` option in the connection dialog in ODBC DSN Administrator.
- Delete the table link from Access and re-create it.

Old records may still display as `#DELETED#`, but newly added/updated records are displayed properly.

- If you still get the error `Another user has changed your data` after adding a `TIMESTAMP` column, the following trick may help you:

Do not use a `table` data sheet view. Instead, create a form with the fields you want, and use that `form` data sheet view. Set the `DefaultValue` property for the `TIMESTAMP` column to `NOW()`. Consider hiding the `TIMESTAMP` column from view so your users are not confused.

- In some cases, Access may generate SQL statements that MySQL cannot understand. You can fix this by selecting "`Query | SQL Specific | Pass-Through`" from the Access menu.
- On Windows NT, Access reports `BLOB` columns as `OLE OBJECTS`. If you want to have `MEMO` columns instead, change `BLOB` columns to `TEXT` with `ALTER TABLE`.
- Access cannot always handle the MySQL `DATE` column properly. If you have a problem with these, change the columns to `DATETIME`.
- If you have in Access a column defined as `BYTE`, Access tries to export this as `TINYINT` instead of `TINYINT UNSIGNED`. This gives you problems if you have values larger than 127 in the column.
- If you have very large (long) tables in Access, it might take a very long time to open them. Or you might run low on virtual memory and eventually get an `ODBC Query Failed` error and the table cannot open. To deal with this, select the following options:
 - Return Matching Rows (2)
 - Allow BIG Results (8).

These add up to a value of 10 (`OPTION=10`).

Some external articles and tips that may be useful when using Access, ODBC and Connector/ODBC:

- Read [How to Trap ODBC Login Error Messages in Access](#)
- Optimizing Access ODBC Applications
 - [Optimizing for Client/Server Performance](#)
 - [Tips for Converting Applications to Using ODBC Direct](#)
 - [Tips for Optimizing Queries on Attached SQL Tables](#)

Microsoft Excel and Column Types

If you have problems importing data into Microsoft Excel, particularly numeric, date, and time values, this is probably because of a bug in Excel, where the column type of the source data is used to determine the data type when that data is inserted into a cell within the worksheet. The result is that Excel incorrectly identifies the content and this affects both the display format and the data when it is used within calculations.

To address this issue, use the `CONCAT()` function in your queries. The use of `CONCAT()` forces Excel to treat the value as a string, which Excel will then parse and usually correctly identify the embedded information.

However, even with this option, some data may be incorrectly formatted, even though the source data remains unchanged. Use the [Format Cells](#) option within Excel to change the format of the displayed information.

Microsoft Visual Basic

To be able to update a table, you must define a [primary key](#) for the table.

Visual Basic with ADO cannot handle big integers. This means that some queries like [SHOW PROCESSLIST](#) do not work properly. The fix is to use [OPTION=16384](#) in the ODBC connect string or to select the [Change BIGINT columns to INT](#) option in the Connector/ODBC connect screen. You may also want to select the [Return matching rows](#) option.

Microsoft Visual InterDev

If you have a [BIGINT](#) in your result, you may get the error [\[Microsoft\]\[ODBC Driver Manager\] Driver does not support this parameter](#). Try selecting the [Change BIGINT columns to INT](#) option in the Connector/ODBC connect screen.

Visual Objects

Select the [Don't optimize column widths](#) option.

Microsoft ADO

When you are coding with the ADO API and Connector/ODBC, you need to pay attention to some default properties that aren't supported by the MySQL server. For example, using the [CursorLocation Property](#) as [adUseServer](#) returns a result of -1 for the [RecordCount Property](#). To have the right value, you need to set this property to [adUseClient](#), as shown in the VB code here:

```
Dim myconn As New ADODB.Connection
Dim myrs As New Recordset
Dim mySQL As String
Dim myrows As Long
myconn.Open "DSN=MyODBCsample"
mySQL = "SELECT * from user"
myrs.Source = mySQL
Set myrs.ActiveConnection = myconn
myrs.CursorLocation = adUseClient
myrs.Open
myrows = myrs.RecordCount
myrs.Close
myconn.Close
```

Another workaround is to use a [SELECT COUNT\(*\)](#) statement for a similar query to get the correct row count.

To find the number of rows affected by a specific SQL statement in ADO, use the [RecordsAffected](#) property in the ADO execute method. For more information on the usage of execute method, refer to <http://msdn.microsoft.com/library/default.asp?url=/library/en-us/ado270/htm/mdmthcnexecute.asp>.

For information, see [ActiveX Data Objects\(ADO\) Frequently Asked Questions](#).

Using Connector/ODBC with Active Server Pages (ASP)

Select the [Return matching rows](#) option in the DSN.

For more information about how to access MySQL through ASP using Connector/ODBC, refer to the following articles:

- [Using MyODBC To Access Your MySQL Database Via ASP](#)

- [ASP and MySQL at DWAM.NT](#)

A Frequently Asked Questions list for ASP can be found at <http://support.microsoft.com/default.aspx?scid=/Support/ActiveServer/faq/data/adofaq.asp>.

Using Connector/ODBC with Visual Basic (ADO, DAO and RDO) and ASP

Some articles that may help with Visual Basic and ASP:

- [MySQL BLOB columns and Visual Basic 6](#) by Mike Hillyer (<mike@openwin.org>).
- [How to map Visual basic data type to MySQL types](#) by Mike Hillyer (<mike@openwin.org>).

5.8.2.2 Using Connector/ODBC with Borland Applications

With all Borland applications where the Borland Database Engine (BDE) is used, follow these steps to improve compatibility:

- Update to BDE 3.2 or newer.
- Enable the `Don't optimize column widths` option in the DSN.
- Enabled the `Return matching rows` option in the DSN.

Using Connector/ODBC with Borland Builder 4

When you start a query, you can use the `Active` property or the `Open` method.

The `Active` property starts by automatically issuing a `SELECT * FROM ...` query. That may affect performance for large tables.

Using Connector/ODBC with Delphi

Also, here is some potentially useful Delphi code that sets up both an ODBC entry and a BDE entry for Connector/ODBC. The BDE entry requires a BDE Alias Editor that is free at a Delphi Super Page near you. (Thanks to Bryan Brunton <bryan@flesherfab.com> for this):

```
fReg:= TRegistry.Create;
fReg.OpenKey('\Software\ODBC\ODBC.INI\DocumentsFab', True);
fReg.WriteString('Database', 'Documents');
fReg.WriteString('Description', '');
fReg.WriteString('Driver', 'C:\WINNT\System32\myodbc.dll');
fReg.WriteString('Flag', '1');
fReg.WriteString('Password', '');
fReg.WriteString('Port', '');
fReg.WriteString('Server', 'xmark');
fReg.WriteString('User', 'winuser');
fReg.OpenKey('\Software\ODBC\ODBC.INI\ODBC Data Sources', True);
fReg.WriteString('DocumentsFab', 'MySQL');
fReg.CloseKey;
fReg.Free;
Memo1.Lines.Add('DATABASE NAME=' );
Memo1.Lines.Add('USER NAME=' );
Memo1.Lines.Add('ODBC DSN=DocumentsFab' );
Memo1.Lines.Add('OPEN MODE=READ/WRITE' );
Memo1.Lines.Add('BATCH COUNT=200' );
Memo1.Lines.Add('LANGDRIVER=' );
Memo1.Lines.Add('MAX ROWS=-1' );
Memo1.Lines.Add('SCHEMA CACHE DIR=' );
Memo1.Lines.Add('SCHEMA CACHE SIZE=8' );
Memo1.Lines.Add('SCHEMA CACHE TIME=-1' );
Memo1.Lines.Add('SQLPASSTHRU MODE=SHARED AUTOCOMMIT' );
Memo1.Lines.Add('SQLQRYMODE=' );
Memo1.Lines.Add('ENABLE SCHEMA CACHE=FALSE' );
Memo1.Lines.Add('ENABLE BCD=FALSE' );
Memo1.Lines.Add('ROWSET SIZE=20' );
```

```
Memo1.Lines.Add('BLOBS TO CACHE=64');
Memo1.Lines.Add('BLOB SIZE=32');
AliasEditor.Add('DocumentsFab', 'MySQL', Memo1.Lines);
```

Using Connector/ODBC with C++ Builder

Tested with BDE 3.0. The only known problem is that when the table schema changes, query fields are not updated. BDE, however, does not seem to recognize primary keys, only the index named **PRIMARY**, although this has not been a problem.

5.8.2.3 Using Connector/ODBC with ColdFusion

The following information is taken from the ColdFusion documentation:

Use the following information to configure ColdFusion Server for Linux to use the [unixODBC](#) driver with Connector/ODBC for MySQL data sources. You can download Connector/ODBC at <https://dev.mysql.com/downloads/Connector/ODBC/>.

ColdFusion version 4.5.1 lets you use the ColdFusion Administrator to add the MySQL data source. However, the driver is not included with ColdFusion version 4.5.1. Before the MySQL driver appears in the ODBC data sources drop-down list, build and copy the Connector/ODBC driver to </opt/coldfusion/lib/libmyodbc.so>.

The Contrib directory contains the program [mydsn-xxx.zip](#) which lets you build and remove the DSN registry file for the Connector/ODBC driver on ColdFusion applications.

For more information and guides on using ColdFusion and Connector/ODBC, see the following external sites:

- [Troubleshooting Data Sources and Database Connectivity for Unix Platforms](#).

5.8.2.4 Using Connector/ODBC with OpenOffice.org

Open Office (<http://www.openoffice.org>) How-to: MySQL + OpenOffice. How-to: OpenOffice + MyODBC + unixODBC.

5.8.2.5 Using Connector/ODBC with Sambar Server

Sambar Server (<http://www.sambarserver.info>) How-to: MyODBC + SambarServer + MySQL.

5.8.2.6 Using Connector/ODBC with Pervasive Software DataJunction

You have to change it to output [VARCHAR](#) rather than [ENUM](#), as it exports the latter in a manner that causes MySQL problems.

5.8.2.7 Using Connector/ODBC with SunSystems Vision

Select the [Return matching rows](#) option.

5.8.3 Connector/ODBC and the Application Both Use OpenSSL

If Connector/ODBC is connecting securely with the MySQL server and the application using the connection makes calls itself to an OpenSSL library, the application might then fail, as two copies of the OpenSSL library will then be in use.

Note

Connector/ODBC 8.0 and higher link to OpenSSL dynamically while earlier Connector/ODBC versions link to OpenSSL statically. This solves problems related to using two OpenSSL copies from the same application.

To prevent the issue, in your application, do not allow OpenSSL initialization in one thread and the opening of an Connector/ODBC connection in another thread (which also initializes OpenSSL) to happen simultaneously. For example, use a mutex to ensure synchronization between `SQLDriverConnect()` or `SQLConnect()` calls and openSSL initialization. In addition to that, implement the following if possible:

- Use a build of Connector/ODBC that links (statically or dynamically) to a version of the `libmysqlclient` library that is in turn dynamically linked to the same OpenSSL library that the application calls.
- When creating a build of Connector/ODBC that links (statically or dynamically) to a version of the `libmysqlclient` library that is in turn statically linked to an OpenSSL library, do NOT export OpenSSL symbols in your build. That prevents incorrect resolution of application symbols; however, that does not prevent other issues that come with running two copies of OpenSSL code within a single application.

5.8.4 Connector/ODBC Errors and Resolutions (FAQ)

The following section details some common errors and their suggested fix or alternative solution. If you are still experiencing problems, use the Connector/ODBC mailing list; see [Section 5.9.1, "Connector/ODBC Community Support"](#).

Many problems can be resolved by upgrading your Connector/ODBC drivers to the latest available release. On Windows, make sure that you have the latest versions of the Microsoft Data Access Components (MDAC) installed.

64-Bit Windows and ODBC Data Source Administrator

I have installed Connector/ODBC on Windows XP x64 Edition or Windows Server 2003 R2 x64. The installation completed successfully, but the Connector/ODBC driver does not appear in [ODBC Data Source Administrator](#).

This is not a bug, but is related to the way Windows x64 editions operate with the ODBC driver. On Windows x64 editions, the Connector/ODBC driver is installed in the `%SystemRoot%\SysWOW64` folder. However, the default [ODBC Data Source Administrator](#) that is available through the [Administrative Tools](#) or [Control Panel](#) in Windows x64 Editions is located in the `%SystemRoot%\system32` folder, and only searches this folder for ODBC drivers.

On Windows x64 editions, use the ODBC administration tool located at `%SystemRoot%\SysWOW64\odbcad32.exe`, this will correctly locate the installed Connector/ODBC drivers and enable you to create a Connector/ODBC DSN.

This issue was originally reported as Bug #20301.

Error 10061 (Cannot connect to server)

When connecting or using the **Test** button in [ODBC Data Source Administrator](#) I get error 10061 (Cannot connect to server)

This error can be raised by a number of different issues, including server problems, network problems, and firewall and port blocking problems. For more information, see [Can't connect to \[local\] MySQL server](#).

"Transactions are not enabled" Error

The following error is reported when using transactions: [Transactions are not enabled](#)

This error indicates that you are trying to use [transactions](#) with a MySQL table that does not support transactions. Transactions are supported within MySQL when using the [InnoDB](#) database engine,

which is the default storage engine in MySQL 5.5 and higher. In versions of MySQL before MySQL 5.1, you may also use the `BDB` engine.

Check the following before continuing:

- Verify that your MySQL server supports a transactional database engine. Use `SHOW ENGINES` to obtain a list of the available engine types.
- Verify that the tables you are updating use a transactional database engine.
- Ensure that you have not enabled the `disable transactions` option in your DSN.

#DELETED# Records Reported by Access

Access reports records as `#DELETED#` when inserting or updating records in linked tables.

If the inserted or updated records are shown as `#DELETED#` in Access, then:

- If you are using Access 2000, get and install the newest (version 2.6 or higher) Microsoft MDAC ([Microsoft Data Access Components](http://support.microsoft.com/kb/110093)) from <http://support.microsoft.com/kb/110093>. This fixes a bug in Access that when you export data to MySQL, the table and column names aren't specified.

Also, get and apply the Microsoft Jet 4.0 Service Pack 5 (SP5), which can be found at <http://support.microsoft.com/default.aspx?scid=kb;EN-US;q239114>. This fixes some cases where columns are marked as `#DELETED#` in Access.

- For all versions of Access, enable the Connector/ODBC `Return matching rows` option. For Access 2.0, also enable the `Simulate ODBC 1.0` option.
- Include a `TIMESTAMP` in all tables that you want to be able to update.
- Include a `primary key` in the table. If not, new or updated rows may show up as `#DELETED#`.
- Use only `DOUBLE` float fields. Access fails when comparing with single-precision floats. The symptom usually is that new or updated rows may show up as `#DELETED#` or that you cannot find or update rows.
- If you are using Connector/ODBC to link to a table that has a `BIGINT` column, the results are displayed as `#DELETED#`. The work around solution is:
 - Have one more dummy column with `TIMESTAMP` as the data type.
 - Select the `Change BIGINT columns to INT` option in the connection dialog in ODBC DSN Administrator.
 - Delete the table link from Access and re-create it.

Old records still display as `#DELETED#`, but newly added/updated records are displayed properly.

Write Conflicts or Row Location Errors

How do I handle Write Conflicts or Row Location errors?

If you see the following errors, select the `Return Matching Rows` option in the DSN configuration dialog, or specify `OPTION=2`, as the connection parameter:

```
Write Conflict. Another user has changed your data.
Row cannot be located for updating. Some values may have been changed
since it was last read.
```

Importing from Access 97

Exporting data from Access 97 to MySQL reports a `Syntax Error`.

This error is specific to Access 97 and versions of Connector/ODBC earlier than 3.51.02. Update to the latest version of the Connector/ODBC driver to resolve this problem.

Importing from Microsoft DTS

Exporting data from Microsoft DTS to MySQL reports a [Syntax Error](#).

This error occurs only with MySQL tables using the `TEXT` or `VARCHAR` data types. You can fix this error by upgrading your Connector/ODBC driver to version 3.51.02 or higher.

SQL_NO_DATA Exception from ODBC.NET

Using ODBC.NET with Connector/ODBC, while fetching empty string (0 length), it starts giving the `SQL_NO_DATA` exception.

You can get the patch that addresses this problem from <http://support.microsoft.com/default.aspx?scid=kb;EN-US;q319243>.

Error with SELECT COUNT(*)

Using `SELECT COUNT(*) FROM tbl_name` within Visual Basic and ASP returns an error.

This error occurs because the `COUNT(*)` expression is returning a `BIGINT`, and ADO cannot make sense of a number this big. Select the `Change BIGINT columns to INT` option (option value 16384).

Multiple-Step Operation Error

Using the `AppendChunk()` or `GetChunk()` ADO methods, the `Multiple-step operation generated errors. Check each status value` error is returned.

The `GetChunk()` and `AppendChunk()` methods from ADO do not work as expected when the cursor location is specified as `adUseServer`. On the other hand, you can overcome this error by using `adUseClient`.

A simple example can be found from http://www.dwam.net/iishelp/ado/docs/adomth02_4.htm

Modified Record Error

Access returns `Another user had modified the record that you have modified` while editing records on a Linked Table.

In most cases, this can be solved by doing one of the following things:

- Add a [primary key](#) for the table if one doesn't exist.
- Add a timestamp column if one doesn't exist.
- Only use double-precision float fields. Some programs may fail when they compare single-precision floats.

If these strategies do not help, start by making a log file from the ODBC manager (the log you get when requesting logs from ODBCADMIN) and a Connector/ODBC log to help you figure out why things go wrong. For instructions, see [Section 5.5.8, "Getting an ODBC Trace File"](#).

Direct Application Linking Under Unix or Linux

When linking an application directly to the Connector/ODBC library under Unix or Linux, the application crashes.

Connector/ODBC under Unix or Linux is not compatible with direct application linking. To connect to an ODBC source, use a driver manager, such as `iODBC` or `unixODBC`.

Microsoft Office and DATE or TIMESTAMP Columns

Applications in the Microsoft Office suite cannot update tables that have [DATE](#) or [TIMESTAMP](#) columns.

This is a known issue with Connector/ODBC. Ensure that the field has a default value (rather than [NULL](#)) and that the default value is nonzero (that is, something other than [0000-00-00 00:00:00](#)).

INFORMATION_SCHEMA Database

When connecting Connector/ODBC 5.x to a MySQL 4.x server, the error [1044 Access denied for user 'xxx'@'%' to database 'information_schema'](#) is returned.

Connector/ODBC 5.x is designed to work with MySQL 5.0 or later, taking advantage of the [INFORMATION_SCHEMA](#) database to determine data definition information. Support for MySQL 4.1 is planned for the final release.

S1T00 Error

When calling [SQLTables](#), the error [S1T00](#) is returned, but I cannot find this in the list of error numbers for Connector/ODBC.

The [S1T00](#) error indicates that a general timeout has occurred within the ODBC system and is not a MySQL error. Typically it indicates that the connection you are using is stale, the server is too busy to accept your request or that the server has gone away.

"Table does not exist" Error in Access 2000

When linking to tables in Access 2000 and generating links to tables programmatically, rather than through the table designer interface, you may get errors about tables not existing.

There is a known issue with a specific version of the [msjet40.dll](#) that exhibits this issue. The version affected is 4.0.9025.0. Reverting to an older version will enable you to create the links. If you have recently updated your version, check your [WINDOWS](#) directory for the older version of the file and copy it to the drivers directory.

Batched Statements

When I try to use batched statements, the execution of the batched statements fails.

Batched statement support was added in 3.51.18. Support for batched statements is not enabled by default. Enable option [FLAG_MULTI_STATEMENTS](#), value 67108864, or select the **Allow multiple statements** flag within a GUI configuration.

Packet Errors with ADODB and Excel

When connecting to a MySQL server using ADODB and Excel, occasionally the application fails to communicate with the server and the error [Got an error reading communication packets](#) appears in the error log.

This error may be related to Keyboard Logger 1.1 from PanteraSoft.com, which is known to interfere with the network communication between MySQL Connector/ODBC and MySQL.

Outer Join Error

When using some applications to access a MySQL server using Connector/ODBC and outer joins, an error is reported regarding the Outer Join Escape Sequence.

This is a known issue with MySQL Connector/ODBC which is not correctly parsing the "Outer Join Escape Sequence", as per the specs at [Microsoft ODBC Specs](#). Currently, Connector/ODBC will return a value > 0 when asked for [SQL_OJ_CAPABILITIES](#) even though no parsing takes place in the driver to handle the outer join escape sequence.

Hebrew/CJK Characters

I can correctly store extended characters in the database (Hebrew/CJK) using Connector/ODBC 5.1, but when I retrieve the data, the text is not formatted correctly and I get garbled characters.

When using ASP and UTF8 characters, add the following to your ASP files to ensure that the data returned is correctly encoded:

```
Response.CodePage = 65001  
Response.CharSet = "utf-8"
```

Duplicate Entry in Installed Programs List

I have a duplicate MySQL Connector/ODBC entry within my **Installed Programs** list, but I cannot delete one of them.

This problem can occur when you upgrade an existing Connector/ODBC installation, rather than removing and then installing the updated version.

Warning

To fix the problem, use any working uninstallers to remove existing installations; then may have to edit the contents of the registry. Make sure you have a backup of your registry information before attempting any editing of the registry contents.

Values Truncated to 255 Characters

When submitting queries with parameter binding using [UPDATE](#), my field values are being truncated to 255 characters.

Ensure that the [FLAG_BIG_PACKETS](#) option is set for your connection. This removes the 255 character limitation on bound parameters.

Disabling Data-At-Execution

Is it possible to disable data-at-execution using a flag?

If you do not want to use data-at-execution, remove the corresponding calls. For example:

```
SQLLEN ylen = SQL_LEN_DATA_AT_EXEC(10);  
SQLBindCol(hstmt, 2, SQL_C_BINARY, buf, 10, &hlen);
```

Would become:

```
SQLBindCol(hstmt, 2, SQL_C_BINARY, buf, 10, NULL);
```

This example also replaced `&hlen` with `NULL` in the call to [SQLBindCol\(\)](#).

For further information, refer to the [MSDN documentation](#) for [SQLBindCol\(\)](#).

NULLABLE Attribute for AUTO_INCREMENT Columns

When you call [SQLColumns\(\)](#) for a table column that is [AUTO_INCREMENT](#), the [NULLABLE](#) column of the result set is always `SQL_NULLABLE (1)`.

This is because MySQL reports the [DEFAULT](#) value for such a column as `NULL`. It means, if you insert a `NULL` value into the column, you will get the next integer value for the table's [auto_increment](#) counter.

5.9 Connector/ODBC Support

There are many different places where you can get support for using Connector/ODBC. Always try the Connector/ODBC Mailing List or Connector/ODBC Forum. See [Section 5.9.1, “Connector/ODBC Community Support”](#), for help before reporting a specific bug or issue to MySQL.

5.9.1 Connector/ODBC Community Support

Community support from experienced users is also available through the [ODBC Forum](#). You may also find help from other users in the other MySQL Forums, located at <http://forums.mysql.com>. See [MySQL Community Support at the MySQL Forums](#).

5.9.2 How to Report Connector/ODBC Problems or Bugs

If you encounter difficulties or problems with Connector/ODBC, start by making a log file from the [ODBC Manager](#) (the log you get when requesting logs from [ODBC ADMIN](#)) and Connector/ODBC. The procedure for doing this is described in [Section 5.5.8, “Getting an ODBC Trace File”](#).

Check the Connector/ODBC trace file to find out what could be wrong. Determine what statements were issued by searching for the string `>mysql_real_query` in the `myodbc.log` file.

Also, try issuing the statements from the `mysql` client program or from `admndemo`. This helps you determine whether the error is in Connector/ODBC or MySQL.

Ideally, include the following information with your bug report:

- Operating system and version
- Connector/ODBC version
- ODBC Driver Manager type and version
- MySQL server version
- ODBC trace from Driver Manager
- Connector/ODBC log file from Connector/ODBC driver
- Simple reproducible sample

The more information you supply, the more likely it is that we can fix the problem.

If you are unable to find out what is wrong, the last option is to create an archive in `tar` or `zip` format that contains a Connector/ODBC trace file, the ODBC log file, and a `README` file that explains the problem. Initiate a bug report for our bugs database at <http://bugs.mysql.com/>, then click the Files tab in the bug report for instructions on uploading the archive to the bugs database. Only MySQL engineers have access to the files you upload, and we are very discreet with the data.

If you can create a program that also demonstrates the problem, please include it in the archive as well.

If the program works with another SQL server, include an ODBC log file where you perform exactly the same SQL statements so that we can compare the results between the two systems.

Remember that the more information you can supply to us, the more likely it is that we can fix the problem.

Chapter 6 MySQL Connector/Python Developer Guide

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MySQL Connector/Python is a self-contained Python driver for communicating with MySQL servers.

For notes detailing the changes in each release of Connector/Python, see [MySQL Connector/Python Release Notes](#).

For legal information, see the [Legal Notices](#).

For help with using MySQL, please visit the [MySQL Forums](#), where you can discuss your issues with other MySQL users.

Licensing information. This product may include third-party software, used under license. If you are using a *Commercial* release of MySQL Connector/Python, see [this document](#) for licensing information, including licensing information relating to third-party software that may be included in this Commercial release. If you are using a *Community* release of MySQL Connector/Python, see [this document](#) for licensing information, including licensing information relating to third-party software that may be included in this Community release.

6.1 Introduction to MySQL Connector/Python

MySQL Connector/Python enables Python programs to access MySQL databases, using an API that is compliant with the [Python Database API Specification v2.0 \(PEP 249\)](#). It is written in pure Python and does not have any dependencies except for the [Python Standard Library](#).

For notes detailing the changes in each release of Connector/Python, see [MySQL Connector/Python Release Notes](#).

MySQL Connector/Python includes support for:

- Almost all features provided by MySQL Server up to and including MySQL Server version 5.7. Connector/Python 8.0 also supports X DevAPI. For documentation of the concepts and the usage of MySQL Connector/Python with X DevAPI, see [X DevAPI User Guide](#).
- Converting parameter values back and forth between Python and MySQL data types, for example Python `datetime` and MySQL `DATETIME`. You can turn automatic conversion on for convenience, or off for optimal performance.
- All MySQL extensions to standard SQL syntax.
- Protocol compression, which enables compressing the data stream between the client and server.
- Connections using TCP/IP sockets and on Unix using Unix sockets.
- Secure TCP/IP connections using SSL.
- Self-contained driver. Connector/Python does not require the MySQL client library or any Python modules outside the standard library.

For information about which versions of Python can be used with different versions of MySQL Connector/Python, see [Section 6.3, “Connector/Python Versions”](#).

Note

Connector/Python does not support the old MySQL Server authentication methods, which means that MySQL versions prior to 4.1 will not work.

6.2 Guidelines for Python Developers

The following guidelines cover aspects of developing MySQL applications that might not be immediately obvious to developers coming from a Python background:

- For security, do not hardcode the values needed to connect and log into the database in your main script. Python has the convention of a `config.py` module, where you can keep such values separate from the rest of your code.
- Python scripts often build up and tear down large data structures in memory, up to the limits of available RAM. Because MySQL often deals with data sets that are many times larger than available memory, techniques that optimize storage space and disk I/O are especially important. For example, in MySQL tables, you typically use numeric IDs rather than string-based dictionary keys, so that the key values are compact and have a predictable length. This is especially important for columns that make up the `primary key` for an `InnoDB` table, because those column values are duplicated within each `secondary index`.
- Any application that accepts input must expect to handle bad data.

The bad data might be accidental, such as out-of-range values or misformatted strings. The application can use server-side checks such as `unique constraints` and `NOT NULL constraints`, to keep the bad data from ever reaching the database. On the client side, use techniques such as exception handlers to report any problems and take corrective action.

The bad data might also be deliberate, representing an “SQL injection” attack. For example, input values might contain quotation marks, semicolons, % and _ wildcard characters and other characters significant in SQL statements. Validate input values to make sure they have only the expected characters. Escape any special characters that could change the intended behavior when substituted into an SQL statement. Never concatenate a user input value into an SQL statement without doing validation and escaping first. Even when accepting input generated by some other program, expect that the other program could also have been compromised and be sending you incorrect or malicious data.

- Because the result sets from SQL queries can be very large, use the appropriate method to retrieve items from the result set as you loop through them. `fetchone()` retrieves a single item, when you know the result set contains a single row. `fetchall()` retrieves all the items, when you know the result set contains a limited number of rows that can fit comfortably into memory. `fetchmany()` is the general-purpose method when you cannot predict the size of the result set: you keep calling it and looping through the returned items, until there are no more results to process.
- Since Python already has convenient modules such as `pickle` and `cPickle` to read and write data structures on disk, data that you choose to store in MySQL instead is likely to have special characteristics:
 - **Too large to all fit in memory at one time.** You use `SELECT` statements to query only the precise items you need, and `aggregate functions` to perform calculations across multiple items. You configure the `innodb_buffer_pool_size` option within the MySQL server to dedicate a certain amount of RAM for caching query results.
 - **Too complex to be represented by a single data structure.** You divide the data between different SQL tables. You can recombine data from multiple tables by using a `join` query. You make sure that related data is kept in sync between different tables by setting up `foreign key` relationships.
 - **Updated frequently, perhaps by multiple users simultaneously.** The updates might only affect a small portion of the data, making it wasteful to write the whole structure each time. You use the SQL `INSERT`, `UPDATE`, and `DELETE` statements to update different items concurrently, writing only the changed values to disk. You use `InnoDB` tables and `transactions` to keep write operations from conflicting with each other, and to return consistent query results even as the underlying data is being updated.
- Using MySQL best practices for performance can help your application to scale without requiring major rewrites and architectural changes. See [Optimization](#) for best practices for MySQL performance. It offers guidelines and tips for SQL tuning, database design, and server configuration.
- You can avoid reinventing the wheel by learning the MySQL SQL statements for common operations: operators to use in queries, techniques for bulk loading data, and so on. Some statements and clauses are extensions to the basic ones defined by the SQL standard. See [Data Manipulation Statements](#), [Data Definition Statements](#), and [SELECT Statement](#) for the main classes of statements.
- Issuing SQL statements from Python typically involves declaring very long, possibly multi-line string literals. Because string literals within the SQL statements could be enclosed by single quotation, double quotation marks, or contain either of those characters, for simplicity you can use Python's triple-quoting mechanism to enclose the entire statement. For example:

```
'''It doesn't matter if this string contains 'single'  
or "double" quotes, as long as there aren't 3 in a  
row.'''
```

You can use either of the ' or " characters for triple-quoting multi-line string literals.

- Many of the secrets to a fast, scalable MySQL application involve using the right syntax at the very start of your setup procedure, in the `CREATE TABLE` statements. For example, Oracle recommends

the `ENGINE=INNODB` clause for most tables, and makes `InnoDB` the default storage engine in MySQL 5.5 and up. Using `InnoDB` tables enables transactional behavior that helps scalability of read-write workloads and offers automatic `crash recovery`. Another recommendation is to declare a numeric `primary key` for each table, which offers the fastest way to look up values and can act as a pointer to associated values in other tables (a `foreign key`). Also within the `CREATE TABLE` statement, using the most compact column data types that meet your application requirements helps performance and scalability because that enables the database server to move less data back and forth between memory and disk.

6.3 Connector/Python Versions

The following table summarizes the available Connector/Python versions. For series that have reached General Availability (GA) status, development releases in the series prior to the GA version are no longer supported.

Note

MySQL Connectors and other MySQL client tools and applications now synchronize the first digit of their version number with the (highest) MySQL server version they support. For example, MySQL Connector/Python 8.0.12 would be designed to support all features of MySQL server version 8 (or lower). This change makes it easy and intuitive to decide which client version to use for which server version.

Connector/Python 8.0.4 is the first release to use the new numbering. It is the successor to Connector/Python 2.2.3.

Table 6.1 Connector/Python Version Reference

Connector/Python Version	MySQL Server Versions	Python Versions	Connector Status
8.0	8.0, 5.7, 5.6, 5.5	3.8, 3.7, 3.6, 3.5, 3.4, 2.7	General Availability
2.2 (continues as 8.0)	5.7, 5.6, 5.5	3.5, 3.4, 2.7	Developer Milestone, No releases
2.1	5.7, 5.6, 5.5	3.5, 3.4, 2.7, 2.6	General Availability
2.0	5.7, 5.6, 5.5	3.5, 3.4, 2.7, 2.6	GA, final release on 2016-10-26
1.2	5.7, 5.6, 5.5 (5.1, 5.0, 4.1)	3.4, 3.3, 3.2, 3.1, 2.7, 2.6	GA, final release on 2014-08-22

Note

MySQL server and Python versions within parentheses are known to work with Connector/Python, but are not officially supported. Bugs might not get fixed for those versions.

Note

Connector/Python does not support the old MySQL Server authentication methods, which means that MySQL versions prior to 4.1 will not work.

6.4 Connector/Python Installation

Connector/Python runs on any platform where Python is installed. Python comes preinstalled on most Unix and Unix-like systems, such as Linux, macOS, and FreeBSD. On Microsoft Windows, a Python

installer is available at the [Python Download website](#). If necessary, download and install Python for Windows before attempting to install Connector/Python.

Note

Connector/Python requires `python` to be in the system's `PATH` and installation fails if `python` cannot be located. On Unix and Unix-like systems, `python` is normally located in a directory included in the default `PATH` setting. On Windows, if you install Python, either enable **Add python.exe to Path** during the installation process, or manually add the directory containing `python.exe` yourself.

For more information about installation and configuration of Python on Windows, see [Using Python on Windows](#) in the Python documentation.

Connector/Python implements the MySQL client/server protocol two ways:

- As pure Python. This implementation of the protocol does not require any other MySQL client libraries or other components.
- As a C Extension that interfaces with the MySQL C client library. This implementation of the protocol is dependent on the client library, but can use the library provided by MySQL Server packages (see [MySQL C API Implementations](#)). The C Extension is available as of Connector/Python 2.1.1.

Neither implementation of the client/server protocol has any third-party dependencies. However, if you need SSL support, verify that your Python installation has been compiled using the [OpenSSL](#) libraries.

Installation of Connector/Python is similar on every platform and follows the standard [Python Distribution Utilities](#) or [Distutils](#). Distributions are available in native format for some platforms, such as RPM packages for Linux.

Python terminology regarding distributions:

- **Built Distribution:** A package created in the native packaging format intended for a given platform. It contains both sources and platform-independent bytecode. Connector/Python binary distributions are built distributions.
- **Source Distribution:** A distribution that contains only source files and is generally platform independent.

6.4.1 Obtaining Connector/Python

Packages are available at the [Connector/Python download site](#). For some packaging formats, there are different packages for different versions of Python; choose the one appropriate for the version of Python installed on your system.

6.4.2 Installing Connector/Python from a Binary Distribution

Connector/Python installers in native package formats are available for Windows and for Unix and Unix-like systems:

- Windows: MSI installer package
- Linux: Yum repository for EL6 and EL7 and Fedora; RPM packages for Oracle Linux, Red Hat, and SuSE; Debian packages for Debian and Ubuntu
- macOS: Disk image package with PKG installer

You may need `root` or administrator privileges to perform the installation operation.

As of Connector/Python 2.1.1, binary distributions are available that include a C Extension that interfaces with the MySQL C client library. Some packaging types have a single distribution file that

includes the pure-Python Connector/Python code together with the C Extension. (Windows MSI and macOS Disk Image packages fall into this category.) Other packaging types have two related distribution files: One that includes the pure-Python Connector/Python code, and one that includes only the C Extension. For packaging types that have separate distribution files, install either one or both packages. The two files have related names, the difference being that the one that contains the C Extension has “cext” in the distribution file name.

Binary distributions that provide the C Extension link to an already installed C client library provided by a MySQL Server installation. For those distributions that are not statically linked, you must install MySQL Server if it is not already present on your system. To obtain it, visit the [MySQL download site](#).

Installing Connector/Python with pip

Use `pip` to install Connector/Python on most any operating system:

```
shell> pip install mysql-connector-python
```

Installing Connector/Python on Microsoft Windows

Managing all of your MySQL products, including MySQL Connector/Python, with MySQL Installer is the recommended approach. It handles all requirements and prerequisites, configurations, and upgrades.

Prerequisite. The [Microsoft Visual C++ 2015 Redistributable](#) must be installed on your system.

- MySQL Installer (recommended): When executing [MySQL Installer](#), choose MySQL Connector/Python as one of the products to install. MySQL Installer installs the Windows MSI Installer described in this documentation.
- Windows MSI Installer (`.msi` file): To use the MSI Installer, launch it and follow the prompts in the screens it presents to install Connector/Python in the location of your choosing.

Like with MySQL Installer, subsequent executions of the Connector/Python MSI enable you to either repair or remove the existing Connector/Python installation.

Connector/Python Windows MSI Installers (`.msi` files) are available from the Connector/Python download site (see [Section 6.4.1, “Obtaining Connector/Python”](#)). Choose an installer appropriate for the version of Python installed on your system. As of Connector/Python 2.1.1, MSI Installers include the C Extension; it need not be installed separately.

Alternatively, to run the installer from the command line, use this command in a console window, where `VER` and `PYVER` are the respective Connector/Python and Python version numbers in the installer file name:

```
shell> msieexec /i mysql-connector-python-VER-pyPYVER.msi
```

Subsequent executions of Connector/Python using the MSI installer permit you to either repair or remove the existing Connector/Python installation.

Installing Connector/Python on Linux Using the MySQL Yum Repository

For EL6 or EL7-based platforms and Fedora 19 or 20, you can install Connector/Python using the MySQL Yum repository (see [Installing Additional MySQL Products and Components with Yum](#)). You must have the MySQL Yum repository on your system's repository list (for details, see [Adding the MySQL Yum Repository](#)). To make sure that your Yum repository is up-to-date, use this command:

```
shell> sudo yum update mysql-community-release
```

Then install Connector/Python as follows:

```
shell> sudo yum install mysql-connector-python
```

Installing Connector/Python on Linux Using an RPM Package

Connector/Python Linux RPM packages (`.rpm` files) are available from the Connector/Python download site (see [Section 6.4.1, “Obtaining Connector/Python”](#)).

To install a Connector/Python RPM package (denoted here as `PACKAGE.rpm`), use this command:

```
shell> rpm -i PACKAGE.rpm
```

To install the C Extension (available as of Connector/Python 2.1.1), install the corresponding package with “cext” in the package name.

RPM provides a feature to verify the integrity and authenticity of packages before installing them. To learn more, see [Verifying Package Integrity Using MD5 Checksums or GnuPG](#).

Installing Connector/Python on Linux Using a Debian Package

Connector/Python Debian packages (`.deb` files) are available for Debian or Debian-like Linux systems from the Connector/Python download site (see [Section 6.4.1, “Obtaining Connector/Python”](#)).

To install a Connector/Python Debian package (denoted here as `PACKAGE.deb`), use this command:

```
shell> dpkg -i PACKAGE.deb
```

To install the C Extension (available as of Connector/Python 2.1.1), install the corresponding package with “cext” in the package name.

Installing Connector/Python on macOS Using a Disk Image

Connector/Python macOS disk images (`.dmg` files) are available from the Connector/Python download site (see [Section 6.4.1, “Obtaining Connector/Python”](#)). As of Connector/Python 2.1.1, macOS disk images include the C Extension; it need not be installed separately.

Download the `.dmg` file and install Connector/Python by opening it and double clicking the resulting `.pkg` file.

6.4.3 Installing Connector/Python from a Source Distribution

Connector/Python source distributions are platform independent and can be used on any platform. Source distributions are packaged in two formats:

- Zip archive format (`.zip` file)
- Compressed `tar` archive format (`.tar.gz` file)

Either packaging format can be used on any platform, but Zip archives are more commonly used on Windows systems and `tar` archives on Unix and Unix-like systems.

Prerequisites for Compiling Connector/Python with the C Extension

As of Connector/Python 2.1.1, source distributions include the C Extension that interfaces with the MySQL C client library. You can build the distribution with or without support for this extension. To build Connector/Python with support for the C Extension, you must satisfy the following prerequisites.

- Linux: A C/C++ compiler, such as `gcc`
Windows: Correct version of Visual Studio: VS 2009 for Python 2.7, VS 2010 for Python 3.3
- Protobuf C++ (version \geq 3.6.1)
- Python development files
- MySQL Server installed, including development files to compile the optional C Extension that interfaces with the MySQL C client library

You must install MySQL Server if it is not already present on your system. To obtain it, visit the [MySQL download site](#).

For certain platforms, MySQL development files are provided in separate packages. This is true for RPM and Debian packages, for example.

Installing Connector/Python from Source on Microsoft Windows

A Connector/Python Zip archive (`.zip` file) is available from the Connector/Python download site (see [Section 6.4.1, “Obtaining Connector/Python”](#)).

To install Connector/Python from a Zip archive, download the latest version and follow these steps:

1. Unpack the Zip archive in the intended installation directory (for example, `C:\mysql-connector\`) using [WinZip](#) or another tool that can read `.zip` files.
2. Start a console window and change location to the folder where you unpacked the Zip archive:

```
shell> cd C:\mysql-connector\
```

3. Inside the Connector/Python folder, perform the installation using this command:

```
shell> python setup.py install
```

To include the C Extension (available as of Connector/Python 2.1.1), use this command instead:

```
shell> python setup.py install --with-mysql-capi="path_name"
```

The argument to `--with-mysql-capi` is the path to the installation directory of MySQL Server.

To see all options and commands supported by `setup.py`, use this command:

```
shell> python setup.py --help
```

Installing Connector/Python from Source on Unix and Unix-Like Systems

For Unix and Unix-like systems such as Linux, Solaris, macOS, and FreeBSD, a Connector/Python `tar` archive (`.tar.gz` file) is available from the Connector/Python download site (see [Section 6.4.1, “Obtaining Connector/Python”](#)).

To install Connector/Python from a `tar` archive, download the latest version (denoted here as `VER`), and execute these commands:

```
shell> tar xzf mysql-connector-python-VER.tar.gz
shell> cd mysql-connector-python-VER
shell> sudo python setup.py install \
--with-protobuf-include-dir=/dir/to/protobuf/include \
--with-protobuf-lib-dir=/dir/to/protobuf/lib \
--with-protoc=/path/to/protoc/binary
```

To include the C Extension (available as of Connector/Python 2.1.1) that interfaces with the MySQL C client library, also add the `--with-mysql-capi` such as:

```
shell> sudo python setup.py install \
--with-protobuf-include-dir=/dir/to/protobuf/include \
--with-protobuf-lib-dir=/dir/to/protobuf/lib \
--with-protoc=/path/to/protoc/binary \
--with-mysql-capi="path_name"
```

The argument to `--with-mysql-capi` is the path to the installation directory of MySQL Server, or the path to the `mysql_config` command.

To see all options and commands supported by `setup.py`, use this command:

```
shell> python setup.py --help
```

6.4.4 Verifying Your Connector/Python Installation

On Windows, the default Connector/Python installation location is `C:\PythonX.Y\Lib\site-packages\`, where `X.Y` is the Python version you used to install the connector.

On Unix-like systems, the default Connector/Python installation location is `/prefix/pythonX.Y/site-packages/`, where `prefix` is the location where Python is installed and `X.Y` is the Python version. See [How installation works](#) in the Python manual.

The C Extension is installed as `_mysql_connector.so` in the `site-packages` directory, not in the `mysql/connector` directory.

Depending on your platform, the installation path might differ from the default. If you are not sure where Connector/Python is installed, do the following to determine its location. The output here shows installation locations as might be seen on macOS:

```
shell> python
>>> from distutils.sysconfig import get_python_lib
>>> print(get_python_lib())                      # Python v2.x
/Library/Python/2.7/site-packages
>>> print(get_python_lib())                      # Python v3.x
/Library/Frameworks/Python.framework/Versions/3.1/lib/python3.1/site-packages
```

To test that your Connector/Python installation is working and able to connect to MySQL Server, you can run a very simple program where you supply the login credentials and host information required for the connection. For an example, see [Section 6.5.1, “Connecting to MySQL Using Connector/Python”](#).

6.5 Connector/Python Coding Examples

These coding examples illustrate how to develop Python applications and scripts which connect to MySQL Server using MySQL Connector/Python.

6.5.1 Connecting to MySQL Using Connector/Python

The `connect()` constructor creates a connection to the MySQL server and returns a `MySQLConnection` object.

The following example shows how to connect to the MySQL server:

```
import mysql.connector
cnx = mysql.connector.connect(user='scott', password='password',
                               host='127.0.0.1',
                               database='employees')
cnx.close()
```

[Section 6.7.1, “Connector/Python Connection Arguments”](#) describes the permitted connection arguments.

It is also possible to create connection objects using the `connection.MySQLConnection()` class:

```
from mysql.connector import (connection)
cnx = connection.MySQLConnection(user='scott', password='password',
                                   host='127.0.0.1',
                                   database='employees')
cnx.close()
```

Both forms (either using the `connect()` constructor or the class directly) are valid and functionally equal, but using `connect()` is preferred and used by most examples in this manual.

To handle connection errors, use the `try` statement and catch all errors using the `errors.Error` exception:

```
import mysql.connector
from mysql.connector import errorcode
try:
```

```
cnx = mysql.connector.connect(user='scott',
                               database='employ')
except mysql.connector.Error as err:
    if err.errno == errorcode.ER_ACCESS_DENIED_ERROR:
        print("Something is wrong with your user name or password")
    elif err.errno == errorcode.ER_BAD_DB_ERROR:
        print("Database does not exist")
    else:
        print(err)
else:
    cnx.close()
```

Defining connection arguments in a dictionary and using the `**` operator is another option:

```
import mysql.connector
config = {
    'user': 'scott',
    'password': 'password',
    'host': '127.0.0.1',
    'database': 'employees',
    'raise_on_warnings': True
}
cnx = mysql.connector.connect(**config)
cnx.close()
```

Using the Connector/Python Python or C Extension

Connector/Python offers two implementations: a pure Python interface and a C extension that uses the MySQL C client library (see [The Connector/Python C Extension](#)). This can be configured at runtime using the `use_pure` connection argument. It defaults to `False` as of MySQL 8, meaning the C extension is used. If the C extension is not available on the system then `use_pure` defaults to `True`. Setting `use_pure=False` causes the connection to use the C Extension if your Connector/Python installation includes it, while `use_pure=True` to `False` means the Python implementation is used if available.

Note

The `use_pure` option and C extension were added in Connector/Python 2.1.1.

The following example shows how to set `use_pure` to `False`.

```
import mysql.connector
cnx = mysql.connector.connect(user='scott', password='password',
                               host='127.0.0.1',
                               database='employees',
                               use_pure=False)
cnx.close()
```

It is also possible to use the C Extension directly by importing the `_mysql_connector` module rather than the `mysql.connector` module. For more information, see [The `_mysql_connector` C Extension Module](#).

6.5.2 Creating Tables Using Connector/Python

All [DDL](#) (Data Definition Language) statements are executed using a handle structure known as a cursor. The following examples show how to create the tables of the [Employee Sample Database](#). You need them for the other examples.

In a MySQL server, tables are very long-lived objects, and are often accessed by multiple applications written in different languages. You might typically work with tables that are already set up, rather than creating them within your own application. Avoid setting up and dropping tables over and over again, as that is an expensive operation. The exception is [temporary tables](#), which can be created and dropped quickly within an application.

```
from __future__ import print_function
import mysql.connector
```

```

from mysql.connector import errorcode
DB_NAME = 'employees'
TABLES = {}
TABLES['employees'] = (
    "CREATE TABLE `employees` ("
    "    `emp_no` int(11) NOT NULL AUTO_INCREMENT,"
    "    `birth_date` date NOT NULL,"
    "    `first_name` varchar(14) NOT NULL,"
    "    `last_name` varchar(16) NOT NULL,"
    "    `gender` enum('M','F') NOT NULL,"
    "    `hire_date` date NOT NULL,"
    "    PRIMARY KEY (`emp_no`)"
    ") ENGINE=InnoDB")
TABLES['departments'] = (
    "CREATE TABLE `departments` ("
    "    `dept_no` char(4) NOT NULL,"
    "    `dept_name` varchar(40) NOT NULL,"
    "    PRIMARY KEY (`dept_no`), UNIQUE KEY `dept_name` (`dept_name`)"
    ") ENGINE=InnoDB")
TABLES['salaries'] = (
    "CREATE TABLE `salaries` ("
    "    `emp_no` int(11) NOT NULL,"
    "    `salary` int(11) NOT NULL,"
    "    `from_date` date NOT NULL,"
    "    `to_date` date NOT NULL,"
    "    PRIMARY KEY (`emp_no`,`from_date`), KEY `emp_no` (`emp_no`),"
    "    CONSTRAINT `salaries_ibfk_1` FOREIGN KEY (`emp_no`) "
        "REFERENCES `employees` (`emp_no`) ON DELETE CASCADE"
    ") ENGINE=InnoDB")
TABLES['dept_emp'] = (
    "CREATE TABLE `dept_emp` ("
    "    `emp_no` int(11) NOT NULL,"
    "    `dept_no` char(4) NOT NULL,"
    "    `from_date` date NOT NULL,"
    "    `to_date` date NOT NULL,"
    "    PRIMARY KEY (`emp_no`,`dept_no`), KEY `emp_no` (`emp_no`),"
    "    KEY `dept_no` (`dept_no`),"
    "    CONSTRAINT `dept_emp_ibfk_1` FOREIGN KEY (`emp_no`)"
        "REFERENCES `employees` (`emp_no`) ON DELETE CASCADE,"
    "    CONSTRAINT `dept_emp_ibfk_2` FOREIGN KEY (`dept_no`)"
        "REFERENCES `departments` (`dept_no`) ON DELETE CASCADE"
    ") ENGINE=InnoDB")
TABLES['dept_manager'] = (
    "CREATE TABLE `dept_manager` ("
    "    `dept_no` char(4) NOT NULL,"
    "    `emp_no` int(11) NOT NULL,"
    "    `from_date` date NOT NULL,"
    "    `to_date` date NOT NULL,"
    "    PRIMARY KEY (`emp_no`,`dept_no`),"
    "    KEY `emp_no` (`emp_no`),"
    "    KEY `dept_no` (`dept_no`),"
    "    CONSTRAINT `dept_manager_ibfk_1` FOREIGN KEY (`emp_no`)"
        "REFERENCES `employees` (`emp_no`) ON DELETE CASCADE,"
    "    CONSTRAINT `dept_manager_ibfk_2` FOREIGN KEY (`dept_no`)"
        "REFERENCES `departments` (`dept_no`) ON DELETE CASCADE"
    ") ENGINE=InnoDB")
TABLES['titles'] = (
    "CREATE TABLE `titles` ("
    "    `emp_no` int(11) NOT NULL,"
    "    `title` varchar(50) NOT NULL,"
    "    `from_date` date NOT NULL,"
    "    `to_date` date DEFAULT NULL,"
    "    PRIMARY KEY (`emp_no`,`title`,`from_date`), KEY `emp_no` (`emp_no`),"
    "    CONSTRAINT `titles_ibfk_1` FOREIGN KEY (`emp_no`)"
        "REFERENCES `employees` (`emp_no`) ON DELETE CASCADE"
    ") ENGINE=InnoDB")

```

The preceding code shows how we are storing the `CREATE` statements in a Python dictionary called `TABLES`. We also define the database in a global variable called `DB_NAME`, which enables you to easily use a different schema.

```
cnx = mysql.connector.connect(user='scott')
```

```
cursor = cnx.cursor()
```

A single MySQL server can manage multiple [databases](#). Typically, you specify the database to switch to when connecting to the MySQL server. This example does not connect to the database upon connection, so that it can make sure the database exists, and create it if not:

```
def create_database(cursor):
    try:
        cursor.execute(
            "CREATE DATABASE {} DEFAULT CHARACTER SET 'utf8'".format(DB_NAME))
    except mysql.connector.Error as err:
        print("Failed creating database: {}".format(err))
        exit(1)

    try:
        cursor.execute("USE {}".format(DB_NAME))
    except mysql.connector.Error as err:
        print("Database {} does not exists.".format(DB_NAME))
        if err.errno == errorcode.ER_BAD_DB_ERROR:
            create_database(cursor)
            print("Database {} created successfully.".format(DB_NAME))
            cnx.database = DB_NAME
        else:
            print(err)
            exit(1)
```

We first try to change to a particular database using the `database` property of the connection object `cnx`. If there is an error, we examine the error number to check if the database does not exist. If so, we call the `create_database` function to create it for us.

On any other error, the application exits and displays the error message.

After we successfully create or change to the target database, we create the tables by iterating over the items of the `TABLES` dictionary:

```
for table_name in TABLES:
    table_description = TABLES[table_name]
    try:
        print("Creating table {}: ".format(table_name), end=' ')
        cursor.execute(table_description)
    except mysql.connector.Error as err:
        if err.errno == errorcode.ER_TABLE_EXISTS_ERROR:
            print("already exists.")
        else:
            print(err.msg)
    else:
        print("OK")
cursor.close()
cnx.close()
```

To handle the error when the table already exists, we notify the user that it was already there. Other errors are printed, but we continue creating tables. (The example shows how to handle the “table already exists” condition for illustration purposes. In a real application, we would typically avoid the error condition entirely by using the `IF NOT EXISTS` clause of the `CREATE TABLE` statement.)

The output would be something like this:

```
Database employees does not exists.
Database employees created successfully.
Creating table employees: OK
Creating table departments: already exists.
Creating table salaries: already exists.
Creating table dept_emp: OK
Creating table dept_manager: OK
Creating table titles: OK
```

To populate the employees tables, use the dump files of the [Employee Sample Database](#). Note that you only need the data dump files that you will find in an archive named like `employees_db-dump-`

[files-1.0.5.tar.bz2](#). After downloading the dump files, execute the following commands, adding connection options to the `mysql` commands if necessary:

```
shell> tar xzf employees_db-dump-files-1.0.5.tar.bz2
shell> cd employees_db
shell> mysql employees < load_employees.dump
shell> mysql employees < load_titles.dump
shell> mysql employees < load_departments.dump
shell> mysql employees < load_salaries.dump
shell> mysql employees < load_dept_emp.dump
shell> mysql employees < load_dept_manager.dump
```

6.5.3 Inserting Data Using Connector/Python

Inserting or updating data is also done using the handler structure known as a cursor. When you use a transactional storage engine such as [InnoDB](#) (the default in MySQL 5.5 and higher), you must [commit](#) the data after a sequence of [INSERT](#), [DELETE](#), and [UPDATE](#) statements.

This example shows how to insert new data. The second [INSERT](#) depends on the value of the newly created [primary key](#) of the first. The example also demonstrates how to use extended formats. The task is to add a new employee starting to work tomorrow with a salary set to 50000.

Note

The following example uses tables created in the example [Section 6.5.2, "Creating Tables Using Connector/Python"](#). The [AUTO_INCREMENT](#) column option for the primary key of the `employees` table is important to ensure reliable, easily searchable data.

```
from __future__ import print_function
from datetime import date, datetime, timedelta
import mysql.connector
cnx = mysql.connector.connect(user='scott', database='employees')
cursor = cnx.cursor()
tomorrow = datetime.now().date() + timedelta(days=1)
add_employee = ("INSERT INTO employees "
                "(first_name, last_name, hire_date, gender, birth_date) "
                "VALUES (%s, %s, %s, %s, %s)")
add_salary = ("INSERT INTO salaries "
              "(emp_no, salary, from_date, to_date) "
              "VALUES (%(emp_no)s, %(salary)s, %(from_date)s, %(to_date)s)")
data_employee = ('Geert', 'Vanderkelen', tomorrow, 'M', date(1977, 6, 14))
# Insert new employee
cursor.execute(add_employee, data_employee)
emp_no = cursor.lastrowid
# Insert salary information
data_salary = {
    'emp_no': emp_no,
    'salary': 50000,
    'from_date': tomorrow,
    'to_date': date(9999, 1, 1),
}
cursor.execute(add_salary, data_salary)
# Make sure data is committed to the database
cnx.commit()
cursor.close()
cnx.close()
```

We first open a connection to the MySQL server and store the [connection object](#) in the variable `cnx`. We then create a new cursor, by default a [MySQLCursor](#) object, using the connection's `cursor()` method.

We could calculate tomorrow by calling a database function, but for clarity we do it in Python using the `datetime` module.

Both [INSERT](#) statements are stored in the variables called `add_employee` and `add_salary`. Note that the second [INSERT](#) statement uses extended Python format codes.

The information of the new employee is stored in the tuple `data_employee`. The query to insert the new employee is executed and we retrieve the newly inserted value for the `emp_no` column (an `AUTO_INCREMENT` column) using the `lastrowid` property of the cursor object.

Next, we insert the new salary for the new employee, using the `emp_no` variable in the dictionary holding the data. This dictionary is passed to the `execute()` method of the cursor object if an error occurred.

Since by default Connector/Python turns `autocommit` off, and MySQL 5.5 and higher uses transactional `InnoDB` tables by default, it is necessary to commit your changes using the connection's `commit()` method. You could also `roll back` using the `rollback()` method.

6.5.4 Querying Data Using Connector/Python

The following example shows how to `query` data using a cursor created using the connection's `cursor()` method. The data returned is formatted and printed on the console.

The task is to select all employees hired in the year 1999 and print their names and hire dates to the console.

```
import datetime
import mysql.connector
cnx = mysql.connector.connect(user='scott', database='employees')
cursor = cnx.cursor()
query = ("SELECT first_name, last_name, hire_date FROM employees "
         "WHERE hire_date BETWEEN %s AND %s")
hire_start = datetime.date(1999, 1, 1)
hire_end = datetime.date(1999, 12, 31)
cursor.execute(query, (hire_start, hire_end))
for (first_name, last_name, hire_date) in cursor:
    print("{}{}, {} was hired on {:d} {:b} {:Y}".format(
        last_name, first_name, hire_date))
cursor.close()
cnx.close()
```

We first open a connection to the MySQL server and store the `connection object` in the variable `cnx`. We then create a new cursor, by default a `MySQLCursor` object, using the connection's `cursor()` method.

In the preceding example, we store the `SELECT` statement in the variable `query`. Note that we are using unquoted `%s`-markers where dates should have been. Connector/Python converts `hire_start` and `hire_end` from Python types to a data type that MySQL understands and adds the required quotes. In this case, it replaces the first `%s` with '`1999-01-01`', and the second with '`1999-12-31`'.

We then execute the operation stored in the `query` variable using the `execute()` method. The data used to replace the `%s`-markers in the query is passed as a tuple: `(hire_start, hire_end)`.

After executing the query, the MySQL server is ready to send the data. The result set could be zero rows, one row, or 100 million rows. Depending on the expected volume, you can use different techniques to process this result set. In this example, we use the `cursor` object as an iterator. The first column in the row is stored in the variable `first_name`, the second in `last_name`, and the third in `hire_date`.

We print the result, formatting the output using Python's built-in `format()` function. Note that `hire_date` was converted automatically by Connector/Python to a Python `datetime.date` object. This means that we can easily format the date in a more human-readable form.

The output should be something like this:

```
..
Wilharm, LiMin was hired on 16 Dec 1999
Wielonsky, Lalit was hired on 16 Dec 1999
Kamble, Dannz was hired on 18 Dec 1999
DuBourdieu, Zhongwei was hired on 19 Dec 1999
Fujisawa, Rosita was hired on 20 Dec 1999
```

..

6.6 Connector/Python Tutorials

These tutorials illustrate how to develop Python applications and scripts that connect to a MySQL database server using MySQL Connector/Python.

6.6.1 Tutorial: Raise Employee's Salary Using a Buffered Cursor

The following example script gives a long-overdue 15% raise effective tomorrow to all employees who joined in the year 2000 and are still with the company.

To iterate through the selected employees, we use buffered cursors. (A buffered cursor fetches and buffers the rows of a result set after executing a query; see [Section 6.9.6.1, "cursor.MySQLCursorBuffered Class"](#).) This way, it is unnecessary to fetch the rows in a new variables. Instead, the cursor can be used as an iterator.

Note

This script is an example; there are other ways of doing this simple task.

```
from __future__ import print_function
from decimal import Decimal
from datetime import datetime, date, timedelta
import mysql.connector
# Connect with the MySQL Server
cnx = mysql.connector.connect(user='scott', database='employees')
# Get two buffered cursors
curA = cnx.cursor(buffered=True)
curB = cnx.cursor(buffered=True)
# Query to get employees who joined in a period defined by two dates
query = (
    "SELECT s.emp_no, salary, from_date, to_date FROM employees AS e "
    "LEFT JOIN salaries AS s USING (emp_no) "
    "WHERE to_date = DATE('9999-01-01')"
    "AND e.hire_date BETWEEN DATE(%s) AND DATE(%s)")
# UPDATE and INSERT statements for the old and new salary
update_old_salary = (
    "UPDATE salaries SET to_date = %s "
    "WHERE emp_no = %s AND from_date = %s")
insert_new_salary = (
    "INSERT INTO salaries (emp_no, from_date, to_date, salary) "
    "VALUES (%s, %s, %s, %s)")
# Select the employees getting a raise
curA.execute(query, (date(2000, 1, 1), date(2000, 12, 31)))
# Iterate through the result of curA
for (emp_no, salary, from_date, to_date) in curA:
    # Update the old and insert the new salary
    new_salary = int(round(salary * Decimal('1.15')))
    curB.execute(update_old_salary, (tomorrow, emp_no, from_date))
    curB.execute(insert_new_salary,
                 (emp_no, tomorrow, date(9999, 1, 1), new_salary))
    # Commit the changes
    cnx.commit()
cnx.close()
```

6.7 Connector/Python Connection Establishment

Connector/Python provides a `connect()` call used to establish connections to the MySQL server. The following sections describe the permitted arguments for `connect()` and describe how to use option files that supply additional arguments.

6.7.1 Connector/Python Connection Arguments

A connection with the MySQL server can be established using either the `mysql.connector.connect()` function or the `mysql.connector.MySQLConnection()` class:

```
cnx = mysql.connector.connect(user='joe', database='test')
cnx = MySQLConnection(user='joe', database='test')
```

The following table describes the arguments that can be used to initiate a connection. An asterisk (*) following an argument indicates a synonymous argument name, available only for compatibility with other Python MySQL drivers. Oracle recommends not to use these alternative names.

Table 6.2 Connection Arguments for Connector/Python

Argument Name	Default	Description
<code>user</code> (<code>username</code> *)		The user name used to authenticate with the MySQL server.
<code>password</code> (<code>passwd</code> *)		The password to authenticate the user with the MySQL server.
<code>database</code> (<code>db</code> *)		The database name to use when connecting with the MySQL server.
<code>host</code>	127.0.0.1	The host name or IP address of the MySQL server.
<code>port</code>	3306	The TCP/IP port of the MySQL server. Must be an integer.
<code>unix_socket</code>		The location of the Unix socket file.
<code>auth_plugin</code>		Authentication plugin to use. Added in 1.2.1.
<code>use_unicode</code>	<code>True</code>	Whether to use Unicode.
<code>charset</code>	<code>utf8</code>	Which MySQL character set to use.
<code>collation</code>	<code>utf8mb4_general_ci</code> (is <code>utf8_general_ci</code> in 2.x)	Which MySQL collation to use. The 8.x default values are generated from the latest MySQL Server 8.0 defaults.
<code>autocommit</code>	<code>False</code>	Whether to <code>autocommit</code> transactions.
<code>time_zone</code>		Set the <code>time_zone</code> session variable at connection time.
<code>sql_mode</code>		Set the <code>sql_mode</code> session variable at connection time.
<code>get_warnings</code>	<code>False</code>	Whether to fetch warnings.
<code>raise_on_warnings</code>	<code>False</code>	Whether to raise an exception on warnings.
<code>connection_timeout</code> (<code>connect_timeout</code> *)		Timeout for the TCP and Unix socket connections.
<code>client_flags</code>		MySQL client flags.
<code>buffered</code>	<code>False</code>	Whether cursor objects fetch the results immediately after executing queries.
<code>raw</code>	<code>False</code>	Whether MySQL results are returned as is, rather than converted to Python types.
<code>consume_results</code>	<code>False</code>	Whether to automatically read result sets.
<code>ssl_ca</code>		File containing the SSL certificate authority.
<code>ssl_cert</code>		File containing the SSL certificate file.
<code>ssl_disabled</code>	<code>False</code>	<code>True</code> disables SSL/TLS usage. Option added in Connector/Python 2.1.7.
<code>ssl_key</code>		File containing the SSL key.
<code>ssl_verify_cert</code>	<code>False</code>	When set to <code>True</code> , checks the server certificate against the certificate file specified by the <code>ssl_ca</code> option. Any mismatch causes a <code>ValueError</code> exception.

Argument Name	Default	Description
<code>ssl_verify_identity</code>	<code>False</code>	When set to <code>True</code> , additionally perform host name identity verification by checking the host name that the client uses for connecting to the server against the identity in the certificate that the server sends to the client. Option added in Connector/Python 8.0.14.
<code>force_ipv6</code>	<code>False</code>	When set to <code>True</code> , uses IPv6 when an address resolves to both IPv4 and IPv6. By default, IPv4 is used in such cases.
<code>dsn</code>		Not supported (raises <code>NotSupportedError</code> when used).
<code>pool_name</code>		Connection pool name. The pool name is restricted to alphanumeric characters and the special characters <code>.</code> , <code>_</code> , <code>*</code> , <code>\$</code> , and <code>#</code> . The pool name must be no more than <code>pooling.CNX_POOL_MAXNAMESIZE</code> characters long (default 64).
<code>pool_size</code>	5	Connection pool size. The pool size must be greater than 0 and less than or equal to <code>pooling.CNX_POOL_MAXSIZE</code> (default 32).
<code>pool_reset_session</code>	<code>True</code>	Whether to reset session variables when connection is returned to pool.
<code>compress</code>	<code>False</code>	Whether to use compressed client/server protocol.
<code>converter_class</code>		Converter class to use.
<code>failover</code>		Server failover sequence.
<code>option_files</code>		Which option files to read. Added in 2.0.0.
<code>option_groups</code>	<code>['client', 'connector_python']</code>	Which groups to read from option files. Added in 2.0.0.
<code>allow_local_infile</code>	<code>True</code>	Whether to enable <code>LOAD DATA LOCAL INFILE</code> . Added in 2.0.0.
<code>use_pure</code>	<code>False</code> as of 8.0.11, and <code>True</code> in earlier versions. If only one implementation (C or Python) is available, then the default value is set to enable the available implementation.	Whether to use pure Python or C Extension. If <code>use_pure=False</code> and the C Extension is not available, then Connector/Python will automatically fall back to the pure Python implementation. Can be set with <code>mysql.connector.connect()</code> but not <code>MySQLConnection.connect()</code> . Added in 2.1.1.

MySQL Authentication Options

Authentication with MySQL uses `username` and `password`.

Note

MySQL Connector/Python does not support the old, less-secure password protocols of MySQL versions prior to 4.1.

When the `database` argument is given, the current database is set to the given value. To change the current database later, execute a `USE` SQL statement or set the `database` property of the `MySQLConnection` instance.

By default, Connector/Python tries to connect to a MySQL server running on the local host using TCP/IP. The `host` argument defaults to IP address 127.0.0.1 and `port` to 3306. Unix sockets are supported by setting `unix_socket`. Named pipes on the Windows platform are not supported.

Connector/Python 1.2.1 and up supports authentication plugins available as of MySQL 5.6. This includes `mysql_clear_password` and `sha256_password`, both of which require an SSL connection. The `sha256_password` plugin does not work over a non-SSL connection because Connector/Python does not support RSA encryption.

The `connect()` method supports an `auth_plugin` argument that can be used to force use of a particular plugin. For example, if the server is configured to use `sha256_password` by default and you want to connect to an account that authenticates using `mysql_native_password`, either connect using SSL or specify `auth_plugin='mysql_native_password'`.

Character Encoding

By default, strings coming from MySQL are returned as Python Unicode literals. To change this behavior, set `use_unicode` to `False`. You can change the character setting for the client connection through the `charset` argument. To change the character set after connecting to MySQL, set the `charset` property of the `MySQLConnection` instance. This technique is preferred over using the `SET NAMES` SQL statement directly. Similar to the `charset` property, you can set the `collation` for the current MySQL session.

Transactions

The `autocommit` value defaults to `False`, so transactions are not automatically committed. Call the `commit()` method of the `MySQLConnection` instance within your application after doing a set of related insert, update, and delete operations. For data consistency and high throughput for write operations, it is best to leave the `autocommit` configuration option turned off when using `InnoDB` or other transactional tables.

Time Zones

The time zone can be set per connection using the `time_zone` argument. This is useful, for example, if the MySQL server is set to UTC and `TIMESTAMP` values should be returned by MySQL converted to the `PST` time zone.

SQL Modes

MySQL supports so-called SQL Modes, which change the behavior of the server globally or per connection. For example, to have warnings raised as errors, set `sql_mode` to `TRADITIONAL`. For more information, see [Server SQL Modes](#).

Troubleshooting and Error Handling

Warnings generated by queries are fetched automatically when `get_warnings` is set to `True`. You can also immediately raise an exception by setting `raise_on_warnings` to `True`. Consider using the MySQL `sql_mode` setting for turning warnings into errors.

To set a timeout value for connections, use `connection_timeout`.

Enabling and Disabling Features Using Client Flags

MySQL uses `client flags` to enable or disable features. Using the `client_flags` argument, you have control of what is set. To find out what flags are available, use the following:

```
from mysql.connector.constants import ClientFlag
```

```
print '\n'.join(ClientFlag.get_full_info())
```

If `client_flags` is not specified (that is, it is zero), defaults are used for MySQL 4.1 and higher. If you specify an integer greater than `0`, make sure all flags are set properly. A better way to set and unset flags individually is to use a list. For example, to set `FOUND_ROWS`, but disable the default `LONG_FLAG`:

```
flags = [ClientFlag.FOUND_ROWS, -ClientFlag.LONG_FLAG]
mysql.connector.connect(client_flags=flags)
```

Result Set Handling

By default, MySQL Connector/Python does not buffer or prefetch results. This means that after a query is executed, your program is responsible for fetching the data. This avoids excessive memory use when queries return large result sets. If you know that the result set is small enough to handle all at once, you can fetch the results immediately by setting `buffered` to `True`. It is also possible to set this per cursor (see [Section 6.9.2.6, “MySQLConnection.cursor\(\) Method”](#)).

Results generated by queries normally are not read until the client program fetches them. To automatically consume and discard result sets, set the `consume_results` option to `True`. The result is that all results are read, which for large result sets can be slow. (In this case, it might be preferable to close and reopen the connection.)

Type Conversions

By default, MySQL types in result sets are converted automatically to Python types. For example, a `DATETIME` column value becomes a `datetime.datetime` object. To disable conversion, set the `raw` option to `True`. You might do this to get better performance or perform different types of conversion yourself.

Connecting through SSL

Using SSL connections is possible when your [Python installation supports SSL](#), that is, when it is compiled against the OpenSSL libraries. When you provide the `ssl_ca`, `ssl_key` and `ssl_cert` options, the connection switches to SSL, and the `client_flags` option includes the `ClientFlag.SSL` value automatically. You can use this in combination with the `compressed` option set to `True`.

As of Connector/Python 2.2.2, if the MySQL server supports SSL connections, Connector/Python attempts to establish a secure (encrypted) connection by default, falling back to an unencrypted connection otherwise.

From Connector/Python 1.2.1 through Connector/Python 2.2.1, it is possible to establish an SSL connection using only the `ssl_ca` option. The `ssl_key` and `ssl_cert` arguments are optional. However, when either is given, both must be given or an `AttributeError` is raised.

```
# Note (Example is valid for Python v2 and v3)
from __future__ import print_function
import sys
#sys.path.insert(0, 'python{0}'.format(sys.version_info[0]))
import mysql.connector
from mysql.connector.constants import ClientFlag
config = {
    'user': 'ssluser',
    'password': 'password',
    'host': '127.0.0.1',
    'client_flags': [ClientFlag.SSL],
    'ssl_ca': '/opt/mysql/ssl/ca.pem',
    'ssl_cert': '/opt/mysql/ssl/client-cert.pem',
    'ssl_key': '/opt/mysql/ssl/client-key.pem',
}
cnx = mysql.connector.connect(**config)
cur = cnx.cursor(buffered=True)
cur.execute("SHOW STATUS LIKE 'Ssl_cipher'")
print(cur.fetchone())
```

```
cur.close()  
cnx.close()
```

Connection Pooling

With either the `pool_name` or `pool_size` argument present, Connector/Python creates the new pool. If the `pool_name` argument is not given, the `connect()` call automatically generates the name, composed from whichever of the `host`, `port`, `user`, and `database` connection arguments are given, in that order. If the `pool_size` argument is not given, the default size is 5 connections.

The `pool_reset_session` permits control over whether session variables are reset when the connection is returned to the pool. The default is to reset them.

For additional information about connection pooling, see [Section 6.8.1, “Connector/Python Connection Pooling”](#).

Protocol Compression

The boolean `compress` argument indicates whether to use the compressed client/server protocol (default `False`). This provides an easier alternative to setting the `ClientFlag.COMPRESS` flag. This argument is available as of Connector/Python 1.1.2.

Converter Class

The `converter_class` argument takes a class and sets it when configuring the connection. An `AttributeError` is raised if the custom converter class is not a subclass of `conversion.MySQLConverterBase`.

Server Failover

The `connect()` method accepts a `failover` argument that provides information to use for server failover in the event of connection failures. The argument value is a tuple or list of dictionaries (tuple is preferred because it is nonmutable). Each dictionary contains connection arguments for a given server in the failover sequence. Permitted dictionary values are: `user`, `password`, `host`, `port`, `unix_socket`, `database`, `pool_name`, `pool_size`. This failover option was added in Connector/Python 1.2.1.

Option File Support

As of Connector/Python 2.0.0, option files are supported using two options for `connect()`:

- `option_files`: Which option files to read. The value can be a file path name (a string) or a sequence of path name strings. By default, Connector/Python reads no option files, so this argument must be given explicitly to cause option files to be read. Files are read in the order specified.
- `option_groups`: Which groups to read from option files, if option files are read. The value can be an option group name (a string) or a sequence of group name strings. If this argument is not given, the default value is `['client', 'connector_python']` to read the `[client]` and `[connector_python]` groups.

For more information, see [Section 6.7.2, “Connector/Python Option-File Support”](#).

LOAD DATA LOCAL INFILE

Prior to Connector/Python 2.0.0, to enable use of `LOAD DATA LOCAL INFILE`, clients had to explicitly set the `ClientFlag.LOCAL_FILES` flag. As of 2.0.0, this flag is enabled by default. To disable it, the `allow_local_infile` connection option can be set to `False` at connect time (the default is `True`).

Compatibility with Other Connection Interfaces

`passwd`, `db` and `connect_timeout` are valid for compatibility with other MySQL interfaces and are respectively the same as `password`, `database` and `connection_timeout`. The

latter take precedence. Data source name syntax or `dsn` is not used; if specified, it raises a `NotSupportedError` exception.

Client/Server Protocol Implementation

Connector/Python can use a pure Python interface to MySQL, or a C Extension that uses the MySQL C client library. The `use_pure mysql.connector.connect()` connection argument determines which. The default changed in Connector/Python 8 from `True` (use the pure Python implementation) to `False`. Setting `use_pure` changes the implementation used.

The `use_pure` argument is available as of Connector/Python 2.1.1. For more information about the C extension, see [The Connector/Python C Extension](#).

6.7.2 Connector/Python Option-File Support

As of version 2.0.0, Connector/Python has the capability of reading options from option files. (For general information about option files in MySQL, see [Using Option Files](#).) Two arguments for the `connect()` call control use of option files in Connector/Python programs:

- `option_files`: Which option files to read. The value can be a file path name (a string) or a sequence of path name strings. By default, Connector/Python reads no option files, so this argument must be given explicitly to cause option files to be read. Files are read in the order specified.
- `option_groups`: Which groups to read from option files, if option files are read. The value can be an option group name (a string) or a sequence of group name strings. If this argument is not given, the default value is `['client', 'connector_python']`, to read the `[client]` and `[connector_python]` groups.

Connector/Python also supports the `!include` and `!includedir` inclusion directives within option files. These directives work the same way as for other MySQL programs (see [Using Option Files](#)).

This example specifies a single option file as a string:

```
cnx = mysql.connector.connect(option_files='/etc/mysql/connectors.cnf')
```

This example specifies multiple option files as a sequence of strings:

```
mysql_option_files = [
    '/etc/mysql/connectors.cnf',
    './development.cnf',
]
cnx = mysql.connector.connect(option_files=mysql_option_files)
```

Connector/Python reads no option files by default, for backward compatibility with versions older than 2.0.0. This differs from standard MySQL clients such as `mysql` or `mysqldump`, which do read option files by default. To find out which option files the standard clients read on your system, invoke one of them with its `--help` option and examine the output. For example:

```
shell> mysql --help
...
Default options are read from the following files in the given order:
/etc/my.cnf /etc/mysql/my.cnf /usr/local/mysql/etc/my.cnf ~/.my.cnf
...
```

If you specify the `option_files` connection argument to read option files, Connector/Python reads the `[client]` and `[connector_python]` option groups by default. To specify explicitly which groups to read, use the `option_groups` connection argument. The following example causes only the `[connector_python]` group to be read:

```
cnx = mysql.connector.connect(option_files='/etc/mysql/connectors.cnf',
                              option_groups='connector_python')
```

Other connection arguments specified in the `connect()` call take precedence over options read from option files. Suppose that `/etc/mysql/connectors.conf` contains these lines:

```
[client]
database=cpyapp
```

The following `connect()` call includes no `database` connection argument. The resulting connection uses `cpyapp`, the database specified in the option file:

```
cnx = mysql.connector.connect(option_files='/etc/mysql/connectors.cnf')
```

By contrast, the following `connect()` call specifies a default database different from the one found in the option file. The resulting connection uses `cpyapp_dev` as the default database, not `cpyapp`:

```
cnx2 = mysql.connector.connect(option_files='/etc/mysql/connectors.cnf',
                               database='cpyapp_dev')
```

Connector/Python raises a `ValueError` if an option file cannot be read, or has already been read. This includes files read by inclusion directives.

For the `[connector_python]` group, only options supported by Connector/Python are accepted. Unrecognized options cause a `ValueError` to be raised.

For other option groups, Connector/Python ignores unrecognized options.

It is not an error for a named option group not to exist.

Connector/Python treats option values in option files as strings and evaluates them using `eval()`. This enables specification of option values more complex than simple scalars.

6.8 Connector/Python Other Topics

This section describes additional Connection/Python features:

- Connection pooling: [Section 6.8.1, “Connector/Python Connection Pooling”](#)
- Django back end for MySQL: [Section 6.8.2, “Connector/Python Django Back End”](#)

6.8.1 Connector/Python Connection Pooling

Simple connection pooling is supported that has these characteristics:

- The `mysql.connector.pooling` module implements pooling.
- A pool opens a number of connections and handles thread safety when providing connections to requesters.
- The size of a connection pool is configurable at pool creation time. It cannot be resized thereafter.
- A connection pool can be named at pool creation time. If no name is given, one is generated using the connection parameters.
- The connection pool name can be retrieved from the connection pool or connections obtained from it.
- It is possible to have multiple connection pools. This enables applications to support pools of connections to different MySQL servers, for example.
- For each connection request, the pool provides the next available connection. No round-robin or other scheduling algorithm is used. If a pool is exhausted, a `PoolError` is raised.
- It is possible to reconfigure the connection parameters used by a pool. These apply to connections obtained from the pool thereafter. Reconfiguring individual connections obtained from the pool by calling the connection `config()` method is not supported.

Applications that can benefit from connection-pooling capability include:

- Middleware that maintains multiple connections to multiple MySQL servers and requires connections to be readily available.
- websites that can have more “permanent” connections open to the MySQL server.

A connection pool can be created implicitly or explicitly.

To create a connection pool implicitly: Open a connection and specify one or more pool-related arguments (`pool_name`, `pool_size`). For example:

```
dbconfig = {
    "database": "test",
    "user": "joe"
}
cnx = mysql.connector.connect(pool_name = "mypool",
                               pool_size = 3,
                               **dbconfig)
```

The pool name is restricted to alphanumeric characters and the special characters `.`, `_`, `*`, `$`, and `#`. The pool name must be no more than `pooling.CNX_POOL_MAXNAMESIZE` characters long (default 64).

The pool size must be greater than 0 and less than or equal to `pooling.CNX_POOL_MAXSIZE` (default 32).

With either the `pool_name` or `pool_size` argument present, Connector/Python creates the new pool. If the `pool_name` argument is not given, the `connect()` call automatically generates the name, composed from whichever of the `host`, `port`, `user`, and `database` connection arguments are given, in that order. If the `pool_size` argument is not given, the default size is 5 connections.

Subsequent calls to `connect()` that name the same connection pool return connections from the existing pool. Any `pool_size` or connection parameter arguments are ignored, so the following `connect()` calls are equivalent to the original `connect()` call shown earlier:

```
cnx = mysql.connector.connect(pool_name = "mypool", pool_size = 3)
cnx = mysql.connector.connect(pool_name = "mypool", **dbconfig)
cnx = mysql.connector.connect(pool_name = "mypool")
```

Pooled connections obtained by calling `connect()` with a pool-related argument have a class of `PooledMySQLConnection` (see [Section 6.9.4, “pooling.PooledMySQLConnection Class”](#)). `PooledMySQLConnection` pooled connection objects are similar to `MySQLConnection` unpooled connection objects, with these differences:

- To release a pooled connection obtained from a connection pool, invoke its `close()` method, just as for any unpooled connection. However, for a pooled connection, `close()` does not actually close the connection but returns it to the pool and makes it available for subsequent connection requests.
- A pooled connection cannot be reconfigured using its `config()` method. Connection changes must be done through the pool object itself, as described shortly.
- A pooled connection has a `pool_name` property that returns the pool name.

To create a connection pool explicitly: Create a `MySQLConnectionPool` object (see [Section 6.9.3, “pooling.MySQLConnectionPool Class”](#)):

```
dbconfig = {
    "database": "test",
    "user": "joe"
}
cnxpool = mysql.connector.pooling.MySQLConnectionPool(pool_name = "mypool",
                                                       pool_size = 3,
                                                       **dbconfig)
```

To request a connection from the pool, use its `get_connection()` method:

```
cnx1 = cnxpool.get_connection()
cnx2 = cnxpool.get_connection()
```

When you create a connection pool explicitly, it is possible to use the pool object's `set_config()` method to reconfigure the pool connection parameters:

```
dbconfig = {
    "database": "performance_schema",
    "user": "admin",
    "password": "password"
}
cnxpool.set_config(**dbconfig)
```

Connections requested from the pool after the configuration change use the new parameters. Connections obtained before the change remain unaffected, but when they are closed (returned to the pool) are reopened with the new parameters before being returned by the pool for subsequent connection requests.

6.8.2 Connector/Python Back End

Connector/Python includes a `mysql.connector.django` module that provides a Django back end for MySQL. This back end supports new features found as of MySQL 5.6 such as fractional seconds support for temporal data types.

Django Configuration

Django uses a configuration file named `settings.py` that contains a variable called `DATABASES` (see <https://docs.djangoproject.com/en/1.5/ref/settings/#std:setting-DATABASES>). To configure Django to use Connector/Python as the MySQL back end, the example found in the Django manual can be used as a basis:

```
DATABASES = {
    'default': {
        'NAME': 'user_data',
        'ENGINE': 'mysql.connector.django',
        'USER': 'mysql_user',
        'PASSWORD': 'password',
        'OPTIONS': {
            'autocommit': True,
        },
    }
}
```

It is possible to add more connection arguments using `OPTIONS`.

Support for MySQL Features

Django can launch the MySQL client application `mysql`. When the Connector/Python back end does this, it arranges for the `sql_mode` system variable to be set to `TRADITIONAL` at startup.

Some MySQL features are enabled depending on the server version. For example, support for fractional seconds precision is enabled when connecting to a server from MySQL 5.6.4 or higher. Django's `DateTimeField` is stored in a MySQL column defined as `DATETIME(6)`, and `TimeField` is stored as `TIME(6)`. For more information about fractional seconds support, see [Fractional Seconds in Time Values](#).

6.9 Connector/Python API Reference

This chapter contains the public API reference for Connector/Python. Examples should be considered working for Python 2.7, and Python 3.1 and greater. They might also work for older versions (such as Python 2.4) unless they use features introduced in newer Python versions. For example, exception handling using the `as` keyword was introduced in Python 2.6 and will not work in Python 2.4.

The following overview shows the `mysql.connector` package with its modules. Currently, only the most useful modules, classes, and methods for end users are documented.

```
mysql.connector
  errorcode
  errors
  connection
  constants
  conversion
  cursor
  dbapi
  locales
  eng
    client_error
  protocol
  utils
```

6.9.1 mysql.connector Module

The `mysql.connector` module provides top-level methods and properties.

6.9.1.1 mysql.connector.connect() Method

This method sets up a connection, establishing a session with the MySQL server. If no arguments are given, it uses the already configured or default values. For a complete list of possible arguments, see [Section 6.7.1, “Connector/Python Connection Arguments”](#).

A connection with the MySQL server can be established using either the `mysql.connector.connect()` method or the `mysql.connector.MySQLConnection()` class:

```
cnx = mysql.connector.connect(user='joe', database='test')
cnx = MySQLConnection(user='joe', database='test')
```

For descriptions of connection methods and properties, see [Section 6.9.2, “connection.MySQLConnection Class”](#).

6.9.1.2 mysql.connector.apilevel Property

This property is a string that indicates the supported DB API level.

```
>>> mysql.connector.apilevel
'2.0'
```

6.9.1.3 mysql.connector.paramstyle Property

This property is a string that indicates the Connector/Python default parameter style.

```
>>> mysql.connector.paramstyle
'pyformat'
```

6.9.1.4 mysql.connector.threadsafety Property

This property is an integer that indicates the supported level of thread safety provided by Connector/Python.

```
>>> mysql.connector.threadsafety
1
```

6.9.1.5 mysql.connector.__version__ Property

This property indicates the Connector/Python version as a string. It is available as of Connector/Python 1.1.0.

```
>>> mysql.connector.__version__
'1.1.0'
```

6.9.1.6 mysql.connector.__version_info__ Property

This property indicates the Connector/Python version as an array of version components. It is available as of Connector/Python 1.1.0.

```
>>> mysql.connector.__version_info__
(1, 1, 0, 'a', 0)
```

6.9.2 connection.MySQLConnection Class

The [MySQLConnection](#) class is used to open and manage a connection to a MySQL server. It also used to send commands and SQL statements and read the results.

6.9.2.1 connection.MySQLConnection() Constructor

Syntax:

```
cnx = MySQLConnection(**kwargs)
```

The [MySQLConnection](#) constructor initializes the attributes and when at least one argument is passed, it tries to connect to the MySQL server.

For a complete list of arguments, see [Section 6.7.1, “Connector/Python Connection Arguments”](#).

6.9.2.2 MySQLConnection.close() Method

Syntax:

```
cnx.close()
```

`close()` is a synonym for `disconnect()`. See [Section 6.9.2.20, “MySQLConnection.disconnect\(\) Method”](#).

For a connection obtained from a connection pool, `close()` does not actually close it but returns it to the pool and makes it available for subsequent connection requests. See [Section 6.8.1, “Connector/Python Connection Pooling”](#).

6.9.2.3 MySQLConnection.commit() Method

This method sends a `COMMIT` statement to the MySQL server, committing the current transaction. Since by default Connector/Python does not autocommit, it is important to call this method after every transaction that modifies data for tables that use transactional storage engines.

```
>>> cursor.execute("INSERT INTO employees (first_name) VALUES (%s)", ('Jane'))
>>> cnx.commit()
```

To roll back instead and discard modifications, see the [rollback\(\)](#) method.

6.9.2.4 MySQLConnection.config() Method

Syntax:

```
cnx.config(**kwargs)
```

Configures a [MySQLConnection](#) instance after it has been instantiated. For a complete list of possible arguments, see [Section 6.7.1, “Connector/Python Connection Arguments”](#).

Arguments:

- `kwargs`: Connection arguments.

You could use the `config()` method to change (for example) the user name, then call `reconnect()`.

Example:

```
cnx = mysql.connector.connect(user='joe', database='test')
# Connected as 'joe'
cnx.config(user='jane')
cnx.reconnect()
# Now connected as 'jane'
```

For a connection obtained from a connection pool, `config()` raises an exception. See [Section 6.8.1, “Connector/Python Connection Pooling”](#).

6.9.2.5 MySQLConnection.connect() Method

Syntax:

```
MySQLConnection.connect(**kwargs)
```

This method sets up a connection, establishing a session with the MySQL server. If no arguments are given, it uses the already configured or default values. For a complete list of possible arguments, see [Section 6.7.1, “Connector/Python Connection Arguments”](#).

Arguments:

- `kwargs`: Connection arguments.

Example:

```
cnx = MySQLConnection(user='joe', database='test')
```

For a connection obtained from a connection pool, the connection object class is `PooledMySQLConnection`. A pooled connection differs from an unpoled connection as described in [Section 6.8.1, “Connector/Python Connection Pooling”](#).

6.9.2.6 MySQLConnection.cursor() Method

Syntax:

```
cursor = cnx.cursor([arg=value[, arg=value]...])
```

This method returns a `MySQLCursor()` object, or a subclass of it depending on the passed arguments. The returned object is a `cursor.CursorBase` instance. For more information about cursor objects, see [Section 6.9.5, “cursor.MySQLCursor Class”](#), and [Section 6.9.6, “Subclasses cursor.MySQLCursor”](#).

Arguments may be passed to the `cursor()` method to control what type of cursor to create:

- If `buffered` is `True`, the cursor fetches all rows from the server after an operation is executed. This is useful when queries return small result sets. `buffered` can be used alone, or in combination with the `dictionary` or `named_tuple` argument.

`buffered` can also be passed to `connect()` to set the default buffering mode for all cursors created from the connection object. See [Section 6.7.1, “Connector/Python Connection Arguments”](#).

For information about the implications of buffering, see [Section 6.9.6.1, “cursor.MySQLCursorBuffered Class”](#).

- If `raw` is `True`, the cursor skips the conversion from MySQL data types to Python types when fetching rows. A raw cursor is usually used to get better performance or when you want to do the conversion yourself.

`raw` can also be passed to `connect()` to set the default raw mode for all cursors created from the connection object. See [Section 6.7.1, “Connector/Python Connection Arguments”](#).

- If `dictionary` is `True`, the cursor returns rows as dictionaries. This argument is available as of Connector/Python 2.0.0.
- If `named_tuple` is `True`, the cursor returns rows as named tuples. This argument is available as of Connector/Python 2.0.0.
- If `prepared` is `True`, the cursor is used for executing prepared statements. This argument is available as of Connector/Python 1.1.2. The C extension supports this as of Connector/Python 8.0.17.
- The `cursor_class` argument can be used to pass a class to use for instantiating a new cursor. It must be a subclass of `cursor.CursorBase`.

The returned object depends on the combination of the arguments. Examples:

- If not buffered and not raw: `MySQLCursor`
- If buffered and not raw: `MySQLCursorBuffered`
- If not buffered and raw: `MySQLCursorRaw`
- If buffered and raw: `MySQLCursorBufferedRaw`

6.9.2.7 MySQLConnection.cmd_change_user() Method

Changes the user using `username` and `password`. It also causes the specified `database` to become the default (current) database. It is also possible to change the character set using the `charset` argument.

Syntax:

```
cnx.cmd_change_user(username='', password='', database='', charset=33)
```

Returns a dictionary containing the OK packet information.

6.9.2.8 MySQLConnection.cmd_debug() Method

Instructs the server to write debugging information to the error log. The connected user must have the `SUPER` privilege.

Returns a dictionary containing the OK packet information.

6.9.2.9 MySQLConnection.cmd_init_db() Method

Syntax:

```
cnx.cmd_init_db(db_name)
```

This method makes specified database the default (current) database. In subsequent queries, this database is the default for table references that include no explicit database qualifier.

Returns a dictionary containing the OK packet information.

6.9.2.10 MySQLConnection.cmd_ping() Method

Checks whether the connection to the server is working.

This method is not to be used directly. Use `ping()` or `is_connected()` instead.

Returns a dictionary containing the OK packet information.

6.9.2.11 MySQLConnection.cmd_process_info() Method

This method raises the `NotSupportedException` exception. Instead, use the `SHOW PROCESSLIST` statement or query the tables found in the database `INFORMATION_SCHEMA`.

Deprecation

This MySQL Server functionality is deprecated.

6.9.2.12 MySQLConnection.cmd_process_kill() Method

Syntax:

```
cnx.cmd_process_kill(mysql_pid)
```

Deprecation

This MySQL Server functionality is deprecated.

Asks the server to kill the thread specified by `mysql_pid`. Although still available, it is better to use the `KILL` SQL statement.

Returns a dictionary containing the OK packet information.

The following two lines have the same effect:

```
>>> cnx.cmd_process_kill(123)
>>> cnx.cmd_query('KILL 123')
```

6.9.2.13 MySQLConnection.cmd_query() Method

Syntax:

```
cnx.cmd_query(statement)
```

This method sends the given `statement` to the MySQL server and returns a result. To send multiple statements, use the `cmd_query_iter()` method instead.

The returned dictionary contains information depending on what kind of query was executed. If the query is a `SELECT` statement, the result contains information about columns. Other statements return a dictionary containing OK or EOF packet information.

Errors received from the MySQL server are raised as exceptions. An `InterfaceError` is raised when multiple results are found.

Returns a dictionary.

6.9.2.14 MySQLConnection.cmd_query_iter() Method

Syntax:

```
cnx.cmd_query_iter(statement)
```

Similar to the `cmd_query()` method, but returns a generator object to iterate through results. Use `cmd_query_iter()` when sending multiple statements, and separate the statements with semicolons.

The following example shows how to iterate through the results after sending multiple statements:

```
statement = 'SELECT 1; INSERT INTO t1 VALUES (); SELECT 2'
for result in cnx.cmd_query_iter(statement):
```

```
if 'columns' in result:
    columns = result['columns']
    rows = cnx.get_rows()
else:
    # do something useful with INSERT result
```

Returns a generator object.

6.9.2.15 MySQLConnection.cmd_quit() Method

This method sends a [QUIT](#) command to the MySQL server, closing the current connection. Since there is no response from the MySQL server, the packet that was sent is returned.

6.9.2.16 MySQLConnection.cmd_refresh() Method

Syntax:

```
cnx.cmd_refresh(options)
```

Deprecation

This MySQL Server functionality is deprecated.

This method flushes tables or caches, or resets replication server information. The connected user must have the [RELOAD](#) privilege.

The `options` argument should be a bitmask value constructed using constants from the `constants.RefreshOption` class.

For a list of options, see [Section 6.9.11, “constants.RefreshOption Class”](#).

Example:

```
>>> from mysql.connector import RefreshOption
>>> refresh = RefreshOption.LOG | RefreshOption.THREADS
>>> cnx.cmd_refresh(refresh)
```

6.9.2.17 MySQLConnection.cmd_reset_connection() Method

Syntax:

```
cnx.cmd_reset_connection()
```

Resets the connection by sending a [COM_RESET_CONNECTION](#) command to the server to clear the session state.

This method permits the session state to be cleared without reauthenticating. For MySQL servers older than 5.7.3 (when [COM_RESET_CONNECTION](#) was introduced), the `reset_session()` method can be used instead. That method resets the session state by reauthenticating, which is more expensive.

This method was added in Connector/Python 1.2.1.

6.9.2.18 MySQLConnection.cmd_shutdown() Method

Deprecation

This MySQL Server functionality is deprecated.

Asks the database server to shut down. The connected user must have the [SHUTDOWN](#) privilege.

Returns a dictionary containing the OK packet information.

6.9.2.19 MySQLConnection.cmd_statistics() Method

Returns a dictionary containing information about the MySQL server including uptime in seconds and the number of running threads, questions, reloads, and open tables.

6.9.2.20 MySQLConnection.disconnect() Method

This method tries to send a `QUIT` command and close the socket. It raises no exceptions.

`MySQLConnection.close()` is a synonymous method name and more commonly used.

To shut down the connection without sending a `QUIT` command first, use `shutdown()`.

6.9.2.21 MySQLConnection.get_row() Method

This method retrieves the next row of a query result set, returning a tuple.

The tuple returned by `get_row()` consists of:

- The row as a tuple containing byte objects, or `None` when no more rows are available.
- EOF packet information as a dictionary containing `status_flag` and `warning_count`, or `None` when the row returned is not the last row.

The `get_row()` method is used by `MySQLCursor` to fetch rows.

6.9.2.22 MySQLConnection.get_rows() Method

Syntax:

```
cnx.get_rows(count=None)
```

This method retrieves all or remaining rows of a query result set, returning a tuple containing the rows as sequences and the EOF packet information. The count argument can be used to obtain a given number of rows. If count is not specified or is `None`, all rows are retrieved.

The tuple returned by `get_rows()` consists of:

- A list of tuples containing the row data as byte objects, or an empty list when no rows are available.
- EOF packet information as a dictionary containing `status_flag` and `warning_count`.

An `InterfaceError` is raised when all rows have been retrieved.

`MySQLCursor` uses the `get_rows()` method to fetch rows.

Returns a tuple.

6.9.2.23 MySQLConnection.get_server_info() Method

This method returns the MySQL server information verbatim as a string, for example '`5.6.11-log`', or `None` when not connected.

6.9.2.24 MySQLConnection.get_server_version() Method

This method returns the MySQL server version as a tuple, or `None` when not connected.

6.9.2.25 MySQLConnection.is_connected() Method

Reports whether the connection to MySQL Server is available.

This method checks whether the connection to MySQL is available using the `ping()` method, but unlike `ping()`, `is_connected()` returns `True` when the connection is available, `False` otherwise.

6.9.2.26 MySQLConnection.isset_client_flag() Method

Syntax:

```
cnx.isset_client_flag(flag)
```

This method returns `True` if the client flag was set, `False` otherwise.

6.9.2.27 MySQLConnection.ping() Method

Syntax:

```
cnx.ping(reconnect=False, attempts=1, delay=0)
```

Check whether the connection to the MySQL server is still available.

When `reconnect` is set to `True`, one or more `attempts` are made to try to reconnect to the MySQL server, and these options are forwarded to the `reconnect()` method. Use the `delay` argument (seconds) if you want to wait between each retry.

When the connection is not available, an `InterfaceError` is raised. Use the `is_connected()` method to check the connection without raising an error.

Raises `InterfaceError` on errors.

6.9.2.28 MySQLConnection.reconnect() Method

Syntax:

```
cnx.reconnect(attempts=1, delay=0)
```

Attempt to reconnect to the MySQL server.

The argument `attempts` specifies the number of times a reconnect is tried. The `delay` argument is the number of seconds to wait between each retry.

You might set the number of attempts higher and use a longer delay when you expect the MySQL server to be down for maintenance, or when you expect the network to be temporarily unavailable.

6.9.2.29 MySQLConnection.reset_session() Method

Syntax:

```
cnx.reset_session(user_variables = None, session_variables = None)
```

Resets the connection by reauthenticating to clear the session state. `user_variables`, if given, is a dictionary of user variable names and values. `session_variables`, if given, is a dictionary of system variable names and values. The method sets each variable to the given value.

Example:

```
user_variables = {'var1': '1', 'var2': '10'}
session_variables = {'wait_timeout': 100000, 'sql_mode': 'TRADITIONAL'}
self.cnx.reset_session(user_variables, session_variables)
```

This method resets the session state by reauthenticating. For MySQL servers 5.7 or higher, the `cmd_reset_connection()` method is a more lightweight alternative.

This method was added in Connector/Python 1.2.1.

6.9.2.30 MySQLConnection.rollback() Method

This method sends a `ROLLBACK` statement to the MySQL server, undoing all data changes from the current transaction. By default, Connector/Python does not autocommit, so it is possible to cancel transactions when using transactional storage engines such as `InnoDB`.

```
>>> cursor.execute("INSERT INTO employees (first_name) VALUES (%s)", ('Jane'))
>>> cnx.rollback()
```

To [commit](#) modifications, see the [commit\(\)](#) method.

6.9.2.31 MySQLConnection.set_charset_collation() Method

Syntax:

```
cnx.set_charset_collation(charset=None, collation=None)
```

This method sets the character set and collation to be used for the current connection. The `charset` argument can be either the name of a character set, or the numerical equivalent as defined in [constants.CharacterSet](#).

When `collation` is `None`, the default collation for the character set is used.

In the following example, we set the character set to `latin1` and the collation to `latin1_swedish_ci` (the default collation for: `latin1`):

```
>>> cnx = mysql.connector.connect(user='scott')
>>> cnx.set_charset_collation('latin1')
```

Specify a given collation as follows:

```
>>> cnx = mysql.connector.connect(user='scott')
>>> cnx.set_charset_collation('latin1', 'latin1_general_ci')
```

6.9.2.32 MySQLConnection.set_client_flags() Method

Syntax:

```
cnx.set_client_flags(flags)
```

This method sets the client flags to use when connecting to the MySQL server, and returns the new value as an integer. The `flags` argument can be either an integer or a sequence of valid client flag values (see [Section 6.9.7, “constants.ClientFlag Class”](#)).

If `flags` is a sequence, each item in the sequence sets the flag when the value is positive or unsets it when negative. For example, to unset `LONG_FLAG` and set the `FOUND_ROWS` flags:

```
>>> from mysql.connector.constants import ClientFlag
>>> cnx.set_client_flags([ClientFlag.FOUND_ROWS, -ClientFlag.LONG_FLAG])
>>> cnx.reconnect()
```

Note

Client flags are only set or used when connecting to the MySQL server. It is therefore necessary to reconnect after making changes.

6.9.2.33 MySQLConnection.shutdown() Method

This method closes the socket. It raises no exceptions.

Unlike `disconnect()`, `shutdown()` closes the client connection without attempting to send a `QUIT` command to the server first. Thus, it will not block if the connection is disrupted for some reason such as network failure.

`shutdown()` was added in Connector/Python 2.0.1.

6.9.2.34 MySQLConnection.start_transaction() Method

This method starts a transaction. It accepts arguments indicating whether to use a consistent snapshot, which transaction isolation level to use, and the transaction access mode:

```
cnx.start_transaction(consistent_snapshot=bool,  
                      isolation_level=level,  
                      readonly=access_mode)
```

The default `consistent_snapshot` value is `False`. If the value is `True`, Connector/Python sends `WITH CONSISTENT SNAPSHOT` with the statement. MySQL ignores this for isolation levels for which that option does not apply.

The default `isolation_level` value is `None`, and permitted values are `'READ UNCOMMITTED'`, `'READ COMMITTED'`, `'REPEATABLE READ'`, and `'SERIALIZABLE'`. If the `isolation_level` value is `None`, no isolation level is sent, so the default level applies.

The `readonly` argument can be `True` to start the transaction in `READ ONLY` mode or `False` to start it in `READ WRITE` mode. If `readonly` is omitted, the server's default access mode is used. For details about transaction access mode, see the description for the `START TRANSACTION` statement at [START TRANSACTION, COMMIT, and ROLLBACK Statements](#). If the server is older than MySQL 5.6.5, it does not support setting the access mode and Connector/Python raises a `ValueError`.

Invoking `start_transaction()` raises a `ProgrammingError` if invoked while a transaction is currently in progress. This differs from executing a `START TRANSACTION` SQL statement while a transaction is in progress; the statement implicitly commits the current transaction.

To determine whether a transaction is active for the connection, use the `in_transaction` property.

`start_transaction()` was added in MySQL Connector/Python 1.1.0. The `readonly` argument was added in Connector/Python 1.1.5.

6.9.2.35 MySQLConnection.autocommit Property

This property can be assigned a value of `True` or `False` to enable or disable the autocommit feature of MySQL. The property can be invoked to retrieve the current autocommit setting.

Note

Autocommit is disabled by default when connecting through Connector/Python. This can be enabled using the `autocommit` connection parameter.

When the autocommit is turned off, you must `commit` transactions when using transactional storage engines such as `InnoDB` or `NDBCluster`.

```
>>> cnx.autocommit  
False  
>>> cnx.autocommit = True  
>>> cnx.autocommit  
True
```

6.9.2.36 MySQLConnection.unread_results Property

Indicates whether there is an unread result. It is set to `False` if there is not an unread result, otherwise `True`. This is used by cursors to check whether another cursor still needs to retrieve its result set.

Do not set the value of this property, as only the connector should change the value. In other words, treat this as a read-only property.

6.9.2.37 MySQLConnection.can_consume_results Property

This property indicates the value of the `consume_results` connection parameter that controls whether result sets produced by queries are automatically read and discarded. See [Section 6.7.1, “Connector/Python Connection Arguments”](#).

This method was added in Connector/Python 2.1.1.

6.9.2.38 MySQLConnection.charset Property

This property returns a string indicating which character set is used for the connection, whether or not it is connected.

6.9.2.39 MySQLConnection.collation Property

This property returns a string indicating which collation is used for the connection, whether or not it is connected.

6.9.2.40 MySQLConnection.connection_id Property

This property returns the integer connection ID (thread ID or session ID) for the current connection or `None` when not connected.

6.9.2.41 MySQLConnection.database Property

This property sets the current (default) database by executing a `USE` statement. The property can also be used to retrieve the current database name.

```
>>> cnx.database = 'test'  
>>> cnx.database = 'mysql'  
>>> cnx.database  
u'mysql'
```

Returns a string.

6.9.2.42 MySQLConnection.get_warnings Property

This property can be assigned a value of `True` or `False` to enable or disable whether warnings should be fetched automatically. The default is `False` (default). The property can be invoked to retrieve the current warnings setting.

Fetching warnings automatically can be useful when debugging queries. Cursors make warnings available through the method `MySQLCursor.fetchwarnings()`.

```
>>> cnx.get_warnings = True  
>>> cursor.execute('SELECT "a"+1')  
>>> cursor.fetchall()  
[(1.0,)]  
>>> cursor.fetchwarnings()  
[(u'Warning', 1292, u"Truncated incorrect DOUBLE value: 'a'")]
```

Returns `True` or `False`.

6.9.2.43 MySQLConnection.in_transaction Property

This property returns `True` or `False` to indicate whether a transaction is active for the connection. The value is `True` regardless of whether you start a transaction using the `start_transaction()` API call or by directly executing an SQL statement such as `START TRANSACTION` or `BEGIN`.

```
>>> cnx.start_transaction()  
>>> cnx.in_transaction  
True  
>>> cnx.commit()  
>>> cnx.in_transaction  
False
```

`in_transaction` was added in MySQL Connector/Python 1.1.0.

6.9.2.44 MySQLConnection.raise_on_warnings Property

This property can be assigned a value of `True` or `False` to enable or disable whether warnings should raise exceptions. The default is `False` (default). The property can be invoked to retrieve the current exceptions setting.

Setting `raise_on_warnings` also sets `get_warnings` because warnings need to be fetched so they can be raised as exceptions.

Note

You might always want to set the SQL mode if you would like to have the MySQL server directly report warnings as errors (see [Section 6.9.2.47, “MySQLConnection.sql_mode Property”](#)). It is also good to use transactional engines so transactions can be rolled back when catching the exception.

Result sets needs to be fetched completely before any exception can be raised. The following example shows the execution of a query that produces a warning:

```
>>> cnx.raise_on_warnings = True
>>> cursor.execute('SELECT "a"+1')
>>> cursor.fetchall()
..
mysql.connector.errors.DataError: 1292: Truncated incorrect DOUBLE value: 'a'
```

Returns `True` or `False`.

6.9.2.45 MySQLConnection.server_host Property

This read-only property returns the host name or IP address used for connecting to the MySQL server.

Returns a string.

6.9.2.46 MySQLConnection.server_port Property

This read-only property returns the TCP/IP port used for connecting to the MySQL server.

Returns an integer.

6.9.2.47 MySQLConnection.sql_mode Property

This property is used to retrieve and set the SQL Modes for the current connection. The value should be a list of different modes separated by comma (","), or a sequence of modes, preferably using the `constants.SQLMode` class.

To unset all modes, pass an empty string or an empty sequence.

```
>>> cnx.sql_mode = 'TRADITIONAL,NO_ENGINE_SUBSTITUTION'
>>> cnx.sql_mode.split(',')
[u'STRRICT_TRANS_TABLES', u'STRRICT_ALL_TABLES', u'NO_ZERO_IN_DATE',
u'NO_ZERO_DATE', u'ERROR_FOR_DIVISION_BY_ZERO', u'TRADITIONAL',
u'NO_AUTO_CREATE_USER', u'NO_ENGINE_SUBSTITUTION']
>>> from mysql.connector.constants import SQLMode
>>> cnx.sql_mode = [ SQLMode.NO_ZERO_DATE, SQLMode.REAL_AS_FLOAT]
>>> cnx.sql_mode
u'REAL_AS_FLOAT,NO_ZERO_DATE'
```

Returns a string.

6.9.2.48 MySQLConnection.time_zone Property

This property is used to set or retrieve the time zone session variable for the current connection.

```
>>> cnx.time_zone = '+00:00'
>>> cursor = cnx.cursor()
>>> cursor.execute('SELECT NOW()') ; cursor.fetchone()
(datetime.datetime(2012, 6, 15, 11, 24, 36),)
>>> cnx.time_zone = '-09:00'
>>> cursor.execute('SELECT NOW()') ; cursor.fetchone()
(datetime.datetime(2012, 6, 15, 2, 24, 44),)
>>> cnx.time_zone
u'-09:00'
```

Returns a string.

6.9.2.49 MySQLConnection.unix_socket Property

This read-only property returns the Unix socket file for connecting to the MySQL server.

Returns a string.

6.9.2.50 MySQLConnection.user Property

This read-only property returns the user name used for connecting to the MySQL server.

Returns a string.

6.9.3 pooling.MySQLConnectionPool Class

This class provides for the instantiation and management of connection pools.

6.9.3.1 pooling.MySQLConnectionPool Constructor

Syntax:

```
MySQLConnectionPool(pool_name=None,
                    pool_size=5,
                    pool_reset_session=True,
                    **kwargs)
```

This constructor instantiates an object that manages a connection pool.

Arguments:

- `pool_name`: The pool name. If this argument is not given, Connector/Python automatically generates the name, composed from whichever of the `host`, `port`, `user`, and `database` connection arguments are given in `kwargs`, in that order.

It is not an error for multiple pools to have the same name. An application that must distinguish pools by their `pool_name` property should create each pool with a distinct name.

- `pool_size`: The pool size. If this argument is not given, the default is 5.
- `pool_reset_session`: Whether to reset session variables when the connection is returned to the pool. This argument was added in Connector/Python 1.1.5. Before 1.1.5, session variables are not reset.
- `kwargs`: Optional additional connection arguments, as described in [Section 6.7.1, “Connector/Python Connection Arguments”](#).

Example:

```
dbconfig = {
```

```
    "database": "test",
    "user":      "joe",
}
cnxpool = mysql.connector.pooling.MySQLConnectionPool(pool_name = "mypool",
                                                       pool_size = 3,
                                                       **dbconfig)
```

6.9.3.2 MySQLConnectionPool.add_connection() Method

Syntax:

```
cnxpool.add_connection(cnx = None)
```

This method adds a new or existing [MySQLConnection](#) to the pool, or raises a [PoolError](#) if the pool is full.

Arguments:

- `cnx`: The [MySQLConnection](#) object to be added to the pool. If this argument is missing, the pool creates a new connection and adds it.

Example:

```
cnxpool.add_connection()      # add new connection to pool
cnxpool.add_connection(cnx)  # add existing connection to pool
```

6.9.3.3 MySQLConnectionPool.get_connection() Method

Syntax:

```
cnxpool.get_connection()
```

This method returns a connection from the pool, or raises a [PoolError](#) if no connections are available.

Example:

```
cnx = cnxpool.get_connection()
```

6.9.3.4 MySQLConnectionPool.set_config() Method

Syntax:

```
cnxpool.set_config(**kwargs)
```

This method sets the configuration parameters for connections in the pool. Connections requested from the pool after the configuration change use the new parameters. Connections obtained before the change remain unaffected, but when they are closed (returned to the pool) are reopened with the new parameters before being returned by the pool for subsequent connection requests.

Arguments:

- `kwargs`: Connection arguments.

Example:

```
dbconfig = {
    "database": "performance_schema",
    "user":      "admin",
    "password": "password",
}
cnxpool.set_config(**dbconfig)
```

6.9.3.5 MySQLConnectionPool.pool_name Property

Syntax:

```
cnxpool.pool_name
```

This property returns the connection pool name.

Example:

```
name = cnxpool.pool_name
```

6.9.4 pooling.PooledMySQLConnection Class

This class is used by [MySQLConnectionPool](#) to return a pooled connection instance. It is also the class used for connections obtained with calls to the `connect()` method that name a connection pool (see [Section 6.8.1, “Connector/Python Connection Pooling”](#)).

[PooledMySQLConnection](#) pooled connection objects are similar to [MySQLConnection](#) unpooled connection objects, with these differences:

- To release a pooled connection obtained from a connection pool, invoke its `close()` method, just as for any unpooled connection. However, for a pooled connection, `close()` does not actually close the connection but returns it to the pool and makes it available for subsequent connection requests.
- A pooled connection cannot be reconfigured using its `config()` method. Connection changes must be done through the pool object itself, as described by [Section 6.8.1, “Connector/Python Connection Pooling”](#).
- A pooled connection has a `pool_name` property that returns the pool name.

6.9.4.1 pooling.PooledMySQLConnection Constructor

Syntax:

```
PooledMySQLConnection(cnxpool, cnx)
```

This constructor takes connection pool and connection arguments and returns a pooled connection. It is used by the [MySQLConnectionPool](#) class.

Arguments:

- `cnxpool`: A [MySQLConnectionPool](#) instance.
- `cnx`: A [MySQLConnection](#) instance.

Example:

```
pcnx = mysql.connector.pooling.PooledMySQLConnection(cnxpool, cnx)
```

6.9.4.2 PooledMySQLConnection.close() Method

Syntax:

```
cnx.close()
```

Returns a pooled connection to its connection pool.

For a pooled connection, `close()` does not actually close it but returns it to the pool and makes it available for subsequent connection requests.

If the pool configuration parameters are changed, a returned connection is closed and reopened with the new configuration before being returned from the pool again in response to a connection request.

6.9.4.3 PooledMySQLConnection.config() Method

For pooled connections, the `config()` method raises a `PoolError` exception. Configuration for pooled connections should be done using the pool object.

6.9.4.4 PooledMySQLConnection.pool_name Property

Syntax:

```
cnx.pool_name
```

This property returns the name of the connection pool to which the connection belongs.

Example:

```
cnx = cnxpool.get_connection()  
name = cnx.pool_name
```

6.9.5 cursor.MySQLCursor Class

The `MySQLCursor` class instantiates objects that can execute operations such as SQL statements. Cursor objects interact with the MySQL server using a `MySQLConnection` object.

To create a cursor, use the `cursor()` method of a connection object:

```
import mysql.connector  
cnx = mysql.connector.connect(database='world')  
cursor = cnx.cursor()
```

Several related classes inherit from `MySQLCursor`. To create a cursor of one of these types, pass the appropriate arguments to `cursor()`:

- `MySQLCursorBuffered` creates a buffered cursor. See [Section 6.9.6.1, “cursor.MySQLCursorBuffered Class”](#).

```
cursor = cnx.cursor(buffered=True)
```

- `MySQLCursorRaw` creates a raw cursor. See [Section 6.9.6.2, “cursor.MySQLCursorRaw Class”](#).

```
cursor = cnx.cursor(raw=True)
```

- `MySQLCursorBufferedRaw` creates a buffered raw cursor. See [Section 6.9.6.3, “cursor.MySQLCursorBufferedRaw Class”](#).

```
cursor = cnx.cursor(raw=True, buffered=True)
```

- `MySQLCursorDict` creates a cursor that returns rows as dictionaries. See [Section 6.9.6.4, “cursor.MySQLCursorDict Class”](#).

```
cursor = cnx.cursor(dictionary=True)
```

- `MySQLCursorBufferedDict` creates a buffered cursor that returns rows as dictionaries. See [Section 6.9.6.5, “cursor.MySQLCursorBufferedDict Class”](#).

```
cursor = cnx.cursor(dictionary=True, buffered=True)
```

- `MySQLCursorNamedTuple` creates a cursor that returns rows as named tuples. See [Section 6.9.6.6, “cursor.MySQLCursorNamedTuple Class”](#).

```
cursor = cnx.cursor(named_tuple=True)
```

- `MySQLCursorBufferedNamedTuple` creates a buffered cursor that returns rows as named tuples. See [Section 6.9.6.7, “cursor.MySQLCursorBufferedNamedTuple Class”](#).

```
cursor = cnx.cursor(named_tuple=True, buffered=True)
```

- `MySQLCursorPrepared` creates a cursor for executing prepared statements. See [Section 6.9.6.8, “cursor.MySQLCursorPrepared Class”](#).

```
cursor = cnx.cursor(prepared=True)
```

6.9.5.1 cursor.MySQLCursor Constructor

In most cases, the `MySQLConnection cursor()` method is used to instantiate a `MySQLCursor` object:

```
import mysql.connector
cnx = mysql.connector.connect(database='world')
cursor = cnx.cursor()
```

It is also possible to instantiate a cursor by passing a `MySQLConnection` object to `MySQLCursor`:

```
import mysql.connector
from mysql.connector.cursor import MySQLCursor
cnx = mysql.connector.connect(database='world')
cursor = MySQLCursor(cnx)
```

The connection argument is optional. If omitted, the cursor is created but its `execute()` method raises an exception.

6.9.5.2 MySQLCursor.callproc() Method

Syntax:

```
result_args = cursor.callproc(proc_name, args=())
```

This method calls the stored procedure named by the `proc_name` argument. The `args` sequence of parameters must contain one entry for each argument that the procedure expects. `callproc()` returns a modified copy of the input sequence. Input parameters are left untouched. Output and input/output parameters may be replaced with new values.

Result sets produced by the stored procedure are automatically fetched and stored as `MySQLCursorBuffered` instances. For more information about using these result sets, see `stored_results()`.

Suppose that a stored procedure takes two parameters, multiplies the values, and returns the product:

```
CREATE PROCEDURE multiply(IN pFac1 INT, IN pFac2 INT, OUT pProd INT)
BEGIN
    SET pProd := pFac1 * pFac2;
END;
```

The following example shows how to execute the `multiply()` procedure:

```
>>> args = (5, 6, 0) # 0 is to hold value of the OUT parameter pProd
>>> cursor.callproc('multiply', args)
('5', '6', 30L)
```

Connector/Python 1.2.1 and up permits parameter types to be specified. To do this, specify a parameter as a two-item tuple consisting of the parameter value and type. Suppose that a procedure `sp1()` has this definition:

```
CREATE PROCEDURE sp1(IN pStr1 VARCHAR(20), IN pStr2 VARCHAR(20),
                     OUT pConCat VARCHAR(100))
BEGIN
    SET pConCat := CONCAT(pStr1, pStr2);
END;
```

To execute this procedure from Connector/Python, specifying a type for the `OUT` parameter, do this:

```
args = ('ham', 'eggs', (0, 'CHAR'))
result_args = cursor.callproc('sp1', args)
```

```
print(result_args[2])
```

6.9.5.3 MySQLCursor.close() Method

Syntax:

```
cursor.close()
```

Use `close()` when you are done using a cursor. This method closes the cursor, resets all results, and ensures that the cursor object has no reference to its original connection object.

6.9.5.4 MySQLCursor.execute() Method

Syntax:

```
cursor.execute(operation, params=None, multi=False)
iterator = cursor.execute(operation, params=None, multi=True)
```

This method executes the given database `operation` (query or command). The parameters found in the tuple or dictionary `params` are bound to the variables in the operation. Specify variables using `%s` or `%(name)s` parameter style (that is, using `format` or `pyformat` style). `execute()` returns an iterator if `multi` is `True`.

Note

In Python, a tuple containing a single value must include a comma. For example, `('abc')` is evaluated as a scalar while `('abc',)` is evaluated as a tuple.

This example inserts information about a new employee, then selects the data for that person. The statements are executed as separate `execute()` operations:

```
insert_stmt = (
    "INSERT INTO employees (emp_no, first_name, last_name, hire_date) "
    "VALUES (%s, %s, %s, %s)"
)
data = (2, 'Jane', 'Doe', datetime.date(2012, 3, 23))
cursor.execute(insert_stmt, data)
select_stmt = "SELECT * FROM employees WHERE emp_no = %(emp_no)s"
cursor.execute(select_stmt, { 'emp_no': 2 })
```

The data values are converted as necessary from Python objects to something MySQL understands. In the preceding example, the `datetime.date()` instance is converted to `'2012-03-23'`.

If `multi` is set to `True`, `execute()` is able to execute multiple statements specified in the `operation` string. It returns an iterator that enables processing the result of each statement. However, using parameters does not work well in this case, and it is usually a good idea to execute each statement on its own.

The following example selects and inserts data in a single `execute()` operation and displays the result of each statement:

```
operation = 'SELECT 1; INSERT INTO t1 VALUES (); SELECT 2'
for result in cursor.execute(operation, multi=True):
    if result.with_rows:
        print("Rows produced by statement '{}': {}".format(
            result.statement))
        print(result.fetchall())
    else:
        print("Number of rows affected by statement '{}': {}".format(
            result.statement, result.rowcount))
```

If the connection is configured to fetch warnings, warnings generated by the operation are available through the `MySQLCursor.fetchwarnings()` method.

6.9.5.5 MySQLCursor.executemany() Method

Syntax:

```
cursor.executemany(operation, seq_of_params)
```

This method prepares a database `operation` (query or command) and executes it against all parameter sequences or mappings found in the sequence `seq_of_params`.

Note

In Python, a tuple containing a single value must include a comma. For example, ('abc') is evaluated as a scalar while ('abc,) is evaluated as a tuple.

In most cases, the `executemany()` method iterates through the sequence of parameters, each time passing the current parameters to the the `execute()` method.

An optimization is applied for inserts: The data values given by the parameter sequences are batched using multiple-row syntax. The following example inserts three records:

```
data = [
    ('Jane', date(2005, 2, 12)),
    ('Joe', date(2006, 5, 23)),
    ('John', date(2010, 10, 3)),
]
stmt = "INSERT INTO employees (first_name, hire_date) VALUES (%s, %s)"
cursor.executemany(stmt, data)
```

For the preceding example, the `INSERT` statement sent to MySQL is:

```
INSERT INTO employees (first_name, hire_date)
VALUES ('Jane', '2005-02-12'), ('Joe', '2006-05-23'), ('John', '2010-10-03')
```

With the `executemany()` method, it is not possible to specify multiple statements to execute in the `operation` argument. Doing so raises an `InternalError` exception. Consider using `execute()` with `multi=True` instead.

6.9.5.6 MySQLCursor.fetchall() Method

Syntax:

```
rows = cursor.fetchall()
```

The method fetches all (or all remaining) rows of a query result set and returns a list of tuples. If no more rows are available, it returns an empty list.

The following example shows how to retrieve the first two rows of a result set, and then retrieve any remaining rows:

```
>>> cursor.execute("SELECT * FROM employees ORDER BY emp_no")
>>> head_rows = cursor.fetchmany(size=2)
>>> remaining_rows = cursor.fetchall()
```

You must fetch all rows for the current query before executing new statements using the same connection.

6.9.5.7 MySQLCursor.fetchmany() Method

Syntax:

```
rows = cursor.fetchmany(size=1)
```

This method fetches the next set of rows of a query result and returns a list of tuples. If no more rows are available, it returns an empty list.

The number of rows returned can be specified using the `size` argument, which defaults to one. Fewer rows are returned if fewer rows are available than specified.

You must fetch all rows for the current query before executing new statements using the same connection.

6.9.5.8 MySQLCursor.fetchone() Method

Syntax:

```
row = cursor.fetchone()
```

This method retrieves the next row of a query result set and returns a single sequence, or `None` if no more rows are available. By default, the returned tuple consists of data returned by the MySQL server, converted to Python objects. If the cursor is a raw cursor, no such conversion occurs; see [Section 6.9.6.2, “cursor.MySQLCursorRaw Class”](#).

The `fetchone()` method is used by `fetchall()` and `fetchmany()`. It is also used when a cursor is used as an iterator.

The following example shows two equivalent ways to process a query result. The first uses `fetchone()` in a `while` loop, the second uses the cursor as an iterator:

```
# Using a while loop
cursor.execute("SELECT * FROM employees")
row = cursor.fetchone()
while row is not None:
    print(row)
    row = cursor.fetchone()
# Using the cursor as iterator
cursor.execute("SELECT * FROM employees")
for row in cursor:
    print(row)
```

You must fetch all rows for the current query before executing new statements using the same connection.

6.9.5.9 MySQLCursor.fetchwarnings() Method

Syntax:

```
tuples = cursor.fetchwarnings()
```

This method returns a list of tuples containing warnings generated by the previously executed operation. To set whether to fetch warnings, use the connection's `get_warnings` property.

The following example shows a `SELECT` statement that generates a warning:

```
>>> cnx.get_warnings = True
>>> cursor.execute("SELECT 'a'+'1")
>>> cursor.fetchall()
[(1.0,)]
>>> cursor.fetchwarnings()
[(u'Warning', 1292, u"Truncated incorrect DOUBLE value: 'a'")]
```

When warnings are generated, it is possible to raise errors instead, using the connection's `raise_on_warnings` property.

6.9.5.10 MySQLCursor.stored_results() Method

Syntax:

```
iterator = cursor.stored_results()
```

This method returns a list iterator object that can be used to process result sets produced by a stored procedure executed using the `callproc()` method. The result sets remain available until you use the cursor to execute another operation or call another stored procedure.

The following example executes a stored procedure that produces two result sets, then uses `stored_results()` to retrieve them:

```
>>> cursor.callproc('myproc')
()
>>> for result in cursor.stored_results():
...     print result.fetchall()
...
[(1,)]
[(2,)]
```

6.9.5.11 MySQLCursor.column_names Property

Syntax:

```
sequence = cursor.column_names
```

This read-only property returns the column names of a result set as sequence of Unicode strings.

The following example shows how to create a dictionary from a tuple containing data with keys using `column_names`:

```
cursor.execute("SELECT last_name, first_name, hire_date "
              "FROM employees WHERE emp_no = %s", (123,))
row = dict(zip(cursor.column_names, cursor.fetchone()))
print("{last_name}, {first_name}: {hire_date}".format(row))
```

Alternatively, as of Connector/Python 2.0.0, you can fetch rows as dictionaries directly; see [Section 6.9.6.4, “cursor.MySQLCursorDict Class”](#).

6.9.5.12 MySQLCursor.description Property

Syntax:

```
tuples = cursor.description
```

This read-only property returns a list of tuples describing the columns in a result set. Each tuple in the list contains values as follows:

```
(column_name,
 type,
 None,
 None,
 None,
 None,
 null_ok,
 column_flags)
```

The following example shows how to interpret `description` tuples:

```
import mysql.connector
from mysql.connector import FieldType
...
cursor.execute("SELECT emp_no, last_name, hire_date "
              "FROM employees WHERE emp_no = %s", (123,))
for i in range(len(cursor.description)):
    print("Column {}:".format(i+1))
    desc = cursor.description[i]
    print("  column_name = {}".format(desc[0]))
    print("  type = {} ({})".format(desc[1], FieldType.get_info(desc[1])))
    print("  null_ok = {}".format(desc[6]))
    print("  column_flags = {}".format(desc[7]))
```

The output looks like this:

```
Column 1:
  column_name = emp_no
  type = 3 (LONG)
```

```
null_ok = 0
column_flags = 20483
Column 2:
column_name = last_name
type = 253 (VAR_STRING)
null_ok = 0
column_flags = 4097
Column 3:
column_name = hire_date
type = 10 (DATE)
null_ok = 0
column_flags = 4225
```

The `column_flags` value is an instance of the `constants.FieldFlag` class. To see how to interpret it, do this:

```
>>> from mysql.connector import FieldFlag
>>> FieldFlag.desc
```

6.9.5.13 MySQLCursor.lastrowid Property

Syntax:

```
id = cursor.lastrowid
```

This read-only property returns the value generated for an `AUTO_INCREMENT` column by the previous `INSERT` or `UPDATE` statement or `None` when there is no such value available. For example, if you perform an `INSERT` into a table that contains an `AUTO_INCREMENT` column, `lastrowid` returns the `AUTO_INCREMENT` value for the new row. For an example, see [Section 6.5.3, “Inserting Data Using Connector/Python”](#).

The `lastrowid` property is like the `mysql_insert_id()` C API function; see [mysql_insert_id\(\)](#).

6.9.5.14 MySQLCursor.rowcount Property

Syntax:

```
count = cursor.rowcount
```

This read-only property returns the number of rows returned for `SELECT` statements, or the number of rows affected by DML statements such as `INSERT` or `UPDATE`. For an example, see [Section 6.9.5.4, “MySQLCursor.execute\(\) Method”](#).

For nonbuffered cursors, the row count cannot be known before the rows have been fetched. In this case, the number of rows is `-1` immediately after query execution and is incremented as rows are fetched.

The `rowcount` property is like the `mysql_affected_rows()` C API function; see [mysql_affected_rows\(\)](#).

6.9.5.15 MySQLCursor.statement Property

Syntax:

```
str = cursor.statement
```

This read-only property returns the last executed statement as a string. The `statement` property can be useful for debugging and displaying what was sent to the MySQL server.

The string can contain multiple statements if a multiple-statement string was executed. This occurs for `execute()` with `multi=True`. In this case, the `statement` property contains the entire statement string and the `execute()` call returns an iterator that can be used to process results from the individual statements. The `statement` property for this iterator shows statement strings for the individual statements.

6.9.5.16 MySQLCursor.with_rows Property

Syntax:

```
boolean = cursor.with_rows
```

This read-only property returns `True` or `False` to indicate whether the most recently executed operation produced rows.

The `with_rows` property is useful when it is necessary to determine whether a statement produces a result set and you need to fetch rows. The following example retrieves the rows returned by the `SELECT` statements, but reports only the affected-rows value for the `UPDATE` statement:

```
import mysql.connector
cnx = mysql.connector.connect(user='scott', database='test')
cursor = cnx.cursor()
operation = 'SELECT 1; UPDATE t1 SET c1 = 2; SELECT 2'
for result in cursor.execute(operation, multi=True):
    if result.with_rows:
        result.fetchall()
    else:
        print("Number of affected rows: {}".format(result.rowcount))
```

6.9.6 Subclasses cursor.MySQLCursor

The cursor classes described in the following sections inherit from the `MySQLCursor` class, which is described in [Section 6.9.5, “cursor.MySQLCursor Class”](#).

6.9.6.1 cursor.MySQLCursorBuffered Class

The `MySQLCursorBuffered` class inherits from `MySQLCursor`.

After executing a query, a `MySQLCursorBuffered` cursor fetches the entire result set from the server and buffers the rows.

For queries executed using a buffered cursor, row-fetching methods such as `fetchone()` return rows from the set of buffered rows. For nonbuffered cursors, rows are not fetched from the server until a row-fetching method is called. In this case, you must be sure to fetch all rows of the result set before executing any other statements on the same connection, or an `InternalError` (Unread result found) exception will be raised.

`MySQLCursorBuffered` can be useful in situations where multiple queries, with small result sets, need to be combined or computed with each other.

To create a buffered cursor, use the `buffered` argument when calling a connection's `cursor()` method. Alternatively, to make all cursors created from the connection buffered by default, use the [buffered connection argument](#).

Example:

```
import mysql.connector
cnx = mysql.connector.connect()
# Only this particular cursor will buffer results
cursor = cnx.cursor(buffered=True)
# All cursors created from cnx2 will be buffered by default
cnx2 = mysql.connector.connect(buffered=True)
```

For a practical use case, see [Section 6.6.1, “Tutorial: Raise Employee's Salary Using a Buffered Cursor”](#).

6.9.6.2 cursor.MySQLCursorRaw Class

The `MySQLCursorRaw` class inherits from `MySQLCursor`.

A `MySQLCursorRaw` cursor skips the conversion from MySQL data types to Python types when fetching rows. A raw cursor is usually used to get better performance or when you want to do the conversion yourself.

To create a raw cursor, use the `raw` argument when calling a connection's `cursor()` method. Alternatively, to make all cursors created from the connection raw by default, use the `raw` [connection argument](#).

Example:

```
import mysql.connector
cnx = mysql.connector.connect()
# Only this particular cursor will be raw
cursor = cnx.cursor(raw=True)
# All cursors created from cnx2 will be raw by default
cnx2 = mysql.connector.connect(raw=True)
```

6.9.6.3 cursor.MySQLCursorBufferedRaw Class

The `MySQLCursorBufferedRaw` class inherits from `MySQLCursor`.

A `MySQLCursorBufferedRaw` cursor is like a `MySQLCursorRaw` cursor, but is buffered: After executing a query, it fetches the entire result set from the server and buffers the rows. For information about the implications of buffering, see [Section 6.9.6.1, “cursor.MySQLCursorBuffered Class”](#).

To create a buffered raw cursor, use the `raw` and `buffered` arguments when calling a connection's `cursor()` method. Alternatively, to make all cursors created from the connection raw and buffered by default, use the `raw` and `buffered` [connection arguments](#).

Example:

```
import mysql.connector
cnx = mysql.connector.connect()
# Only this particular cursor will be raw and buffered
cursor = cnx.cursor(raw=True, buffered=True)
# All cursors created from cnx2 will be raw and buffered by default
cnx2 = mysql.connector.connect(raw=True, buffered=True)
```

6.9.6.4 cursor.MySQLCursorDict Class

The `MySQLCursorDict` class inherits from `MySQLCursor`. This class is available as of Connector/Python 2.0.0.

A `MySQLCursorDict` cursor returns each row as a dictionary. The keys for each dictionary object are the column names of the MySQL result.

Example:

```
cnx = mysql.connector.connect(database='world')
cursor = cnx.cursor(dictionary=True)
cursor.execute("SELECT * FROM country WHERE Continent = 'Europe'")
print("Countries in Europe:")
for row in cursor:
    print("* {Name}".format(Name=row['Name']))
```

The preceding code produces output like this:

```
Countries in Europe:
* Albania
* Andorra
* Austria
* Belgium
* Bulgaria
...
```

It may be convenient to pass the dictionary to `format()` as follows:

```
cursor.execute("SELECT Name, Population FROM country WHERE Continent = 'Europe' ")
print("Countries in Europe with population:")
for row in cursor:
    print("* {Name}: {Population}".format(**row))
```

6.9.6.5 cursor.MySQLCursorBufferedDict Class

The `MySQLCursorBufferedDict` class inherits from `MySQLCursor`. This class is available as of Connector/Python 2.0.0.

A `MySQLCursorBufferedDict` cursor is like a `MySQLCursorDict` cursor, but is buffered: After executing a query, it fetches the entire result set from the server and buffers the rows. For information about the implications of buffering, see [Section 6.9.6.1, “cursor.MySQLCursorBuffered Class”](#).

To get a buffered cursor that returns dictionaries, add the `buffered` argument when instantiating a new dictionary cursor:

```
cursor = cnx.cursor(dictionary=True, buffered=True)
```

6.9.6.6 cursor.MySQLCursorNamedTuple Class

The `MySQLCursorNamedTuple` class inherits from `MySQLCursor`. This class is available as of Connector/Python 2.0.0.

A `MySQLCursorNamedTuple` cursor returns each row as a named tuple. The attributes for each named-tuple object are the column names of the MySQL result.

Example:

```
cnx = mysql.connector.connect(database='world')
cursor = cnx.cursor(named_tuple=True)
cursor.execute("SELECT * FROM country WHERE Continent = 'Europe' ")
print("Countries in Europe with population:")
for row in cursor:
    print("* {Name}: {Population}".format(
        Name=row.Name,
        Population=row.Population
    ))
```

6.9.6.7 cursor.MySQLCursorBufferedNamedTuple Class

The `MySQLCursorBufferedNamedTuple` class inherits from `MySQLCursor`. This class is available as of Connector/Python 2.0.0.

A `MySQLCursorBufferedNamedTuple` cursor is like a `MySQLCursorNamedTuple` cursor, but is buffered: After executing a query, it fetches the entire result set from the server and buffers the rows. For information about the implications of buffering, see [Section 6.9.6.1, “cursor.MySQLCursorBuffered Class”](#).

To get a buffered cursor that returns named tuples, add the `buffered` argument when instantiating a new named-tuple cursor:

```
cursor = cnx.cursor(named_tuple=True, buffered=True)
```

6.9.6.8 cursor.MySQLCursorPrepared Class

The `MySQLCursorPrepared` class inherits from `MySQLCursor`.

Note

This class is available as of Connector/Python 1.1.0. The C extension supports it as of Connector/Python 8.0.17.

In MySQL, there are two ways to execute a prepared statement:

- Use the `PREPARE` and `EXECUTE` statements.
- Use the binary client/server protocol to send and receive data. To repeatedly execute the same statement with different data for different executions, this is more efficient than using `PREPARE` and `EXECUTE`. For information about the binary protocol, see [C API Prepared Statements](#).

In Connector/Python, there are two ways to create a cursor that enables execution of prepared statements using the binary protocol. In both cases, the `cursor()` method of the connection object returns a `MySQLCursorPrepared` object:

- The simpler syntax uses a `prepared=True` argument to the `cursor()` method. This syntax is available as of Connector/Python 1.1.2.

```
import mysql.connector
cnx = mysql.connector.connect(database='employees')
cursor = cnx.cursor(prepared=True)
```

- Alternatively, create an instance of the `MySQLCursorPrepared` class using the `cursor_class` argument to the `cursor()` method. This syntax is available as of Connector/Python 1.1.0.

```
import mysql.connector
from mysql.connector.cursor import MySQLCursorPrepared
cnx = mysql.connector.connect(database='employees')
cursor = cnx.cursor(cursor_class=MySQLCursorPrepared)
```

A cursor instantiated from the `MySQLCursorPrepared` class works like this:

- The first time you pass a statement to the cursor's `execute()` method, it prepares the statement. For subsequent invocations of `execute()`, the preparation phase is skipped if the statement is the same.
- The `execute()` method takes an optional second argument containing a list of data values to associate with parameter markers in the statement. If the list argument is present, there must be one value per parameter marker.

Example:

```
cursor = cnx.cursor(prepared=True)
stmt = "SELECT fullname FROM employees WHERE id = %s" # (1)
cursor.execute(stmt, (5,))                                # (2)
# ... fetch data ...
cursor.execute(stmt, (10,))                               # (3)
# ... fetch data ...
```

1. The `%s` within the statement is a parameter marker. Do not put quote marks around parameter markers.
2. For the first call to the `execute()` method, the cursor prepares the statement. If data is given in the same call, it also executes the statement and you should fetch the data.
3. For subsequent `execute()` calls that pass the same SQL statement, the cursor skips the preparation phase.

Prepared statements executed with `MySQLCursorPrepared` can use the `format (%s)` or `qmark (?)` parameterization style. This differs from nonprepared statements executed with `MySQLCursor`, which can use the `format` or `pyformat` parameterization style.

To use multiple prepared statements simultaneously, instantiate multiple cursors from the `MySQLCursorPrepared` class.

The MySQL client/server protocol has an option to send prepared statement parameters via the `COM_STMT_SEND_LONG_DATA` command. To use this from Connector/Python scripts, send the parameter in question using the `IOBase` interface. Example:

```
from io import IOBase
```

```
...
cur = cnx.cursor(prepared=True)
cur.execute("SELECT (%s)", (io.BytesIO(bytes("A", "latin1"))), )
```

6.9.7 constants.ClientFlag Class

This class provides constants defining MySQL client flags that can be used when the connection is established to configure the session. The `ClientFlag` class is available when importing `mysql.connector`.

```
>>> import mysql.connector
>>> mysql.connector.ClientFlag.FOUND_ROWS
2
```

See [Section 6.9.2.32, “MySQLConnection.set_client_flags\(\) Method”](#) and the `connection` argument `client_flag`.

The `ClientFlag` class cannot be instantiated.

6.9.8 constants.FieldType Class

This class provides all supported MySQL field or data types. They can be useful when dealing with raw data or defining your own converters. The field type is stored with every cursor in the description for each column.

The following example shows how to print the name of the data type for each column in a result set.

```
from __future__ import print_function
import mysql.connector
from mysql.connector import FieldType
cnx = mysql.connector.connect(user='scott', database='test')
cursor = cnx.cursor()
cursor.execute(
    "SELECT DATE(NOW()) AS `c1`, TIME(NOW()) AS `c2`, "
    "NOW() AS `c3`, 'a string' AS `c4`, 42 AS `c5`")
rows = cursor.fetchall()
for desc in cursor.description:
    colname = desc[0]
    coltype = desc[1]
    print("Column {} has type {}".format(
        colname, FieldType.get_info(coltype)))
cursor.close()
cnx.close()
```

The `FieldType` class cannot be instantiated.

6.9.9 constants.SQLMode Class

This class provides all known MySQL [Server SQL Modes](#). It is mostly used when setting the SQL modes at connection time using the connection's `sql_mode` property. See [Section 6.9.2.47, “MySQLConnection.sql_mode Property”](#).

The `SQLMode` class cannot be instantiated.

6.9.10 constants.CharacterSet Class

This class provides all known MySQL characters sets and their default collations. For examples, see [Section 6.9.2.31, “MySQLConnection.set_charset_collation\(\) Method”](#).

The `CharacterSet` class cannot be instantiated.

6.9.11 constants.RefreshOption Class

This class performs various flush operations.

- `RefreshOption.GRANT`

Refresh the grant tables, like `FLUSH PRIVILEGES`.

- `RefreshOption.LOG`

Flush the logs, like `FLUSH LOGS`.

- `RefreshOption.TABLES`

Flush the table cache, like `FLUSH TABLES`.

- `RefreshOption.HOSTS`

Flush the host cache, like `FLUSH HOSTS`.

- `RefreshOption.STATUS`

Reset status variables, like `FLUSH STATUS`.

- `RefreshOption.THREADS`

Flush the thread cache.

- `RefreshOption.SLAVE`

On a slave replication server, reset the master server information and restart the slave, like `RESET SLAVE`.

6.9.12 Errors and Exceptions

The `mysql.connector.errors` module defines exception classes for errors and warnings raised by MySQL Connector/Python. Most classes defined in this module are available when you import `mysql.connector`.

The exception classes defined in this module mostly follow the Python Database API Specification v2.0 (PEP 249). For some MySQL client or server errors it is not always clear which exception to raise. It is good to discuss whether an error should be reclassified by opening a bug report.

MySQL Server errors are mapped with Python exception based on their SQLSTATE value (see [Server Error Message Reference](#)). The following table shows the SQLSTATE classes and the exception Connector/Python raises. It is, however, possible to redefine which exception is raised for each server error. The default exception is `DatabaseError`.

Table 6.3 Mapping of Server Errors to Python Exceptions

SQLSTATE Class	Connector/Python Exception
02	<code>DataError</code>
02	<code>DataError</code>
07	<code>DatabaseError</code>
08	<code>OperationalError</code>
0A	<code>NotSupportedError</code>
21	<code>DataError</code>
22	<code>DataError</code>
23	<code>IntegrityError</code>
24	<code>ProgrammingError</code>

SQLSTATE Class	Connector/Python Exception
25	ProgrammingError
26	ProgrammingError
27	ProgrammingError
28	ProgrammingError
2A	ProgrammingError
2B	DatabaseError
2C	ProgrammingError
2D	DatabaseError
2E	DatabaseError
33	DatabaseError
34	ProgrammingError
35	ProgrammingError
37	ProgrammingError
3C	ProgrammingError
3D	ProgrammingError
3F	ProgrammingError
40	InternalError
42	ProgrammingError
44	InternalError
HZ	OperationalError
XA	IntegrityError
OK	OperationalError
HY	DatabaseError

6.9.12.1 errorcode Module

This module contains both MySQL server and client error codes defined as module attributes with the error number as value. Using error codes instead of error numbers could make reading the source code a bit easier.

```
>>> from mysql.connector import errorcode
>>> errorcode.ER_BAD_TABLE_ERROR
1051
```

For more information about MySQL errors, see [Errors, Error Codes, and Common Problems](#).

6.9.12.2 errors.Error Exception

This exception is the base class for all other exceptions in the `errors` module. It can be used to catch all errors in a single `except` statement.

The following example shows how we could catch syntax errors:

```
import mysql.connector
try:
    cnx = mysql.connector.connect(user='scott', database='employees')
    cursor = cnx.cursor()
    cursor.execute("SELECT * FORM employees")    # Syntax error in query
    cnx.close()
except mysql.connector.Error as err:
```

```
print("Something went wrong: {}".format(err))
```

Initializing the exception supports a few optional arguments, namely `msg`, `errno`, `values` and `sqlstate`. All of them are optional and default to `None`. `errors.Error` is internally used by Connector/Python to raise MySQL client and server errors and should not be used by your application to raise exceptions.

The following examples show the result when using no arguments or a combination of the arguments:

```
>>> from mysql.connector.errors import Error
>>> str(Error())
'Unknown error'
>>> str(Error("Oops! There was an error."))
'Oops! There was an error.'
>>> str(Error(errno=2006))
'2006: MySQL server has gone away'
>>> str(Error(errno=2002, values=('/tmp/mysql.sock', 2)))
'2002: Can't connect to local MySQL server through socket '/tmp/mysql.sock' (2)'
>>> str(Error(errno=1146, sqlstate='42S02', msg="Table 'test.spam' doesn't exist"))
'1146 (42S02): Table 'test.spam' doesn't exist'
```

The example which uses error number 1146 is used when Connector/Python receives an error packet from the MySQL Server. The information is parsed and passed to the `Error` exception as shown.

Each exception subclassing from `Error` can be initialized using the previously mentioned arguments. Additionally, each instance has the attributes `errno`, `msg` and `sqlstate` which can be used in your code.

The following example shows how to handle errors when dropping a table which does not exist (when the `DROP TABLE` statement does not include a `IF EXISTS` clause):

```
import mysql.connector
from mysql.connector import errorcode
cnx = mysql.connector.connect(user='scott', database='test')
cursor = cnx.cursor()
try:
    cursor.execute("DROP TABLE spam")
except mysql.connector.Error as err:
    if err errno == errorcode.ER_BAD_TABLE_ERROR:
        print("Creating table spam")
    else:
        raise
```

Prior to Connector/Python 1.1.1, the original message passed to `errors.Error()` is not saved in such a way that it could be retrieved. Instead, the `Error.msg` attribute was formatted with the error number and SQLSTATE value. As of 1.1.1, only the original message is saved in the `Error.msg` attribute. The formatted value together with the error number and SQLSTATE value can be obtained by printing or getting the string representation of the error object. Example:

```
try:
    conn = mysql.connector.connect(database = "baddb")
except mysql.connector.Error as e:
    print "Error code:", e errno          # error number
    print "SQLSTATE value:", e.sqlstate # SQLSTATE value
    print "Error message:", e.msg      # error message
    print "Error:", e                  # errno, sqlstate, msg values
    s = str(e)
    print "Error:", s                  # errno, sqlstate, msg values
```

`errors.Error` is a subclass of the Python `StandardError`.

6.9.12.3 errors.DataError Exception

This exception is raised when there were problems with the data. Examples are a column set to `NULL` that cannot be `NUL`, out-of-range values for a column, division by zero, column count does not match value count, and so on.

`errors.DataError` is a subclass of `errors.DatabaseError`.

6.9.12.4 `errors.DatabaseError` Exception

This exception is the default for any MySQL error which does not fit the other exceptions.

`errors.DatabaseError` is a subclass of `errors.Error`.

6.9.12.5 `errors.IntegrityError` Exception

This exception is raised when the relational integrity of the data is affected. For example, a duplicate key was inserted or a foreign key constraint would fail.

The following example shows a duplicate key error raised as `IntegrityError`:

```
cursor.execute("CREATE TABLE t1 (id int, PRIMARY KEY (id))")  
try:  
    cursor.execute("INSERT INTO t1 (id) VALUES (1)")  
    cursor.execute("INSERT INTO t1 (id) VALUES (1)")  
except mysql.connector.IntegrityError as err:  
    print("Error: {}".format(err))
```

`errors.IntegrityError` is a subclass of `errors.DatabaseError`.

6.9.12.6 `errors.InterfaceError` Exception

This exception is raised for errors originating from Connector/Python itself, not related to the MySQL server.

`errors.InterfaceError` is a subclass of `errors.Error`.

6.9.12.7 `errors.InternalError` Exception

This exception is raised when the MySQL server encounters an internal error, for example, when a deadlock occurred.

`errors.InternalError` is a subclass of `errors.DatabaseError`.

6.9.12.8 `errors.NotSupportedError` Exception

This exception is raised when some feature was used that is not supported by the version of MySQL that returned the error. It is also raised when using functions or statements that are not supported by stored routines.

`errors.NotSupportedError` is a subclass of `errors.DatabaseError`.

6.9.12.9 `errors.OperationalError` Exception

This exception is raised for errors which are related to MySQL's operations. For example: too many connections; a host name could not be resolved; bad handshake; server is shutting down, communication errors.

`errors.OperationalError` is a subclass of `errors.DatabaseError`.

6.9.12.10 `errors.PoolError` Exception

This exception is raised for connection pool errors. `errors.PoolError` is a subclass of `errors.Error`.

6.9.12.11 `errors.ProgrammingError` Exception

This exception is raised on programming errors, for example when you have a syntax error in your SQL or a table was not found.

The following example shows how to handle syntax errors:

```
try:
    cursor.execute("CREATE DESK t1 (id int, PRIMARY KEY (id))")
except mysql.connector.ProgrammingError as err:
    if err errno == errorcode.ER_SYNTAX_ERROR:
        print("Check your syntax!")
    else:
        print("Error: {}".format(err))
```

`errors.ProgrammingError` is a subclass of `errors.DatabaseError`.

6.9.12.12 `errors.Warning` Exception

This exception is used for reporting important warnings, however, Connector/Python does not use it. It is included to be compliant with the Python Database Specification v2.0 (PEP-249).

Consider using either more strict [Server SQL Modes](#) or the `raise_on_warnings` connection argument to make Connector/Python raise errors when your queries produce warnings.

`errors.Warning` is a subclass of the Python `StandardError`.

6.9.12.13 `errors.custom_error_exception()` Function

Syntax:

```
errors.custom_error_exception(error=None, exception=None)
```

This method defines custom exceptions for MySQL server errors and returns current customizations.

If `error` is a MySQL Server error number, you must also pass the `exception` class. The `error` argument can be a dictionary, in which case the key is the server error number, and value the class of the exception to be raised.

To reset the customizations, supply an empty dictionary.

```
import mysql.connector
from mysql.connector import errorcode
# Server error 1028 should raise a DatabaseError
mysql.connector.custom_error_exception(1028, mysql.connector.DatabaseError)
# Or using a dictionary:
mysql.connector.custom_error_exception({
    1028: mysql.connector.DatabaseError,
    1029: mysql.connector.OperationalError,
})
# To reset, pass an empty dictionary:
mysql.connector.custom_error_exception({})
```

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This chapter describes the PHP extensions and interfaces that can be used with MySQL.

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For help with using MySQL, please visit the [MySQL Forums](#), where you can discuss your issues with other MySQL users.

7.1 Introduction to the MySQL PHP API

PHP is a server-side, HTML-embedded scripting language that may be used to create dynamic Web pages. It is available for most operating systems and Web servers, and can access most common databases, including MySQL. PHP may be run as a separate program or compiled as a module for use with a Web server.

PHP provides four different MySQL API extensions:

- [Section 7.3, “MySQL Improved Extension”](#): Stands for “MySQL, Improved”; this extension is available as of PHP 5.0.0. It is intended for use with MySQL 4.1.1 and later. This extension fully supports the authentication protocol used in MySQL 5.0, as well as the Prepared Statements and Multiple

Statements APIs. In addition, this extension provides an advanced, object-oriented programming interface.

- [Section 7.4, “MySQL Functions \(PDO_MYSQL\)”: Not its own API, but instead it’s a MySQL driver for the PHP database abstraction layer PDO \(PHP Data Objects\). The PDO MySQL driver sits in the layer below PDO itself, and provides MySQL-specific functionality. This extension is available as of PHP 5.1.0.](#)
- [Mysql_xdevapi](#): This extension uses MySQL’s X DevAPI and is available as a PECL extension named `mysql_xdevapi`. For general concepts and X DevAPI usage details, see [X DevAPI User Guide](#).
- [Section 7.5, “Original MySQL API”](#): Available for PHP versions 4 and 5, this extension is intended for use with MySQL versions prior to MySQL 4.1. This extension does not support the improved authentication protocol used in MySQL 4.1, nor does it support prepared statements or multiple statements. To use this extension with MySQL 4.1, you will likely configure the MySQL server to set the `old_passwords` system variable to 1 (see [Client does not support authentication protocol](#)).

Warning

This extension was removed from PHP 5.5.0. All users must migrate to either `mysqli`, `PDO_MySQL`, or `mysql_xdevapi`. For further information, see [Section 7.2.3, “Choosing an API”](#).

Note

This documentation, and other publications, sometimes uses the term [Connector/PHP](#). This term refers to the full set of MySQL related functionality in PHP, which includes the three APIs that are described in the preceding discussion, along with the `mysqlnd` core library and all of its plugins.

The PHP distribution and documentation are available from the [PHP website](#).

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7.2 Overview of the MySQL PHP drivers

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7.2.1 Introduction

Depending on the version of PHP, there are either two or three PHP APIs for accessing the MySQL database. PHP 5 users can choose between the deprecated `mysql` extension, `mysqli`, or `PDO_MySQL`. PHP 7 removes the `mysql` extension, leaving only the latter two options.

This guide explains the [terminology](#) used to describe each API, information about [choosing which API](#) to use, and also information to help choose which MySQL [library to use](#) with the API.

7.2.2 Terminology overview

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This section provides an introduction to the options available to you when developing a PHP application that needs to interact with a MySQL database.

What is an API?

An Application Programming Interface, or API, defines the classes, methods, functions and variables that your application will need to call in order to carry out its desired task. In the case of PHP applications that need to communicate with databases the necessary APIs are usually exposed via PHP extensions.

APIs can be procedural or object-oriented. With a procedural API you call functions to carry out tasks, with the object-oriented API you instantiate classes and then call methods on the resulting objects. Of the two the latter is usually the preferred interface, as it is more modern and leads to better organized code.

When writing PHP applications that need to connect to the MySQL server there are several API options available. This document discusses what is available and how to select the best solution for your application.

What is a Connector?

In the MySQL documentation, the term *connector* refers to a piece of software that allows your application to connect to the MySQL database server. MySQL provides connectors for a variety of languages, including PHP.

If your PHP application needs to communicate with a database server you will need to write PHP code to perform such activities as connecting to the database server, querying the database and other database-related functions. Software is required to provide the API that your PHP application will use, and also handle the communication between your application and the database server, possibly using other intermediate libraries where necessary. This software is known generically as a connector, as it allows your application to *connect* to a database server.

What is a Driver?

A driver is a piece of software designed to communicate with a specific type of database server. The driver may also call a library, such as the MySQL Client Library or the MySQL Native Driver. These libraries implement the low-level protocol used to communicate with the MySQL database server.

By way of an example, the [PHP Data Objects \(PDO\)](#) database abstraction layer may use one of several database-specific drivers. One of the drivers it has available is the PDO MYSQL driver, which allows it to interface with the MySQL server.

Sometimes people use the terms connector and driver interchangeably, this can be confusing. In the MySQL-related documentation the term “driver” is reserved for software that provides the database-specific part of a connector package.

What is an Extension?

In the PHP documentation you will come across another term - *extension*. The PHP code consists of a core, with optional extensions to the core functionality. PHP's MySQL-related extensions, such as the `mysqli` extension, and the `mysql` extension, are implemented using the PHP extension framework.

An extension typically exposes an API to the PHP programmer, to allow its facilities to be used programmatically. However, some extensions which use the PHP extension framework do not expose an API to the PHP programmer.

The PDO MySQL driver extension, for example, does not expose an API to the PHP programmer, but provides an interface to the PDO layer above it.

The terms API and extension should not be taken to mean the same thing, as an extension may not necessarily expose an API to the programmer.

7.2.3 Choosing an API

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PHP offers three different APIs to connect to MySQL. Below we show the APIs provided by the `mysql`, `mysqli`, and `PDO` extensions. Each code snippet creates a connection to a MySQL server running on "example.com" using the username "user" and the password "password". And a query is run to greet the user.

Example 7.1 Comparing the three MySQL APIs

```
<?php
// mysqli
$mysqli = new mysqli("example.com", "user", "password", "database");
$result = $mysqli->query("SELECT 'Hello, dear MySQL user!' AS _message FROM DUAL");
$row = $result->fetch_assoc();
echo htmlentities($row['_message']);
// PDO
$pdo = new PDO('mysql:host=example.com;dbname=database', 'user', 'password');
$statement = $pdo->query("SELECT 'Hello, dear MySQL user!' AS _message FROM DUAL");
$row = $statement->fetch(PDO::FETCH_ASSOC);
echo htmlentities($row['_message']);
// mysql
$c = mysql_connect("example.com", "user", "password");
mysql_select_db("database");
$result = mysql_query("SELECT 'Hello, dear MySQL user!' AS _message FROM DUAL");
$row = mysql_fetch_assoc($result);
echo htmlentities($row['_message']);
?>
```

Recommended API

It is recommended to use either the `mysqli` or `PDO_MySQL` extensions. It is not recommended to use the old `mysql` extension for new development, as it was deprecated in PHP 5.5.0 and was removed in PHP 7. A detailed feature comparison matrix is provided below. The overall performance of all three extensions is considered to be about the same. Although the performance of the extension contributes only a fraction of the total run time of a PHP web request. Often, the impact is as low as 0.1%.

Feature comparison

	ext/mysqli	PDO_MySQL	ext/mysql
PHP version introduced	5.0	5.1	2.0
Included with PHP 5.x	Yes	Yes	Yes
Included with PHP 7.x	Yes	Yes	No
Development status	Active	Active	Maintenance only in 5.x; removed in 7.x
Lifecycle	Active	Active	Deprecated in 5.x; removed in 7.x
Recommended for new projects	Yes	Yes	No
OOP Interface	Yes	Yes	No
Procedural Interface	Yes	No	Yes
API supports non-blocking, asynchronous queries with mysqlnd	Yes	No	No
Persistent Connections	Yes	Yes	Yes
API supports Charsets	Yes	Yes	Yes
API supports server-side Prepared Statements	Yes	Yes	No

	ext/mysql	PDO_MySQL	ext/mysql
API supports client-side Prepared Statements	No	Yes	No
API supports Stored Procedures	Yes	Yes	No
API supports Multiple Statements	Yes	Most	No
API supports Transactions	Yes	Yes	No
Transactions can be controlled with SQL	Yes	Yes	Yes
Supports all MySQL 5.1+ functionality	Yes	Most	No

7.2.4 Choosing a library

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The mysqli, PDO_MySQL and mysql PHP extensions are lightweight wrappers on top of a C client library. The extensions can either use the [mysqlnd](#) library or the [libmysqlclient](#) library. Choosing a library is a compile time decision.

The mysqlnd library is part of the PHP distribution since 5.3.0. It offers features like lazy connections and query caching, features that are not available with libmysqlclient, so using the built-in mysqlnd library is highly recommended. See the [mysqlnd documentation](#) for additional details, and a listing of features and functionality that it offers.

Example 7.2 Configure commands for using mysqlnd or libmysqlclient

```
// Recommended, compiles with mysqlnd
$ ./configure --with-mysqli=mysqlnd --with-pdo-mysql=mysqlnd --with-mysql=mysqlnd
// Alternatively recommended, compiles with mysqlnd as of PHP 5.4
$ ./configure --with-mysqli --with-pdo-mysql --with-mysql
// Not recommended, compiles with libmysqlclient
$ ./configure --with-mysqli=/path/to/mysql_config --with-pdo-mysql=/path/to/mysql_config --with-mysql=/path
```

Library feature comparison

It is recommended to use the [mysqlnd](#) library instead of the MySQL Client Server library ([libmysqlclient](#)). Both libraries are supported and constantly being improved.

	MySQL native driver (mysqlnd)	MySQL client server library (libmysqlclient)
Part of the PHP distribution	Yes	No
PHP version introduced	5.3.0	N/A
License	PHP License 3.01	Dual-License
Development status	Active	Active
Lifecycle	No end announced	No end announced
PHP 5.4 and above; compile default (for all MySQL extensions)	Yes	No
PHP 5.3; compile default (for all MySQL extensions)	No	Yes

	MySQL native driver (mysqlnd)	MySQL client server library (libmysqlclient)
Compression protocol support	Yes (5.3.1+)	Yes
SSL support	Yes (5.3.3+)	Yes
Named pipe support	Yes (5.3.4+)	Yes
Non-blocking, asynchronous queries	Yes	No
Performance statistics	Yes	No
LOAD LOCAL INFILE respects the open_basedir directive	Yes	No
Uses PHP's native memory management system (e.g., follows PHP memory limits)	Yes	No
Return numeric column as double (COM_QUERY)	Yes	No
Return numeric column as string (COM_QUERY)	Yes	Yes
Plugin API	Yes	Limited
Read/Write splitting for MySQL Replication	Yes, with plugin	No
Load Balancing	Yes, with plugin	No
Fail over	Yes, with plugin	No
Lazy connections	Yes, with plugin	No
Query caching	Yes, with plugin	No
Transparent query manipulations (E.g., auto-EXPLAIN or monitoring)	Yes, with plugin	No
Automatic reconnect	No	Optional

7.2.5 Concepts

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These concepts are specific to the MySQL drivers for PHP.

7.2.5.1 Buffered and Unbuffered queries

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Queries are using the buffered mode by default. This means that query results are immediately transferred from the MySQL Server to PHP and then are kept in the memory of the PHP process. This allows additional operations like counting the number of rows, and moving (seeking) the current result pointer. It also allows issuing further queries on the same connection while working on the result set. The downside of the buffered mode is that larger result sets might require quite a lot memory. The memory will be kept occupied till all references to the result set are unset or the result set was explicitly freed, which will automatically happen during request end the latest. The terminology "store result" is also used for buffered mode, as the whole result set is stored at once.

Note

When using libmysqlclient as library PHP's memory limit won't count the memory used for result sets unless the data is fetched into PHP variables. With mysqlnd the memory accounted for will include the full result set.

Unbuffered MySQL queries execute the query and then return a resource while the data is still waiting on the MySQL server for being fetched. This uses less memory on the PHP-side, but can increase the load on the server. Unless the full result set was fetched from the server no further queries can be sent over the same connection. Unbuffered queries can also be referred to as "use result".

Following these characteristics buffered queries should be used in cases where you expect only a limited result set or need to know the amount of returned rows before reading all rows. Unbuffered mode should be used when you expect larger results.

Because buffered queries are the default, the examples below will demonstrate how to execute unbuffered queries with each API.

Example 7.3 Unbuffered query example: mysqli

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
$stmt = $mysqli->query("SELECT Name FROM City", MYSQLI_USE_RESULT);
if ($stmt) {
    while ($row = $stmt->fetch_assoc()) {
        echo $row['Name'] . PHP_EOL;
    }
}
$stmt->close();
?>
```

Example 7.4 Unbuffered query example: pdo_mysql

```
<?php
$pdo = new PDO("mysql:host=localhost;dbname=world", 'my_user', 'my_pass');
$pdo->setAttribute(PDO::MYSQL_ATTR_USE_BUFFERED_QUERY, false);
$stmt = $pdo->query("SELECT Name FROM City");
if ($stmt) {
    while ($row = $stmt->fetch(PDO::FETCH_ASSOC)) {
        echo $row['Name'] . PHP_EOL;
    }
}
?>
```

Example 7.5 Unbuffered query example: mysql

```
<?php
$conn = mysql_connect("localhost", "my_user", "my_pass");
$db   = mysql_select_db("world");
$stmt = mysql_unbuffered_query("SELECT Name FROM City");
if ($stmt) {
    while ($row = mysql_fetch_assoc($stmt)) {
        echo $row['Name'] . PHP_EOL;
    }
}
?>
```

7.2.5.2 Character sets

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Ideally a proper character set will be set at the server level, and doing this is described within the [Character Set Configuration](#) section of the MySQL Server manual. Alternatively, each MySQL API offers a method to set the character set at runtime.

The character set and character escaping

The character set should be understood and defined, as it has an affect on every action, and includes security implications. For example, the escaping mechanism (e.g., `mysqli_real_escape_string` for mysqli, `mysql_real_escape_string` for mysql, and `PDO::quote` for PDO_MySQL) will adhere to this setting. It is important to realize that these functions will not use the character set that is defined with a query, so for example the following will not have an effect on them:

Example 7.6 Problems with setting the character set with SQL

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
// Will NOT affect $mysqli->real_escape_string();
$mysqli->query("SET NAMES utf8");
// Will NOT affect $mysqli->real_escape_string();
$mysqli->query("SET CHARACTER SET utf8");
// But, this will affect $mysqli->real_escape_string();
$mysqli->set_charset('utf8');
// But, this will NOT affect it (utf-8 vs utf8) -- don't use dashes here
$mysqli->set_charset('utf-8');
?>
```

Below are examples that demonstrate how to properly alter the character set at runtime using each API.

Possible UTF-8 confusion

Because character set names in MySQL do not contain dashes, the string "utf8" is valid in MySQL to set the character set to UTF-8. The string "utf-8" is not valid, as using "utf-8" will fail to change the character set.

Example 7.7 Setting the character set example: mysqli

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
printf("Initial character set: %s\n", $mysqli->character_set_name());
if (!($mysqli->set_charset('utf8'))) {
    printf("Error loading character set utf8: %s\n", $mysqli->error);
    exit;
}
echo "New character set information:\n";
print_r( $mysqli->get_charset() );
?>
```

Example 7.8 Setting the character set example: pdo_mysql

Note: This only works as of PHP 5.3.6.

```
<?php
$pdo = new PDO("mysql:host=localhost;dbname=world;charset=utf8", 'my_user', 'my_pass');
?>
```

Example 7.9 Setting the character set example: mysql

```
<?php
$conn = mysql_connect("localhost", "my_user", "my_pass");
$db   = mysql_select_db("world");
echo 'Initial character set: ' . mysql_client_encoding($conn) . "\n";
if (!mysql_set_charset('utf8', $conn)) {
    echo "Error: Unable to set the character set.\n";
    exit;
}
echo 'Your current character set is: ' . mysql_client_encoding($conn);
?>
```

7.3 MySQL Improved Extension

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The [mysqli](#) extension allows you to access the functionality provided by MySQL 4.1 and above. More information about the MySQL Database server can be found at <http://www.mysql.com/>

An overview of software available for using MySQL from PHP can be found at [Section 7.3.1, “Overview”](#)

Documentation for MySQL can be found at <http://dev.mysql.com/doc/>.

Parts of this documentation included from MySQL manual with permissions of Oracle Corporation.

Examples use either the [world](#) or [sakila](#) database, which are freely available.

7.3.1 Overview

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This section provides an introduction to the options available to you when developing a PHP application that needs to interact with a MySQL database.

What is an API?

An Application Programming Interface, or API, defines the classes, methods, functions and variables that your application will need to call in order to carry out its desired task. In the case of PHP applications that need to communicate with databases the necessary APIs are usually exposed via PHP extensions.

APIs can be procedural or object-oriented. With a procedural API you call functions to carry out tasks, with the object-oriented API you instantiate classes and then call methods on the resulting objects. Of the two the latter is usually the preferred interface, as it is more modern and leads to better organized code.

When writing PHP applications that need to connect to the MySQL server there are several API options available. This document discusses what is available and how to select the best solution for your application.

What is a Connector?

In the MySQL documentation, the term *connector* refers to a piece of software that allows your application to connect to the MySQL database server. MySQL provides connectors for a variety of languages, including PHP.

If your PHP application needs to communicate with a database server you will need to write PHP code to perform such activities as connecting to the database server, querying the database and other database-related functions. Software is required to provide the API that your PHP application will use,

and also handle the communication between your application and the database server, possibly using other intermediate libraries where necessary. This software is known generically as a connector, as it allows your application to *connect* to a database server.

What is a Driver?

A driver is a piece of software designed to communicate with a specific type of database server. The driver may also call a library, such as the MySQL Client Library or the MySQL Native Driver. These libraries implement the low-level protocol used to communicate with the MySQL database server.

By way of an example, the [PHP Data Objects \(PDO\)](#) database abstraction layer may use one of several database-specific drivers. One of the drivers it has available is the PDO MYSQL driver, which allows it to interface with the MySQL server.

Sometimes people use the terms connector and driver interchangeably, this can be confusing. In the MySQL-related documentation the term "driver" is reserved for software that provides the database-specific part of a connector package.

What is an Extension?

In the PHP documentation you will come across another term - *extension*. The PHP code consists of a core, with optional extensions to the core functionality. PHP's MySQL-related extensions, such as the `mysqli` extension, and the `mysql` extension, are implemented using the PHP extension framework.

An extension typically exposes an API to the PHP programmer, to allow its facilities to be used programmatically. However, some extensions which use the PHP extension framework do not expose an API to the PHP programmer.

The PDO MySQL driver extension, for example, does not expose an API to the PHP programmer, but provides an interface to the PDO layer above it.

The terms API and extension should not be taken to mean the same thing, as an extension may not necessarily expose an API to the programmer.

What are the main PHP API offerings for using MySQL?

There are three main API options when considering connecting to a MySQL database server:

- PHP's MySQL Extension
- PHP's `mysqli` Extension
- PHP Data Objects (PDO)

Each has its own advantages and disadvantages. The following discussion aims to give a brief introduction to the key aspects of each API.

What is PHP's MySQL Extension?

This is the original extension designed to allow you to develop PHP applications that interact with a MySQL database. The `mysql` extension provides a procedural interface and is intended for use only with MySQL versions older than 4.1.3. This extension can be used with versions of MySQL 4.1.3 or newer, but not all of the latest MySQL server features will be available.

Note

If you are using MySQL versions 4.1.3 or later it is *strongly* recommended that you use the `mysqli` extension instead.

The `mysql` extension source code is located in the PHP extension directory `ext/mysql`.

For further information on the `mysql` extension, see [Section 7.5, “Original MySQL API”](#).

What is PHP's mysqli Extension?

The `mysqli` extension, or as it is sometimes known, the MySQL *improved* extension, was developed to take advantage of new features found in MySQL systems versions 4.1.3 and newer. The `mysqli` extension is included with PHP versions 5 and later.

The `mysqli` extension has a number of benefits, the key enhancements over the `mysql` extension being:

- Object-oriented interface
- Support for Prepared Statements
- Support for Multiple Statements
- Support for Transactions
- Enhanced debugging capabilities
- Embedded server support

Note

If you are using MySQL versions 4.1.3 or later it is *strongly* recommended that you use this extension.

As well as the object-oriented interface the extension also provides a procedural interface.

The `mysqli` extension is built using the PHP extension framework, its source code is located in the directory `ext/mysqli`.

For further information on the `mysqli` extension, see [Section 7.3, “MySQL Improved Extension”](#).

What is PDO?

PHP Data Objects, or PDO, is a database abstraction layer specifically for PHP applications. PDO provides a consistent API for your PHP application regardless of the type of database server your application will connect to. In theory, if you are using the PDO API, you could switch the database server you used, from say Firebird to MySQL, and only need to make minor changes to your PHP code.

Other examples of database abstraction layers include JDBC for Java applications and DBI for Perl.

While PDO has its advantages, such as a clean, simple, portable API, its main disadvantage is that it doesn't allow you to use all of the advanced features that are available in the latest versions of MySQL server. For example, PDO does not allow you to use MySQL's support for Multiple Statements.

PDO is implemented using the PHP extension framework, its source code is located in the directory `ext/pdo`.

For further information on PDO, see the <http://www.php.net/book pdo>.

What is the PDO MYSQL driver?

The PDO MYSQL driver is not an API as such, at least from the PHP programmer's perspective. In fact the PDO MYSQL driver sits in the layer below PDO itself and provides MySQL-specific functionality. The programmer still calls the PDO API, but PDO uses the PDO MYSQL driver to carry out communication with the MySQL server.

The PDO MYSQL driver is one of several available PDO drivers. Other PDO drivers available include those for the Firebird and PostgreSQL database servers.

The PDO MYSQL driver is implemented using the PHP extension framework. Its source code is located in the directory [ext/pdo_mysql](#). It does not expose an API to the PHP programmer.

For further information on the PDO MYSQL driver, see [Section 7.4, “MySQL Functions \(PDO_MYSQL\)”](#).

What is PHP's MySQL Native Driver?

In order to communicate with the MySQL database server the `mysql` extension, `mysqli` and the PDO MYSQL driver each use a low-level library that implements the required protocol. In the past, the only available library was the MySQL Client Library, otherwise known as `libmysqlclient`.

However, the interface presented by `libmysqlclient` was not optimized for communication with PHP applications, as `libmysqlclient` was originally designed with C applications in mind. For this reason the MySQL Native Driver, `mysqlnd`, was developed as an alternative to `libmysqlclient` for PHP applications.

The `mysql` extension, the `mysqli` extension and the PDO MySQL driver can each be individually configured to use either `libmysqlclient` or `mysqlnd`. As `mysqlnd` is designed specifically to be utilised in the PHP system it has numerous memory and speed enhancements over `libmysqlclient`. You are strongly encouraged to take advantage of these improvements.

Note

The MySQL Native Driver can only be used with MySQL server versions 4.1.3 and later.

The MySQL Native Driver is implemented using the PHP extension framework. The source code is located in [ext/mysqlnd](#). It does not expose an API to the PHP programmer.

Comparison of Features

The following table compares the functionality of the three main methods of connecting to MySQL from PHP:

Table 7.1 Comparison of MySQL API options for PHP

	PHP's mysqli Extension	PDO (Using PDO MySQL Driver and MySQL Native Driver)	PHP's MySQL Extension
PHP version introduced	5.0	5.0	Prior to 3.0
Included with PHP 5.x	yes	yes	Yes
MySQL development status	Active development	Active development as of PHP 5.3	Maintenance only
Recommended by MySQL for new projects	Yes - preferred option	Yes	No
API supports Charsets	Yes	Yes	No
API supports server-side Prepared Statements	Yes	Yes	No
API supports client-side Prepared Statements	No	Yes	No
API supports Stored Procedures	Yes	Yes	No

	PHP's mysqli Extension	PDO (Using PDO MySQL Driver and MySQL Native Driver)	PHP's MySQL Extension
API supports Multiple Statements	Yes	Most	No
Supports all MySQL 4.1+ functionality	Yes	Most	No

7.3.2 Quick start guide

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This quick start guide will help with choosing and gaining familiarity with the PHP MySQL API.

This quick start gives an overview on the mysqli extension. Code examples are provided for all major aspects of the API. Database concepts are explained to the degree needed for presenting concepts specific to MySQL.

Required: A familiarity with the PHP programming language, the SQL language, and basic knowledge of the MySQL server.

7.3.2.1 Dual procedural and object-oriented interface

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The mysqli extension features a dual interface. It supports the procedural and object-oriented programming paradigm.

Users migrating from the old mysql extension may prefer the procedural interface. The procedural interface is similar to that of the old mysql extension. In many cases, the function names differ only by prefix. Some mysqli functions take a connection handle as their first argument, whereas matching functions in the old mysql interface take it as an optional last argument.

Example 7.10 Easy migration from the old mysql extension

```
<?php
$mysqli = mysqli_connect("example.com", "user", "password", "database");
$res = mysqli_query($mysqli, "SELECT 'Please, do not use ' AS _msg FROM DUAL");
$row = mysqli_fetch_assoc($res);
echo $row['_msg'];
$mysql = mysql_connect("example.com", "user", "password");
mysql_select_db("test");
$res = mysql_query("SELECT 'the mysql extension for new developments.' AS _msg FROM DUAL", $mysql);
$row = mysql_fetch_assoc($res);
echo $row['_msg'];
?>
```

The above example will output:

Please, do not use the mysql extension for new developments.

The object-oriented interface

In addition to the classical procedural interface, users can choose to use the object-oriented interface. The documentation is organized using the object-oriented interface. The object-oriented interface shows functions grouped by their purpose, making it easier to get started. The reference section gives examples for both syntax variants.

There are no significant performance differences between the two interfaces. Users can base their choice on personal preference.

Example 7.11 Object-oriented and procedural interface

```
<?php
$mysqli = mysqli_connect("example.com", "user", "password", "database");
if ($mysqli_connect_errno()) {
    echo "Failed to connect to MySQL: " . mysqli_connect_error();
}
$res = mysqli_query($mysqli, "SELECT 'A world full of ' AS _msg FROM DUAL");
$row = mysqli_fetch_assoc($res);
echo $row['_msg'];
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: " . $mysqli->connect_error;
}
$res = $mysqli->query("SELECT 'choices to please everybody.' AS _msg FROM DUAL");
$row = $res->fetch_assoc();
echo $row['_msg'];
?>
```

The above example will output:

```
A world full of choices to please everybody.
```

The object oriented interface is used for the quickstart because the reference section is organized that way.

Mixing styles

It is possible to switch between styles at any time. Mixing both styles is not recommended for code clarity and coding style reasons.

Example 7.12 Bad coding style

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: " . $mysqli->connect_error;
}
$res = mysqli_query($mysqli, "SELECT 'Possible but bad style.' AS _msg FROM DUAL");
if (!$res) {
    echo "Failed to run query: (" . $mysqli->errno . ") " . $mysqli->error;
}
if ($row = $res->fetch_assoc()) {
    echo $row['_msg'];
}
?>
```

The above example will output:

```
Possible but bad style.
```

See also

[mysqli::__construct](#)

```
mysqli::query
mysqli_result::fetch_assoc
$mysqli::connect_errno
$mysqli::connect_error
$mysqli::errno
$mysqli::error
The MySQLi Extension Function Summary
```

7.3.2.2 Connections

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The MySQL server supports the use of different transport layers for connections. Connections use TCP/IP, Unix domain sockets or Windows named pipes.

The hostname `localhost` has a special meaning. It is bound to the use of Unix domain sockets. It is not possible to open a TCP/IP connection using the hostname `localhost` you must use `127.0.0.1` instead.

Example 7.13 Special meaning of localhost

```
<?php
$mysqli = new mysqli("localhost", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
echo $mysqli->host_info . "\n";
$mysqli = new mysqli("127.0.0.1", "user", "password", "database", 3306);
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
echo $mysqli->host_info . "\n";
?>
```

The above example will output:

```
localhost via UNIX socket
127.0.0.1 via TCP/IP
```

Connection parameter defaults

Depending on the connection function used, assorted parameters can be omitted. If a parameter is not provided, then the extension attempts to use the default values that are set in the PHP configuration file.

Example 7.14 Setting defaults

```
mysqli.default_host=192.168.2.27
mysqli.default_user=root
mysqli.default_pw=""
mysqli.default_port=3306
mysqli.default_socket=/tmp/mysql.sock
```

The resulting parameter values are then passed to the client library that is used by the extension. If the client library detects empty or unset parameters, then it may default to the library built-in values.

Built-in connection library defaults

If the host value is unset or empty, then the client library will default to a Unix socket connection on `localhost`. If socket is unset or empty, and a Unix socket connection is requested, then a connection to the default socket on `/tmp/mysql.sock` is attempted.

On Windows systems, the host name `.` is interpreted by the client library as an attempt to open a Windows named pipe based connection. In this case the socket parameter is interpreted as the pipe name. If not given or empty, then the socket (pipe name) defaults to `\.\pipe\MySQL`.

If neither a Unix domain socket based nor a Windows named pipe based connection is to be established and the port parameter value is unset, the library will default to port `3306`.

The `mysqlnd` library and the MySQL Client Library (`libmysqlclient`) implement the same logic for determining defaults.

Connection options

Connection options are available to, for example, set init commands which are executed upon connect, or for requesting use of a certain charset. Connection options must be set before a network connection is established.

For setting a connection option, the connect operation has to be performed in three steps: creating a connection handle with `mysqli_init`, setting the requested options using `mysqli_options`, and establishing the network connection with `mysqli_real_connect`.

Connection pooling

The `mysqli` extension supports persistent database connections, which are a special kind of pooled connections. By default, every database connection opened by a script is either explicitly closed by the user during runtime or released automatically at the end of the script. A persistent connection is not. Instead it is put into a pool for later reuse, if a connection to the same server using the same username, password, socket, port and default database is opened. Reuse saves connection overhead.

Every PHP process is using its own `mysqli` connection pool. Depending on the web server deployment model, a PHP process may serve one or multiple requests. Therefore, a pooled connection may be used by one or more scripts subsequently.

Persistent connection

If a unused persistent connection for a given combination of host, username, password, socket, port and default database can not be found in the connection pool, then `mysqli` opens a new connection. The use of persistent connections can be enabled and disabled using the PHP directive `mysqli.allow_persistent`. The total number of connections opened by a script can be limited with `mysqli.max_links`. The maximum number of persistent connections per PHP process can be restricted with `mysqli.max_persistent`. Please note, that the web server may spawn many PHP processes.

A common complain about persistent connections is that their state is not reset before reuse. For example, open and unfinished transactions are not automatically rolled back. But also, authorization changes which happened in the time between putting the connection into the pool and reusing it are not reflected. This may be seen as an unwanted side-effect. On the contrary, the name `persistent` may be understood as a promise that the state is persisted.

The `mysqli` extension supports both interpretations of a persistent connection: state persisted, and state reset before reuse. The default is reset. Before a persistent connection is reused, the `mysqli` extension implicitly calls `mysqli_change_user` to reset the state. The persistent connection appears to the user as if it was just opened. No artifacts from previous usages are visible.

The `mysqli_change_user` function is an expensive operation. For best performance, users may want to recompile the extension with the compile flag `MYSQLI_NO_CHANGE_USER_ON_PCONNECT` being set.

It is left to the user to choose between safe behavior and best performance. Both are valid optimization goals. For ease of use, the safe behavior has been made the default at the expense of maximum performance.

See also

[mysqli::__construct](#)
[mysqli::init](#)
[mysqli::options](#)
[mysqli::real_connect](#)
[mysqli::change_user](#)
[\\$mysqli::host_info](#)
[MySQLi Configuration Options](#)
[Persistent Database Connections](#)

7.3.2.3 Executing statements

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Statements can be executed with the [mysqli_query](#), [mysqli_real_query](#) and [mysqli_multi_query](#) functions. The [mysqli_query](#) function is the most common, and combines the executing statement with a buffered fetch of its result set, if any, in one call. Calling [mysqli_query](#) is identical to calling [mysqli_real_query](#) followed by [mysqli_store_result](#).

Example 7.15 Connecting to MySQL

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT)") ||
    !$mysqli->query("INSERT INTO test(id) VALUES (1)")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
?>
```

Buffered result sets

After statement execution results can be retrieved at once to be buffered by the client or by read row by row. Client-side result set buffering allows the server to free resources associated with the statement results as early as possible. Generally speaking, clients are slow consuming result sets. Therefore, it is recommended to use buffered result sets. [mysqli_query](#) combines statement execution and result set buffering.

PHP applications can navigate freely through buffered results. Navigation is fast because the result sets are held in client memory. Please, keep in mind that it is often easier to scale by client than it is to scale the server.

Example 7.16 Navigation through buffered results

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT)") ||
    !$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
```

```

}
$res = $mysqli->query("SELECT id FROM test ORDER BY id ASC");
echo "Reverse order...\n";
for ($row_no = $res->num_rows - 1; $row_no >= 0; $row_no--) {
    $res->data_seek($row_no);
    $row = $res->fetch_assoc();
    echo " id = " . $row['id'] . "\n";
}
echo "Result set order...\n";
$res->data_seek(0);
while ($row = $res->fetch_assoc()) {
    echo " id = " . $row['id'] . "\n";
}
?>

```

The above example will output:

```

Reverse order...
id = 3
id = 2
id = 1
Result set order...
id = 1
id = 2
id = 3

```

Unbuffered result sets

If client memory is a short resource and freeing server resources as early as possible to keep server load low is not needed, unbuffered results can be used. Scrolling through unbuffered results is not possible before all rows have been read.

Example 7.17 Navigation through unbuffered results

```

<?php
$mysqli->real_query("SELECT id FROM test ORDER BY id ASC");
$res = $mysqli->use_result();
echo "Result set order...\n";
while ($row = $res->fetch_assoc()) {
    echo " id = " . $row['id'] . "\n";
}
?>

```

Result set values data types

The `mysqli_query`, `mysqli_real_query` and `mysqli_multi_query` functions are used to execute non-prepared statements. At the level of the MySQL Client Server Protocol, the command `COM_QUERY` and the text protocol are used for statement execution. With the text protocol, the MySQL server converts all data of a result sets into strings before sending. This conversion is done regardless of the SQL result set column data type. The mysql client libraries receive all column values as strings. No further client-side casting is done to convert columns back to their native types. Instead, all values are provided as PHP strings.

Example 7.18 Text protocol returns strings by default

```

<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}

```

```

}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT, label CHAR(1))") ||
    !$mysqli->query("INSERT INTO test(id, label) VALUES (1, 'a')")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
$res = $mysqli->query("SELECT id, label FROM test WHERE id = 1");
$row = $res->fetch_assoc();
printf("id = %s (%s)\n", $row['id'], gettype($row['id']));
printf("label = %s (%s)\n", $row['label'], gettype($row['label']));
?>

```

The above example will output:

```

id = 1 (string)
label = a (string)

```

It is possible to convert integer and float columns back to PHP numbers by setting the `MYSQLI_OPT_INT_AND_FLOAT_NATIVE` connection option, if using the `mysqlnd` library. If set, the `mysqlnd` library will check the result set meta data column types and convert numeric SQL columns to PHP numbers, if the PHP data type value range allows for it. This way, for example, SQL INT columns are returned as integers.

Example 7.19 Native data types with mysqlnd and connection option

```

<?php
$mysqli = mysqli_init();
$mysqli->options(MYSQLI_OPT_INT_AND_FLOAT_NATIVE, 1);
$mysqli->real_connect("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT, label CHAR(1))") ||
    !$mysqli->query("INSERT INTO test(id, label) VALUES (1, 'a')")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
$res = $mysqli->query("SELECT id, label FROM test WHERE id = 1");
$row = $res->fetch_assoc();
printf("id = %s (%s)\n", $row['id'], gettype($row['id']));
printf("label = %s (%s)\n", $row['label'], gettype($row['label']));
?>

```

The above example will output:

```

id = 1 (integer)
label = a (string)

```

See also

[mysqli::__construct](#)
[mysqli::init](#)
[mysqli::options](#)
[mysqli::real_connect](#)
[mysqli::query](#)
[mysqli::multi_query](#)
[mysqli::use_result](#)

```
mysqli::store_result
mysqli_result::free
```

7.3.2.4 Prepared Statements

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The MySQL database supports prepared statements. A prepared statement or a parameterized statement is used to execute the same statement repeatedly with high efficiency.

Basic workflow

The prepared statement execution consists of two stages: prepare and execute. At the prepare stage a statement template is sent to the database server. The server performs a syntax check and initializes server internal resources for later use.

The MySQL server supports using anonymous, positional placeholder with `?`.

Example 7.20 First stage: prepare

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
/* Non-prepared statement */
if (!$mysqli->query("DROP TABLE IF EXISTS test") || !$mysqli->query("CREATE TABLE test(id INT)")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
/* Prepared statement, stage 1: prepare */
if (!$stmt = $mysqli->prepare("INSERT INTO test(id) VALUES (?)")) {
    echo "Prepare failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
?>
```

Prepare is followed by execute. During execute the client binds parameter values and sends them to the server. The server creates a statement from the statement template and the bound values to execute it using the previously created internal resources.

Example 7.21 Second stage: bind and execute

```
<?php
/* Prepared statement, stage 2: bind and execute */
$id = 1;
if (!$stmt->bind_param("i", $id)) {
    echo "Binding parameters failed: (" . $stmt->errno . ") " . $stmt->error;
}
if (!$stmt->execute()) {
    echo "Execute failed: (" . $stmt->errno . ") " . $stmt->error;
}
?>
```

Repeated execution

A prepared statement can be executed repeatedly. Upon every execution the current value of the bound variable is evaluated and sent to the server. The statement is not parsed again. The statement template is not transferred to the server again.

Example 7.22 INSERT prepared once, executed multiple times

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
/* Non-prepared statement */
if (!$mysqli->query("DROP TABLE IF EXISTS test") || !$mysqli->query("CREATE TABLE test(id INT)")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
/* Prepared statement, stage 1: prepare */
if (!($stmt = $mysqli->prepare("INSERT INTO test(id) VALUES (?)")) ) {
    echo "Prepare failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
/* Prepared statement, stage 2: bind and execute */
$id = 1;
if (!$stmt->bind_param("i", $id)) {
    echo "Binding parameters failed: (" . $stmt->errno . ") " . $stmt->error;
}
if (!$stmt->execute()) {
    echo "Execute failed: (" . $stmt->errno . ") " . $stmt->error;
}
/* Prepared statement: repeated execution, only data transferred from client to server */
for ($id = 2; $id < 5; $id++) {
    if (!$stmt->execute()) {
        echo "Execute failed: (" . $stmt->errno . ") " . $stmt->error;
    }
}
/* explicit close recommended */
$stmt->close();
/* Non-prepared statement */
$res = $mysqli->query("SELECT id FROM test");
var_dump($res->fetch_all());
?>
```

The above example will output:

```
array(4) {
[0]=>
array(1) {
[0]=>
string(1) "1"
}
[1]=>
array(1) {
[0]=>
string(1) "2"
}
[2]=>
array(1) {
[0]=>
string(1) "3"
}
[3]=>
array(1) {
[0]=>
string(1) "4"
}
```

Every prepared statement occupies server resources. Statements should be closed explicitly immediately after use. If not done explicitly, the statement will be closed when the statement handle is freed by PHP.

Using a prepared statement is not always the most efficient way of executing a statement. A prepared statement executed only once causes more client-server round-trips than a non-prepared statement. This is why the `SELECT` is not run as a prepared statement above.

Also, consider the use of the MySQL multi-INSERT SQL syntax for INSERTs. For the example, multi-INSERT requires less round-trips between the server and client than the prepared statement shown above.

Example 7.23 Less round trips using multi-INSERT SQL

```
<?php
if (!mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3), (4)")) {
    echo "Multi-INSERT failed: (" . mysqli->errno . ") " . mysqli->error;
}
?>
```

Result set values data types

The MySQL Client Server Protocol defines a different data transfer protocol for prepared statements and non-prepared statements. Prepared statements are using the so called binary protocol. The MySQL server sends result set data "as is" in binary format. Results are not serialized into strings before sending. The client libraries do not receive strings only. Instead, they will receive binary data and try to convert the values into appropriate PHP data types. For example, results from an SQL `INT` column will be provided as PHP integer variables.

Example 7.24 Native datatypes

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT, label CHAR(1))") ||
    !$mysqli->query("INSERT INTO test(id, label) VALUES (1, 'a')")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
$stmt = $mysqli->prepare("SELECT id, label FROM test WHERE id = 1");
$stmt->execute();
$res = $stmt->get_result();
$row = $res->fetch_assoc();
printf("id = %s (%s)\n", $row['id'], gettype($row['id']));
printf("label = %s (%s)\n", $row['label'], gettype($row['label']));
?>
```

The above example will output:

```
id = 1 (integer)
label = a (string)
```

This behavior differs from non-prepared statements. By default, non-prepared statements return all results as strings. This default can be changed using a connection option. If the connection option is used, there are no differences.

Fetching results using bound variables

Results from prepared statements can either be retrieved by binding output variables, or by requesting a `mysqli_result` object.

Output variables must be bound after statement execution. One variable must be bound for every column of the statements result set.

Example 7.25 Output variable binding

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT, label CHAR(1))") ||
    !$mysqli->query("INSERT INTO test(id, label) VALUES (1, 'a')")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$stmt = $mysqli->prepare("SELECT id, label FROM test")) {
    echo "Prepare failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$stmt->execute()) {
    echo "Execute failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
$out_id     = NULL;
$out_label  = NULL;
if (!$stmt->bind_result($out_id, $out_label)) {
    echo "Binding output parameters failed: (" . $stmt->errno . ") " . $stmt->error;
}
while ($stmt->fetch()) {
    printf("id = %s (%s), label = %s (%s)\n", $out_id, gettype($out_id), $out_label, gettype($out_label));
}
?>
```

The above example will output:

```
id = 1 (integer), label = a (string)
```

Prepared statements return unbuffered result sets by default. The results of the statement are not implicitly fetched and transferred from the server to the client for client-side buffering. The result set takes server resources until all results have been fetched by the client. Thus it is recommended to consume results timely. If a client fails to fetch all results or the client closes the statement before having fetched all data, the data has to be fetched implicitly by [mysqli](#).

It is also possible to buffer the results of a prepared statement using [mysqli_stmt_store_result](#).

Fetching results using mysqli_result interface

Instead of using bound results, results can also be retrieved through the [mysqli_result](#) interface. [mysqli_stmt_get_result](#) returns a buffered result set.

Example 7.26 Using mysqli_result to fetch results

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT, label CHAR(1))") ||
    !$mysqli->query("INSERT INTO test(id, label) VALUES (1, 'a')")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$stmt = $mysqli->prepare("SELECT id, label FROM test ORDER BY id ASC")) {
    echo "Prepare failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$stmt->execute()) {
    echo "Execute failed: (" . $stmt->errno . ") " . $stmt->error;
}
```

```

if (!$res = $stmt->get_result()) {
    echo "Getting result set failed: (" . $stmt->errno . ") " . $stmt->error;
}
var_dump($res->fetch_all());
?>

```

The above example will output:

```

array(1) {
[0]=>
array(2) {
[0]=>
int(1)
[1]=>
string(1) "a"
}
}

```

Using the [mysqli_result interface](#) offers the additional benefit of flexible client-side result set navigation.

Example 7.27 Buffered result set for flexible read out

```

<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT, label CHAR(1))") ||
    !$mysqli->query("INSERT INTO test(id, label) VALUES (1, 'a'), (2, 'b'), (3, 'c')")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$stmt = $mysqli->prepare("SELECT id, label FROM test")) {
    echo "Prepare failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$stmt->execute()) {
    echo "Execute failed: (" . $stmt->errno . ") " . $stmt->error;
}
if (!$res = $stmt->get_result()) {
    echo "Getting result set failed: (" . $stmt->errno . ") " . $stmt->error;
}
for ($row_no = ($res->num_rows - 1); $row_no >= 0; $row_no--) {
    $res->data_seek($row_no);
    var_dump($res->fetch_assoc());
}
$res->close();
?>

```

The above example will output:

```

array(2) {
["id"]=>
int(3)
["label"]=>
string(1) "c"
}
array(2) {
["id"]=>
int(2)
["label"]=>
string(1) "b"
}

```

```

}
array(2) {
    ["id"]=>
    int(1)
    ["label"]=>
    string(1) "a"
}

```

Escaping and SQL injection

Bound variables are sent to the server separately from the query and thus cannot interfere with it. The server uses these values directly at the point of execution, after the statement template is parsed. Bound parameters do not need to be escaped as they are never substituted into the query string directly. A hint must be provided to the server for the type of bound variable, to create an appropriate conversion. See the [mysqli_stmt_bind_param](#) function for more information.

Such a separation sometimes considered as the only security feature to prevent SQL injection, but the same degree of security can be achieved with non-prepared statements, if all the values are formatted correctly. It should be noted that correct formatting is not the same as escaping and involves more logic than simple escaping. Thus, prepared statements are simply a more convenient and less error-prone approach to this element of database security.

Client-side prepared statement emulation

The API does not include emulation for client-side prepared statement emulation.

Quick prepared - non-prepared statement comparison

The table below compares server-side prepared and non-prepared statements.

Table 7.2 Comparison of prepared and non-prepared statements

	Prepared Statement	Non-prepared statement
Client-server round trips, SELECT, single execution	2	1
Statement string transferred from client to server	1	1
Client-server round trips, SELECT, repeated (n) execution	1 + n	n
Statement string transferred from client to server	1 template, n times bound parameter, if any	n times together with parameter, if any
Input parameter binding API	Yes, automatic input escaping	No, manual input escaping
Output variable binding API	Yes	No
Supports use of mysqli_result API	Yes, use mysqli_stmt_get_result	Yes
Buffered result sets	Yes, use mysqli_stmt_get_result or binding with mysqli_stmt_store_result	Yes, default of mysqli_query
Unbuffered result sets	Yes, use output binding API	Yes, use mysqli_real_query with mysqli_use_result
MySQL Client Server protocol data transfer flavor	Binary protocol	Text protocol
Result set values SQL data types	Preserved when fetching	Converted to string or preserved when fetching

	Prepared Statement	Non-prepared statement
Supports all SQL statements	Recent MySQL versions support most but not all	Yes

See also

```
mysqli::__construct
mysqli::query
mysqli::prepare
mysqli_stmt::prepare
mysqli_stmt::execute
mysqli_stmt::bind_param
mysqli_stmt::bind_result
```

7.3.2.5 Stored Procedures

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The MySQL database supports stored procedures. A stored procedure is a subroutine stored in the database catalog. Applications can call and execute the stored procedure. The `CALL` SQL statement is used to execute a stored procedure.

Parameter

Stored procedures can have `IN`, `INOUT` and `OUT` parameters, depending on the MySQL version. The `mysqli` interface has no special notion for the different kinds of parameters.

IN parameter

Input parameters are provided with the `CALL` statement. Please, make sure values are escaped correctly.

Example 7.28 Calling a stored procedure

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") || !$mysqli->query("CREATE TABLE test(id INT)")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$mysqli->query("DROP PROCEDURE IF EXISTS p") ||
    !$mysqli->query("CREATE PROCEDURE p(IN id_val INT) BEGIN INSERT INTO test(id) VALUES(id_val); END;")) {
    echo "Stored procedure creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$mysqli->query("CALL p(1)")) {
    echo "CALL failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$res = $mysqli->query("SELECT id FROM test")) {
    echo "SELECT failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
var_dump($res->fetch_assoc());
?>
```

The above example will output:

```
array(1) {
    ["id"]=>
    string(1) "1"
}
```

INOUT/OUT parameter

The values of [INOUT/OUT](#) parameters are accessed using session variables.

Example 7.29 Using session variables

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP PROCEDURE IF EXISTS p") ||
    !$mysqli->query('CREATE PROCEDURE p(OUT msg VARCHAR(50)) BEGIN SELECT "Hi!" INTO msg; END;')) {
    echo "Stored procedure creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$mysqli->query("SET @msg = ''") || !$mysqli->query("CALL p(@msg)")) {
    echo "CALL failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$res = $mysqli->query("SELECT @msg as _p_out")) {
    echo "Fetch failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
$row = $res->fetch_assoc();
echo $row['_p_out'];
?>
```

The above example will output:

```
Hi!
```

Application and framework developers may be able to provide a more convenient API using a mix of session variables and databased catalog inspection. However, please note the possible performance impact of a custom solution based on catalog inspection.

Handling result sets

Stored procedures can return result sets. Result sets returned from a stored procedure cannot be fetched correctly using [mysqli_query](#). The [mysqli_query](#) function combines statement execution and fetching the first result set into a buffered result set, if any. However, there are additional stored procedure result sets hidden from the user which cause [mysqli_query](#) to fail returning the user expected result sets.

Result sets returned from a stored procedure are fetched using [mysqli_real_query](#) or [mysqli_multi_query](#). Both functions allow fetching any number of result sets returned by a statement, such as [CALL](#). Failing to fetch all result sets returned by a stored procedure causes an error.

Example 7.30 Fetching results from stored procedures

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT)") ||
    !$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
```

```

}
if (!$mysqli->query("DROP PROCEDURE IF EXISTS p") ||
    !$mysqli->query('CREATE PROCEDURE p() READS SQL DATA BEGIN SELECT id FROM test; SELECT id + 1 FROM
    echo "Stored procedure creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$mysqli->multi_query("CALL p()")) {
    echo "CALL failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
do {
    if ($res = $mysqli->store_result()) {
        printf("---\n");
        var_dump($res->fetch_all());
        $res->free();
    } else {
        if ($mysqli->errno) {
            echo "Store failed: (" . $mysqli->errno . ") " . $mysqli->error;
        }
    }
} while ($mysqli->more_results() && $mysqli->next_result());
?>

```

The above example will output:

```

---
array(3) {
[0]=>
array(1) {
[0]=>
string(1) "1"
}
[1]=>
array(1) {
[0]=>
string(1) "2"
}
[2]=>
array(1) {
[0]=>
string(1) "3"
}
}
---
array(3) {
[0]=>
array(1) {
[0]=>
string(1) "2"
}
[1]=>
array(1) {
[0]=>
string(1) "3"
}
[2]=>
array(1) {
[0]=>
string(1) "4"
}
}

```

Use of prepared statements

No special handling is required when using the prepared statement interface for fetching results from the same stored procedure as above. The prepared statement and non-prepared statement interfaces are similar. Please note, that not every MYSQL server version may support preparing the `CALL` SQL statement.

Example 7.31 Stored Procedures and Prepared Statements

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT)") ||
    !$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)")) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$mysqli->query("DROP PROCEDURE IF EXISTS p") ||
    !$mysqli->query('CREATE PROCEDURE p() READS SQL DATA BEGIN SELECT id FROM test; SELECT id + 1 FROM test'));
    echo "Stored procedure creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!($stmt = $mysqli->prepare("CALL p()")))) {
    echo "Prepare failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$stmt->execute()) {
    echo "Execute failed: (" . $stmt->errno . ") " . $stmt->error;
}
do {
    if ($res = $stmt->get_result()) {
        printf("---\n");
        var_dump(mysqli_fetch_all($res));
        mysqli_free_result($res);
    } else {
        if ($stmt->errno) {
            echo "Store failed: (" . $stmt->errno . ") " . $stmt->error;
        }
    }
} while ($stmt->more_results() && $stmt->next_result());
?>
```

Of course, use of the bind API for fetching is supported as well.

Example 7.32 Stored Procedures and Prepared Statements using bind API

```
<?php
if (!($stmt = $mysqli->prepare("CALL p()")))) {
    echo "Prepare failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
if (!$stmt->execute()) {
    echo "Execute failed: (" . $stmt->errno . ") " . $stmt->error;
}
do {
    $id_out = NULL;
    if (!$stmt->bind_result($id_out)) {
        echo "Bind failed: (" . $stmt->errno . ") " . $stmt->error;
    }

    while ($stmt->fetch()) {
        echo "id = $id_out\n";
    }
} while ($stmt->more_results() && $stmt->next_result());
?>
```

See also

[mysqli::query](#)
[mysqli::multi_query](#)
[mysqli_result::next_result](#)
[mysqli_result::more_results](#)

7.3.2.6 Multiple Statements

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MySQL optionally allows having multiple statements in one statement string. Sending multiple statements at once reduces client-server round trips but requires special handling.

Multiple statements or multi queries must be executed with [mysqli_multi_query](#). The individual statements of the statement string are separated by semicolon. Then, all result sets returned by the executed statements must be fetched.

The MySQL server allows having statements that do return result sets and statements that do not return result sets in one multiple statement.

Example 7.33 Multiple Statements

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
if (!$mysqli->query("DROP TABLE IF EXISTS test") || !$mysqli->query("CREATE TABLE test(id INT)") ) {
    echo "Table creation failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
$sql = "SELECT COUNT(*) AS _num FROM test; ";
$sql.= "INSERT INTO test(id) VALUES (1); ";
$sql.= "SELECT COUNT(*) AS _num FROM test; ";
if (!$mysqli->multi_query($sql)) {
    echo "Multi query failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
do {
    if ($res = $mysqli->store_result()) {
        var_dump($res->fetch_all(MYSQLI_ASSOC));
        $res->free();
    }
} while ($mysqli->more_results() && $mysqli->next_result());
?>
```

The above example will output:

```
array(1) {
[0]=>
array(1) {
["_num"]=>
string(1) "0"
}
array(1) {
[0]=>
array(1) {
["_num"]=>
string(1) "1"
}
}
```

Security considerations

The API functions [mysqli_query](#) and [mysqli_real_query](#) do not set a connection flag necessary for activating multi queries in the server. An extra API call is used for multiple statements to reduce the likeliness of accidental SQL injection attacks. An attacker may try to add statements such as ; [DROP DATABASE mysql](#) or ; [SELECT SLEEP\(999\)](#). If the attacker succeeds in adding SQL to

the statement string but `mysqli_multi_query` is not used, the server will not execute the second, injected and malicious SQL statement.

Example 7.34 SQL Injection

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
$res   = $mysqli->query("SELECT 1; DROP TABLE mysql.user");
if (!$res) {
    echo "Error executing query: (" . $mysqli->errno . ") " . $mysqli->error;
}
?>
```

The above example will output:

```
Error executing query: (1064) You have an error in your SQL syntax;
check the manual that corresponds to your MySQL server version for the right syntax
to use near 'DROP TABLE mysql.user' at line 1
```

Prepared statements

Use of the multiple statement with prepared statements is not supported.

See also

`mysqli::query`
`mysqli::multi_query`
`mysqli_result::next_result`
`mysqli_result::more_results`

7.3.2.7 API support for transactions

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The MySQL server supports transactions depending on the storage engine used. Since MySQL 5.5, the default storage engine is InnoDB. InnoDB has full ACID transaction support.

Transactions can either be controlled using SQL or API calls. It is recommended to use API calls for enabling and disabling the auto commit mode and for committing and rolling back transactions.

Example 7.35 Setting auto commit mode with SQL and through the API

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
/* Recommended: using API to control transactional settings */
$mysqli->autocommit(false);
/* Won't be monitored and recognized by the replication and the load balancing plugin */
if (!$mysqli->query('SET AUTOCOMMIT = 0')) {
    echo "Query failed: (" . $mysqli->errno . ") " . $mysqli->error;
}
?>
```

Optional feature packages, such as the replication and load balancing plugin, can easily monitor API calls. The replication plugin offers transaction aware load balancing, if transactions are controlled with API calls. Transaction aware load balancing is not available if SQL statements are used for setting auto commit mode, committing or rolling back a transaction.

Example 7.36 Commit and rollback

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
$mysqli->autocommit(false);
$mysqli->query("INSERT INTO test(id) VALUES (1)");
$mysqli->rollback();
$mysqli->query("INSERT INTO test(id) VALUES (2)");
$mysqli->commit();
?>
```

Please note, that the MySQL server cannot roll back all statements. Some statements cause an implicit commit.

See also

[mysqli::autocommit](#)
[mysqli_result::commit](#)
[mysqli_result::rollback](#)

7.3.2.8 Metadata

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A MySQL result set contains metadata. The metadata describes the columns found in the result set. All metadata sent by MySQL is accessible through the [mysqli](#) interface. The extension performs no or negligible changes to the information it receives. Differences between MySQL server versions are not aligned.

Meta data is access through the [mysqli_result](#) interface.

Example 7.37 Accessing result set meta data

```
<?php
$mysqli = new mysqli("example.com", "user", "password", "database");
if ($mysqli->connect_errno) {
    echo "Failed to connect to MySQL: (" . $mysqli->connect_errno . ") " . $mysqli->connect_error;
}
$res = $mysqli->query("SELECT 1 AS _one, 'Hello' AS _two FROM DUAL");
var_dump($res->fetch_fields());
?>
```

The above example will output:

```
array(2) {
[0]=>
object(stdClass)#3 (13) {
    ["name"]=>
    string(4) "_one"
    ["orgname"]=>
    string(0) ""
    ["table"]=>
    string(0) ""
    ["orgtable"]=>
    string(0) ""
    ["def"]=>
    string(0) ""
    ["db"]=>
    string(0) ""
    ["catalog"]=>
    string(3) "def"
    ["max_length"]=>
```

```

    int(1)
    [ "length" ]=>
    int(1)
    [ "charsetnr" ]=>
    int(63)
    [ "flags" ]=>
    int(32897)
    [ "type" ]=>
    int(8)
    [ "decimals" ]=>
    int(0)
}
[1]=>
object(stdClass)#4 (13) {
    [ "name" ]=>
    string(4) "_two"
    [ "orgname" ]=>
    string(0) ""
    [ "table" ]=>
    string(0) ""
    [ "orgtable" ]=>
    string(0) ""
    [ "def" ]=>
    string(0) ""
    [ "db" ]=>
    string(0) ""
    [ "catalog" ]=>
    string(3) "def"
    [ "max_length" ]=>
    int(5)
    [ "length" ]=>
    int(5)
    [ "charsetnr" ]=>
    int(8)
    [ "flags" ]=>
    int(1)
    [ "type" ]=>
    int(253)
    [ "decimals" ]=>
    int(31)
}
}

```

Prepared statements

Meta data of result sets created using prepared statements are accessed the same way. A suitable `mysqli_result` handle is returned by `mysqli_stmt_result_metadata`.

Example 7.38 Prepared statements metadata

```

<?php
$stmt = $mysqli->prepare("SELECT 1 AS _one, 'Hello' AS _two FROM DUAL");
$stmt->execute();
$res = $stmt->result_metadata();
var_dump($res->fetch_fields());
?>

```

See also

`mysqli::query`
`mysqli_result::fetch_fields`

7.3.3 Installing/Configuring

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7.3.3.1 Requirements

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In order to have these functions available, you must compile PHP with support for the mysqli extension.

MySQL 8

When running a PHP version before 7.1.16, or PHP 7.2 before 7.2.4, set MySQL 8 Server's default password plugin to `mysql_native_password` or else you will see errors similar to *The server requested authentication method unknown to the client [caching_sha2_password]* even when `caching_sha2_password` is not used.

This is because MySQL 8 defaults to `caching_sha2_password`, a plugin that is not recognized by the older PHP (`mysqlnd`) releases. Instead, change it by setting `default_authentication_plugin=mysql_native_password` in `my.cnf`. The `caching_sha2_password` plugin will be supported in a future PHP release. In the meantime, the `mysql_xdevapi` extension does support it.

7.3.3.2 Installation

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The `mysqli` extension was introduced with PHP version 5.0.0. The MySQL Native Driver was included in PHP version 5.3.0.

Installation on Linux

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The common Unix distributions include binary versions of PHP that can be installed. Although these binary versions are typically built with support for the MySQL extensions, the extension libraries themselves may need to be installed using an additional package. Check the package manager that comes with your chosen distribution for availability.

For example, on Ubuntu the `php5-mysql` package installs the `ext/mysql`, `ext/mysqli`, and `pdo_mysql` PHP extensions. On CentOS, the `php-mysql` package also installs these three PHP extensions.

Alternatively, you can compile this extension yourself. Building PHP from source allows you to specify the MySQL extensions you want to use, as well as your choice of client library for each extension.

The MySQL Native Driver is the recommended client library option, as it results in improved performance and gives access to features not available when using the MySQL Client Library. Refer to [What is PHP's MySQL Native Driver?](#) for a brief overview of the advantages of MySQL Native Driver.

The `/path/to/mysql_config` represents the location of the `mysql_config` program that comes with MySQL Server.

Table 7.3 mysqli compile time support matrix

PHP Version	Default	Configure Options: <code>mysqlnd</code>	Configure Options: <code>libmysqlclient</code>	Changelog
5.4.x and above	<code>mysqlnd</code>	<code>--with-mysqli</code>	<code>--with-mysqli=/path/to/mysql_config</code>	<code>mysqlnd</code> is the default
5.3.x	<code>libmysqlclient</code>	<code>--with-mysqli=mysqlnd</code>	<code>--with-mysqli=/</code>	<code>mysqlnd</code> is supported

PHP Version	Default	Configure Options: <code>mysqlnd</code>	Configure Options: <code>libmysqlclient</code>	Changelog
			<code>path/to/mysql_config</code>	
5.0.x, 5.1.x, 5.2.x	<code>libmysqlclient</code>	Not Available	<code>--with-mysqli=/path/to/mysql_config</code>	<code>mysqlnd</code> is not supported

Note that it is possible to freely mix MySQL extensions and client libraries. For example, it is possible to enable the MySQL extension to use the MySQL Client Library (`libmysqlclient`), while configuring the `mysqli` extension to use the MySQL Native Driver. However, all permutations of extension and client library are possible.

Installation on Windows Systems

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On Windows, PHP is most commonly installed using the binary installer.

PHP 5.3.0 and newer

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On Windows, for PHP versions 5.3 and newer, the `mysqli` extension is enabled and uses the MySQL Native Driver by default. This means you don't need to worry about configuring access to `libmysql.dll`.

PHP 5.0, 5.1, 5.2

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On these old unsupported PHP versions (PHP 5.2 reached EOL on '6 Jan 2011'), additional configuration procedures are required to enable `mysqli` and specify the client library you want it to use.

The `mysqli` extension is not enabled by default, so the `php_mysqli.dll` DLL must be enabled inside of `php.ini`. In order to do this you need to find the `php.ini` file (typically located in `c:\php`), and make sure you remove the comment (semi-colon) from the start of the line `extension=php_mysqli.dll`, in the section marked `[PHP_MYSQLI]`.

Also, if you want to use the MySQL Client Library with `mysqli`, you need to make sure PHP can access the client library file. The MySQL Client Library is included as a file named `libmysql.dll` in the Windows PHP distribution. This file needs to be available in the Windows system's `PATH` environment variable, so that it can be successfully loaded. See the FAQ titled "[How do I add my PHP directory to the PATH on Windows](#)" for information on how to do this. Copying `libmysql.dll` to the Windows system directory (typically `c:\Windows\system`) also works, as the system directory is by default in the system's `PATH`. However, this practice is strongly discouraged.

As with enabling any PHP extension (such as `php_mysqli.dll`), the PHP directive `extension_dir` should be set to the directory where the PHP extensions are located. See also the [Manual Windows Installation Instructions](#). An example `extension_dir` value for PHP 5 is `c:\php\ext`.

Note

If when starting the web server an error similar to the following occurs: "`Unable to load dynamic library './php_mysqli.dll'`", this is because `php_mysqli.dll` and/or `libmysql.dll` cannot be found by the system.

7.3.3.3 Runtime Configuration

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The behaviour of these functions is affected by settings in [php.ini](#).

Table 7.4 MySQLi Configuration Options

Name	Default	Changeable	Changelog
<code>mysqli.allow_local_infile</code>	"0"	PHP_INI_SYSTEM	Available as of PHP 5.2.4. Before PHP 7.2.16 and 7.3.3 the default was "1".
<code>mysqli.allow_persistent</code>	"1"	PHP_INI_SYSTEM	Available as of PHP 5.3.0.
<code>mysqli.max_persistent</code>	"-1"	PHP_INI_SYSTEM	Available as of PHP 5.3.0.
<code>mysqli.max_links</code>	"-1"	PHP_INI_SYSTEM	
<code>mysqli.default_port</code>	"3306"	PHP_INI_ALL	
<code>mysqli.default_socket</code>	NULL	PHP_INI_ALL	
<code>mysqli.default_host</code>	NULL	PHP_INI_ALL	
<code>mysqli.default_user</code>	NULL	PHP_INI_ALL	
<code>mysqli.default_pw</code>	NULL	PHP_INI_ALL	
<code>mysqli.reconnect</code>	"0"	PHP_INI_SYSTEM	
<code>mysqli.rollback_on_cached_result</code>	TRUE	PHP_INI_SYSTEM	Available as of PHP 5.6.0.

For further details and definitions of the preceding PHP_INI_* constants, see the chapter on [configuration changes](#).

Here's a short explanation of the configuration directives.

<code>mysqli.allow_local_infile</code> integer	Allow accessing, from PHP's perspective, local files with LOAD DATA statements
<code>mysqli.allow_persistent</code> integer	Enable the ability to create persistent connections using <code>mysqli_connect</code> .
<code>mysqli.max_persistent</code> integer	Maximum of persistent connections that can be made. Set to 0 for unlimited.
<code>mysqli.max_links</code> integer	The maximum number of MySQL connections per process.
<code>mysqli.default_port</code> integer	The default TCP port number to use when connecting to the database server if no other port is specified. If no default is specified, the port will be obtained from the <code>MYSQL_TCP_PORT</code> environment variable, the <code>mysql-tcp</code> entry in <code>/etc/services</code> or the compile-time <code>MYSQL_PORT</code> constant, in that order. Win32 will only use the <code>MYSQL_PORT</code> constant.
<code>mysqli.default_socket</code> string	The default socket name to use when connecting to a local database server if no other socket name is specified.
<code>mysqli.default_host</code> string	The default server host to use when connecting to the database server if no other host is specified. Doesn't apply in safe mode .
<code>mysqli.default_user</code> string	The default user name to use when connecting to the database server if no other name is specified. Doesn't apply in safe mode .

`mysqli.default_pw` string The default password to use when connecting to the database server if no other password is specified. Doesn't apply in [safe mode](#).

`mysqli.reconnect` integer Automatically reconnect if the connection was lost.

Note

This [php.ini](#) setting is ignored by the mysqlnd driver.

`mysqli.rollback_on_cached_persistent` If this option is enabled, closing a persistent connection will rollback any pending transactions of this connection before it is put back into the persistent connection pool. Otherwise, pending transactions will be rolled back only when the connection is reused, or when it is actually closed.

Users cannot set `MYSQL_OPT_READ_TIMEOUT` through an API call or runtime configuration setting. Note that if it were possible there would be differences between how `libmysqlclient` and streams would interpret the value of `MYSQL_OPT_READ_TIMEOUT`.

7.3.3.4 Resource Types

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This extension has no resource types defined.

7.3.4 The mysqli Extension and Persistent Connections

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Persistent connection support was introduced in PHP 5.3 for the `mysqli` extension. Support was already present in PDO MySQL and ext/mysql. The idea behind persistent connections is that a connection between a client process and a database can be reused by a client process, rather than being created and destroyed multiple times. This reduces the overhead of creating fresh connections every time one is required, as unused connections are cached and ready to be reused.

Unlike the `mysql` extension, `mysqli` does not provide a separate function for opening persistent connections. To open a persistent connection you must prepend `p:` to the hostname when connecting.

The problem with persistent connections is that they can be left in unpredictable states by clients. For example, a table lock might be activated before a client terminates unexpectedly. A new client process reusing this persistent connection will get the connection "as is". Any cleanup would need to be done by the new client process before it could make good use of the persistent connection, increasing the burden on the programmer.

The persistent connection of the `mysqli` extension however provides built-in cleanup handling code. The cleanup carried out by `mysqli` includes:

- Rollback active transactions
- Close and drop temporary tables
- Unlock tables
- Reset session variables
- Close prepared statements (always happens with PHP)
- Close handler
- Release locks acquired with `GET_LOCK`

This ensures that persistent connections are in a clean state on return from the connection pool, before the client process uses them.

The `mysqli` extension does this cleanup by automatically calling the C-API function `mysql_change_user()`.

The automatic cleanup feature has advantages and disadvantages though. The advantage is that the programmer no longer needs to worry about adding cleanup code, as it is called automatically. However, the disadvantage is that the code could *potentially* be a little slower, as the code to perform the cleanup needs to run each time a connection is returned from the connection pool.

It is possible to switch off the automatic cleanup code, by compiling PHP with `MYSQLI_NO_CHANGE_USER_ON_PCONNECT` defined.

Note

The `mysqli` extension supports persistent connections when using either MySQL Native Driver or MySQL Client Library.

7.3.5 Predefined Constants

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The constants below are defined by this extension, and will only be available when the extension has either been compiled into PHP or dynamically loaded at runtime.

<code>MYSQLI_READ_DEFAULT_GROUP</code>	Read options from the named group from <code>my.cnf</code> or the file specified with <code>MYSQLI_READ_DEFAULT_FILE</code>
<code>MYSQLI_READ_DEFAULT_FILE</code>	Read options from the named option file instead of from <code>my.cnf</code>
<code>MYSQLI_OPT_CONNECT_TIMEOUT</code>	Connect timeout in seconds
<code>MYSQLI_OPT_LOCAL_INFILE</code>	Enables command <code>LOAD LOCAL INFILE</code>
<code>MYSQLI_INIT_COMMAND</code>	Command to execute when connecting to MySQL server. Will automatically be re-executed when reconnecting.
<code>MYSQLI_CLIENT_SSL</code>	Use SSL (encrypted protocol). This option should not be set by application programs; it is set internally in the MySQL client library
<code>MYSQLI_CLIENT_COMPRESS</code>	Use compression protocol
<code>MYSQLI_CLIENT_INTERACTIVE</code>	Allow <code>interactive_timeout</code> seconds (instead of <code>wait_timeout</code> seconds) of inactivity before closing the connection. The client's session <code>wait_timeout</code> variable will be set to the value of the session <code>interactive_timeout</code> variable.
<code>MYSQLI_CLIENT_IGNORE_SPACE</code>	Allow spaces after function names. Makes all functions names reserved words.
<code>MYSQLI_CLIENT_NO_SCHEMA</code>	Don't allow the <code>db_name.tbl_name.col_name</code> syntax.
<code>MYSQLI_CLIENT_MULTI_QUERY</code>	Allows multiple semicolon-delimited queries in a single <code>mysqli_query</code> call.
<code>MYSQLI_STORE_RESULT</code>	For using buffered resultsets
<code>MYSQLI_USE_RESULT</code>	For using unbuffered resultsets
<code>MYSQLI_ASSOC</code>	Columns are returned into the array having the fieldname as the array index.

<code>MYSQLI_NUM</code>	Columns are returned into the array having an enumerated index.
<code>MYSQLI_BOTH</code>	Columns are returned into the array having both a numerical index and the fieldname as the associative index.
<code>MYSQLI_NOT_NULL_FLAG</code>	Indicates that a field is defined as <code>NOT NULL</code>
<code>MYSQLI_PRI_KEY_FLAG</code>	Field is part of a primary index
<code>MYSQLI_UNIQUE_KEY_FLAG</code>	Field is part of a unique index.
<code>MYSQLI_MULTIPLE_KEY_FLAG</code>	Field is part of an index.
<code>MYSQLI_BLOB_FLAG</code>	Field is defined as <code>BLOB</code>
<code>MYSQLI_UNSIGNED_FLAG</code>	Field is defined as <code>UNSIGNED</code>
<code>MYSQLI_ZEROFILL_FLAG</code>	Field is defined as <code>ZEROFILL</code>
<code>MYSQLI_AUTO_INCREMENT_FLAG</code>	Field is defined as <code>AUTO_INCREMENT</code>
<code>MYSQLI_TIMESTAMP_FLAG</code>	Field is defined as <code>TIMESTAMP</code>
<code>MYSQLI_SET_FLAG</code>	Field is defined as <code>SET</code>
<code>MYSQLI_NUM_FLAG</code>	Field is defined as <code>NUMERIC</code>
<code>MYSQLI_PART_KEY_FLAG</code>	Field is part of an multi-index
<code>MYSQLI_GROUP_FLAG</code>	Field is part of <code>GROUP BY</code>
<code>MYSQLI_TYPE_DECIMAL</code>	Field is defined as <code>DECIMAL</code>
<code>MYSQLI_TYPE_NEWDECIMAL</code>	Precision math <code>DECIMAL</code> or <code>NUMERIC</code> field (MySQL 5.0.3 and up)
<code>MYSQLI_TYPE_BIT</code>	Field is defined as <code>BIT</code> (MySQL 5.0.3 and up)
<code>MYSQLI_TYPE_TINY</code>	Field is defined as <code>TINYINT</code>
<code>MYSQLI_TYPE_SHORT</code>	Field is defined as <code>SMALLINT</code>
<code>MYSQLI_TYPE_LONG</code>	Field is defined as <code>INT</code>
<code>MYSQLI_TYPE_FLOAT</code>	Field is defined as <code>FLOAT</code>
<code>MYSQLI_TYPE_DOUBLE</code>	Field is defined as <code>DOUBLE</code>
<code>MYSQLI_TYPE_NULL</code>	Field is defined as <code>DEFAULT NULL</code>
<code>MYSQLI_TYPE_TIMESTAMP</code>	Field is defined as <code>TIMESTAMP</code>
<code>MYSQLI_TYPE_LONGLONG</code>	Field is defined as <code>BIGINT</code>
<code>MYSQLI_TYPE_INT24</code>	Field is defined as <code>MEDIUMINT</code>
<code>MYSQLI_TYPE_DATE</code>	Field is defined as <code>DATE</code>
<code>MYSQLI_TYPE_TIME</code>	Field is defined as <code>TIME</code>
<code>MYSQLI_TYPE_DATETIME</code>	Field is defined as <code>DATETIME</code>
<code>MYSQLI_TYPE_YEAR</code>	Field is defined as <code>YEAR</code>
<code>MYSQLI_TYPE_NEWDATE</code>	Field is defined as <code>DATE</code>

<code>MYSQLI_TYPE_INTERVAL</code>	Field is defined as <code>INTERVAL</code>
<code>MYSQLI_TYPE_ENUM</code>	Field is defined as <code>ENUM</code>
<code>MYSQLI_TYPE_SET</code>	Field is defined as <code>SET</code>
<code>MYSQLI_TYPE_TINY_BLOB</code>	Field is defined as <code>TINYBLOB</code>
<code>MYSQLI_TYPE_MEDIUM_BLOB</code>	Field is defined as <code>MEDIUMBLOB</code>
<code>MYSQLI_TYPE_LONG_BLOB</code>	Field is defined as <code>LONGBLOB</code>
<code>MYSQLI_TYPE_BLOB</code>	Field is defined as <code>BLOB</code>
<code>MYSQLI_TYPE_VAR_STRING</code>	Field is defined as <code>VARCHAR</code>
<code>MYSQLI_TYPE_STRING</code>	Field is defined as <code>CHAR</code> or <code>BINARY</code>
<code>MYSQLI_TYPE_CHAR</code>	Field is defined as <code>TINYINT</code> . For <code>CHAR</code> , see <code>MYSQLI_TYPE_STRING</code>
<code>MYSQLI_TYPE_GEOMETRY</code>	Field is defined as <code>GEOMETRY</code>
<code>MYSQLI_NEED_DATA</code>	More data available for bind variable
<code>MYSQLI_NO_DATA</code>	No more data available for bind variable
<code>MYSQLI_DATA_TRUNCATED</code>	Data truncation occurred. Available since PHP 5.1.0 and MySQL 5.0.5.
<code>MYSQLI_ENUM_FLAG</code>	Field is defined as <code>ENUM</code> . Available since PHP 5.3.0.
<code>MYSQLI_BINARY_FLAG</code>	Field is defined as <code>BINARY</code> . Available since PHP 5.3.0.
<code>MYSQLI_CURSOR_TYPE_FOR_UPDATE</code>	
<code>MYSQLI_CURSOR_TYPE_NO_CURSOR</code>	
<code>MYSQLI_CURSOR_TYPE_READ_ONLY</code>	
<code>MYSQLI_CURSOR_TYPE_SCROLLABLE</code>	
<code>MYSQLI_STMT_ATTR_CURSOR_TYPE</code>	
<code>MYSQLI_STMT_ATTR_PREFETCH_ROWS</code>	
<code>MYSQLI_STMT_ATTR_UPDATE_MAX_LENGTH</code>	
<code>MYSQLI_SET_CHARSET_NAME</code>	
<code>MYSQLI_REPORT_INDEX</code>	Report if no index or bad index was used in a query.
<code>MYSQLI_REPORT_ERROR</code>	Report errors from <code>mysqli</code> function calls.
<code>MYSQLI_REPORT_STRICT</code>	Throw a <code>mysqli_sql_exception</code> for errors instead of warnings.
<code>MYSQLI_REPORT_ALL</code>	Set all options on (report all).
<code>MYSQLI_REPORT_OFF</code>	Turns reporting off.
<code>MYSQLI_DEBUG_TRACE_ENABLED</code>	Is set to 1 if <code>mysqli_debug</code> functionality is enabled.
<code>MYSQLI_SERVER_QUERY_NO_GOOD_INDEX_USED</code>	
<code>MYSQLI_SERVER_QUERY_NO_INDEX_USED</code>	

<code>MYSQLI_REFRESH_GRANT</code>	Refreshes the grant tables.
<code>MYSQLI_REFRESH_LOG</code>	Flushes the logs, like executing the <code>FLUSH LOGS</code> SQL statement.
<code>MYSQLI_REFRESH_TABLES</code>	Flushes the table cache, like executing the <code>FLUSH TABLES</code> SQL statement.
<code>MYSQLI_REFRESH_HOSTS</code>	Flushes the host cache, like executing the <code>FLUSH HOSTS</code> SQL statement.
<code>MYSQLI_REFRESH_STATUS</code>	Reset the status variables, like executing the <code>FLUSH STATUS</code> SQL statement.
<code>MYSQLI_REFRESH_THREADS</code>	Flushes the thread cache.
<code>MYSQLI_REFRESH_SLAVE</code>	On a slave replication server: resets the master server information, and restarts the slave. Like executing the <code>RESET SLAVE</code> SQL statement.
<code>MYSQLI_REFRESH_MASTER</code>	On a master replication server: removes the binary log files listed in the binary log index, and truncates the index file. Like executing the <code>RESET MASTER</code> SQL statement.
<code>MYSQLI_TRANS_COR_AND_CHAIN</code>	Appends "AND CHAIN" to <code>mysqli_commit</code> or <code>mysqli_rollback</code> .
<code>MYSQLI_TRANS_COR_AND_NO_CHAIN</code>	Appends "AND NO CHAIN" to <code>mysqli_commit</code> or <code>mysqli_rollback</code> .
<code>MYSQLI_TRANS_COR_RELEASE</code>	Appends "RELEASE" to <code>mysqli_commit</code> or <code>mysqli_rollback</code> .
<code>MYSQLI_TRANS_COR_NO_RELEASE</code>	Appends "NO RELEASE" to <code>mysqli_commit</code> or <code>mysqli_rollback</code> .
<code>MYSQLI_TRANS_START_READ_ONLY</code>	Start the transaction as "START TRANSACTION READ ONLY" with <code>mysqli_begin_transaction</code> .
<code>MYSQLI_TRANS_START_READ_WRITE</code>	Start the transaction as "START TRANSACTION READ WRITE" with <code>mysqli_begin_transaction</code> .
<code>MYSQLI_TRANS_START_CONSISTENT_SNAPSHOT</code>	Start the transaction as "START TRANSACTION WITH CONSISTENT SNAPSHOT" with <code>mysqli_begin_transaction</code> .

7.3.6 Notes

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Some implementation notes:

1. Support was added for `MYSQL_TYPE_GEOMETRY` to the MySQLi extension in PHP 5.3.
2. Note there are different internal implementations within `libmysqlclient` and `mysqld` for handling columns of type `MYSQL_TYPE_GEOMETRY`. Generally speaking, `mysqld` will allocate significantly less memory. For example, if there is a `POINT` column in a result set, `libmysqlclient` may pre-allocate up to 4GB of RAM although less than 50 bytes are needed for holding a `POINT` column in memory. Memory allocation is much lower, less than 50 bytes, if using `mysqld`.

7.3.7 The MySQLi Extension Function Summary

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Table 7.5 Summary of `mysqli` methods

mysqli Class			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
<i>Properties</i>			
<code>\$mysqli::affected_rows</code>	<code>mysqli_affected_rows</code>	N/A	Gets the number of affected rows in a previous MySQL operation
<code>\$mysqli::client_info</code>	<code>mysqli_get_client_info</code>	N/A	Returns the MySQL client version as a string
<code>\$mysqli::client_version</code>	<code>mysqli_get_client_version</code>	N/A	Returns MySQL client version info as an integer
<code>\$mysqli::connect_errno</code>	<code>mysqli_connect_errno</code>	N/A	Returns the error code from last connect call
<code>\$mysqli::connect_error</code>	<code>mysqli_connect_error</code>	N/A	Returns a string description of the last connect error
<code>\$mysqli::errno</code>	<code>mysqli_errno</code>	N/A	Returns the error code for the most recent function call
<code>\$mysqli::error</code>	<code>mysqli_error</code>	N/A	Returns a string description of the last error
<code>\$mysqli::field_count</code>	<code>mysqli_field_count</code>	N/A	Returns the number of columns for the most recent query
<code>\$mysqli::host_info</code>	<code>mysqli_get_host_info</code>	N/A	Returns a string representing the type of connection used
<code>\$mysqli::protocol_version</code>	<code>mysqli_get_proto_info</code>	N/A	Returns the version of the MySQL protocol used
<code>\$mysqli::server_info</code>	<code>mysqli_get_server_info</code>	N/A	Returns the version of the MySQL server
<code>\$mysqli::server_version</code>	<code>mysqli_get_server_version</code>	N/A	Returns the version of the MySQL server as an integer
<code>\$mysqli::info</code>	<code>mysqli_info</code>	N/A	Retrieves information about the most recently executed query
<code>\$mysqli::insert_id</code>	<code>mysqli_insert_id</code>	N/A	Returns the auto generated id used in the last query
<code>\$mysqli::sqlstate</code>	<code>mysqli_sqlstate</code>	N/A	Returns the SQLSTATE error from previous MySQL operation
<code>\$mysqli::warning_count</code>	<code>mysqli_warning_count</code>	N/A	Returns the number of warnings from the last query for the given link

mysqli Class			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
<i>Methods</i>			
<code>mysqli::autocommit</code>	<code>mysqli_autocommit</code>	N/A	Turns on or off auto-committing database modifications
<code>mysqli::change_user</code>	<code>mysqli_change_user</code>	N/A	Changes the user of the specified database connection
<code>mysqli::character_set_name</code> <code>mysqli::client_encoding</code>	<code>mysqli_character_set_name</code> <code>mysqli_client_encoding</code>		Returns the default character set for the database connection
<code>mysqli::close</code>	<code>mysqli_close</code>	N/A	Closes a previously opened database connection
<code>mysqli::commit</code>	<code>mysqli_commit</code>	N/A	Commits the current transaction
<code>mysqli::__construct</code>	<code>mysqli_connect</code>	N/A	Open a new connection to the MySQL server [Note: static (i.e. class) method]
<code>mysqli::debug</code>	<code>mysqli_debug</code>	N/A	Performs debugging operations
<code>mysqli::dump_debug</code>	<code>mysqli_dump_debug</code>	N/A	Dump debugging information into the log
<code>mysqli::get_charset</code>	<code>mysqli_get_charset</code>	N/A	Returns a character set object
<code>mysqli::get_connect_stats</code>	<code>mysqli_get_connect_stats</code>	N/A	Returns client connection statistics. Available only with <code>mysqlnd</code> .
<code>mysqli::get_client_info</code>	<code>mysqli_get_client_info</code>	N/A	Returns the MySQL client version as a string
<code>mysqli::get_client_stats</code>	<code>mysqli_get_client_stats</code>	N/A	Returns client per-process statistics. Available only with <code>mysqlnd</code> .
<code>mysqli::get_cache_size</code>	<code>mysqli_get_cache_size</code>	N/A	Returns client Zval cache statistics. Available only with <code>mysqlnd</code> .
<code>mysqli::get_server_info</code>	<code>mysqli_get_server_info</code>	N/A	Returns a string representing the version of the MySQL server that the MySQLi extension is connected to
<code>mysqli::get_warnings</code>	<code>mysqli_get_warnings</code>	N/A	NOT DOCUMENTED
<code>mysqli::init</code>	<code>mysqli_init</code>	N/A	Initializes MySQLi and returns a resource for use with

mysqli Class			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
			mysql_real_connect. [Not called on an object, as it returns a \$mysqli object.]
<code>mysqli::kill</code>	<code>mysqli_kill</code>	N/A	Asks the server to kill a MySQL thread
<code>mysqli::more_results</code>	<code>mysqli_more_results</code>	N/A	Check if there are any more query results from a multi query
<code>mysqli::multi_query</code>	<code>mysqli_multi_query</code>	N/A	Performs a query on the database
<code>mysqli::next_result</code>	<code>mysqli_next_result</code>	N/A	Prepare next result from multi_query
<code>mysqli::options</code>	<code>mysqli_options</code>	<code>mysqli_set_opt</code>	Set options
<code>mysqli::ping</code>	<code>mysqli_ping</code>	N/A	Pings a server connection, or tries to reconnect if the connection has gone down
<code>mysqli::prepare</code>	<code>mysqli_prepare</code>	N/A	Prepare an SQL statement for execution
<code>mysqli::query</code>	<code>mysqli_query</code>	N/A	Performs a query on the database
<code>mysqli::real_connect</code>	<code>mysqli_real_connect</code>	N/A	Opens a connection to a mysql server
<code>mysqli::real_escape_string</code>	<code>mysqli_real_escape_string</code>	<code>mysqli_real_escape_string</code>	Escapes special characters in a string for use in an SQL statement, taking into account the current charset of the connection
<code>mysqli::real_query</code>	<code>mysqli_real_query</code>	N/A	Execute an SQL query
<code>mysqli::refresh</code>	<code>mysqli_refresh</code>	N/A	Flushes tables or caches, or resets the replication server information
<code>mysqli::rollback</code>	<code>mysqli_rollback</code>	N/A	Rolls back current transaction
<code>mysqli::select_db</code>	<code>mysqli_select_db</code>	N/A	Selects the default database for database queries
<code>mysqli::set_charset</code>	<code>mysqli_set_charset</code>	N/A	Sets the default client character set
<code>mysqli::set_local_infile</code>	<code>mysqli_set_local_infile</code>	N/A	Unsets user defined handler for load local infile command

mysqli Class			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
<code>mysqli::set_local_infile_handler</code>		N/A	Set callback function for LOAD DATA LOCAL INFILE command
<code>mysqli::ssl_set</code>	<code>mysqli_ssl_set</code>	N/A	Used for establishing secure connections using SSL
<code>mysqli::stat</code>	<code>mysqli_stat</code>	N/A	Gets the current system status
<code>mysqli::stmt_init</code>	<code>mysqli_stmt_init</code>	N/A	Initializes a statement and returns an object for use with <code>mysqli_stmt_prepare</code>
<code>mysqli::store_result</code>	<code>mysqli_store_result</code>	N/A	Transfers a result set from the last query
<code>mysqli::thread_id</code>	<code>mysqli_thread_id</code>	N/A	Returns the thread ID for the current connection
<code>mysqli::thread_safe</code>	<code>mysqli_thread_safe</code>	N/A	Returns whether thread safety is given or not
<code>mysqli::use_result</code>	<code>mysqli_use_result</code>	N/A	Initiate a result set retrieval

Table 7.6 Summary of `mysqli_stmt` methods

MySQL_STMT			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
<i>Properties</i>			
<code>\$mysqli_stmt::affected_rows</code>	<code>mysqli_stmt_affected_rows</code>	N/A	Returns the total number of rows changed, deleted, or inserted by the last executed statement
<code>\$mysqli_stmt::errno</code>	<code>mysqli_stmt_errno</code>	N/A	Returns the error code for the most recent statement call
<code>\$mysqli_stmt::error</code>	<code>mysqli_stmt_error</code>	N/A	Returns a string description for last statement error
<code>\$mysqli_stmt::field_count</code>	<code>mysqli_stmt_field_count</code>	N/A	Returns the number of field in the given statement - not documented
<code>\$mysqli_stmt::insert_id</code>	<code>mysqli_stmt_insert_id</code>	N/A	Get the ID generated from the previous INSERT operation
<code>\$mysqli_stmt::num_rows</code>	<code>mysqli_stmt_num_rows</code>	N/A	Return the number of rows in statements result set

MySQL_STMT			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
\$mysqli_stmt::param_count	mysqli_stmt_param_count	mysqli_param_count	Returns the number of parameter for the given statement
\$mysqli_stmt::sqlstate	mysqli_stmt_sqlstate	N/A	Returns SQLSTATE error from previous statement operation
<i>Methods</i>			
mysqli_stmt::attr_get	mysqli_stmt_attr_get	N/A	Used to get the current value of a statement attribute
mysqli_stmt::attr_set	mysqli_stmt_attr_set	N/A	Used to modify the behavior of a prepared statement
mysqli_stmt::bind_param	mysqli_stmt_bind_param	N/A	Binds variables to a prepared statement as parameters
mysqli_stmt::bind_result	mysqli_stmt_bind_result	mysqli_bind_result	Binds variables to a prepared statement for result storage
mysqli_stmt::close	mysqli_stmt_close	N/A	Closes a prepared statement
mysqli_stmt::data_seek	mysqli_stmt_data_seek	N/A	Seeks to an arbitrary row in statement result set
mysqli_stmt::execute	mysqli_stmt_execute	mysqli_execute	Executes a prepared Query
mysqli_stmt::fetch	mysqli_stmt_fetch	mysqli_fetch	Fetch results from a prepared statement into the bound variables
mysqli_stmt::free_result	mysqli_stmt_free_result	N/A	Frees stored result memory for the given statement handle
mysqli_stmt::get_result	mysqli_stmt_get_result	N/A	Gets a result set from a prepared statement. Available only with mysqlnd.
mysqli_stmt::get_warnings	mysqli_stmt_get_warnings	N/A	NOT DOCUMENTED
mysqli_stmt::more_results	mysqli_stmt_more_results	N/A	Checks if there are more query results from a multiple query
mysqli_stmt::next_result	mysqli_stmt_next_result	N/A	Reads the next result from a multiple query
mysqli_stmt::num_rows	mysqli_stmt_num_rows	N/A	See also property \$mysqli_stmt::num_rows
mysqli_stmt::prepare	mysqli_stmt_prepare	N/A	Prepare an SQL statement for execution
mysqli_stmt::reset	mysqli_stmt_reset	N/A	Resets a prepared statement

MySQL_STMT			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
<code>mysqli_stmt::result_metadata</code>	<code>mysqlnd_stmt_result_metadata</code>	<code>mysqlnd_get_metadata</code>	Returns result set metadata from a prepared statement
<code>mysqli_stmt::send_long_data</code>	<code>mysqlnd_stmt_send_long_data</code>	<code>mysqlnd_send_long_data</code>	Send data in blocks

Table 7.7 Summary of `mysqli_result` methods

mysqli_result			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
<i>Properties</i>			
<code>\$mysqli_result::current_field</code>	<code>mysqlnd_field_tell</code>	N/A	Get current field offset of a result pointer
<code>\$mysqli_result::field_count</code>	<code>mysqlnd_num_fields</code>	N/A	Get the number of fields in a result
<code>\$mysqli_result::lengths</code>	<code>mysqlnd_fetch_lengths</code>	N/A	Returns the lengths of the columns of the current row in the result set
<code>\$mysqli_result::num_rows</code>	<code>mysqlnd_num_rows</code>	N/A	Gets the number of rows in a result
<i>Methods</i>			
<code>mysqli_result::data_seek</code>		N/A	Adjusts the result pointer to an arbitrary row in the result
<code>mysqli_result::fetch_all</code>		N/A	Fetches all result rows and returns the result set as an associative array, a numeric array, or both. Available only with <code>mysqlnd</code> .
<code>mysqli_result::fetch_array</code>		N/A	Fetch a result row as an associative, a numeric array, or both
<code>mysqli_result::fetch_assoc</code>		N/A	Fetch a result row as an associative array
<code>mysqli_result::fetch_field</code>	<code>mysqlnd_fetch_field</code>	N/A	Fetch meta-data for a single field
<code>mysqli_result::fetch_field_direct</code>		N/A	
<code>mysqli_result::fetch_fields</code>		N/A	Returns an array of objects representing the fields in a result set
<code>mysqli_result::fetch_object</code>		N/A	Returns the current row of a result set as an object

mysqli_result			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
<code>mysqli_result::fetch</code>	<code>mysql_fetch_row</code>	N/A	Get a result row as an enumerated array
<code>mysqli_result::field</code>	<code>mysql_field_seek</code>	N/A	Set result pointer to a specified field offset
<code>mysqli_result::free</code>	<code>mysql_free_result</code>	N/A	Frees the memory associated with a result
<code>mysqli_result::close</code>			
<code>mysqli_result::free_result</code>			

Table 7.8 Summary of `mysqli_driver` methods

MySQL_Driver			
OOP Interface	Procedural Interface	Alias (Do not use)	Description
<i>Properties</i>			
N/A			
<i>Methods</i>			
<code>mysqli_driver::embed</code>	<code>mysqlisembeded_ser</code>	<code>N/A_end</code>	NOT DOCUMENTED
<code>mysqli_driver::embed</code>	<code>mysqlisembededrser</code>	<code>N/A_start</code>	NOT DOCUMENTED

Note

Alias functions are provided for backward compatibility purposes only. Do not use them in new projects.

7.3.8 Examples

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7.3.8.1 MySQLi extension basic examples

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This example shows how to connect, execute a query, use basic error handling, print resulting rows, and disconnect from a MySQL database.

This example uses the freely available Sakila database that can be downloaded from dev.mysql.com, as described here. To get this example to work, (a) install sakila and (b) modify the connection variables (host, your_user, your_pass).

Example 7.39 MySQLi extension overview example

```
<?php
// Let's pass in a $_GET variable to our example, in this case
// it's aid for actor_id in our Sakila database. Let's make it
// default to 1, and cast it to an integer as to avoid SQL injection
// and/or related security problems. Handling all of this goes beyond
// the scope of this simple example. Example:
//   http://example.org/script.php?aid=42
if (isset($_GET['aid']) && is_numeric($_GET['aid'])) {
    $aid = (int) $_GET['aid'];
} else {
    $aid = 1;
}
// Connecting to and selecting a MySQL database named sakila
// Hostname: 127.0.0.1, username: your_user, password: your_pass, db: sakila
$mysqli = new mysqli('127.0.0.1', 'your_user', 'your_pass', 'sakila');
// Oh no! A connect_errno exists so the connection attempt failed!
```

```
if ($mysqli->connect_errno) {
    // The connection failed. What do you want to do?
    // You could contact yourself (email?), log the error, show a nice page, etc.
    // You do not want to reveal sensitive information
    // Let's try this:
    echo "Sorry, this website is experiencing problems.";
    // Something you should not do on a public site, but this example will show you
    // anyways, is print out MySQL error related information -- you might log this
    echo "Error: Failed to make a MySQL connection, here is why: \n";
    echo "Errno: " . $mysqli->connect_errno . "\n";
    echo "Error: " . $mysqli->connect_error . "\n";

    // You might want to show them something nice, but we will simply exit
    exit;
}
// Perform an SQL query
$sql = "SELECT actor_id, first_name, last_name FROM actor WHERE actor_id = $aid";
if (!$result = $mysqli->query($sql)) {
    // Oh no! The query failed.
    echo "Sorry, the website is experiencing problems.";
    // Again, do not do this on a public site, but we'll show you how
    // to get the error information
    echo "Error: Our query failed to execute and here is why: \n";
    echo "Query: " . $sql . "\n";
    echo "Errno: " . $mysqli->errno . "\n";
    echo "Error: " . $mysqli->error . "\n";
    exit;
}
// Phew, we made it. We know our MySQL connection and query
// succeeded, but do we have a result?
if ($result->num_rows === 0) {
    // Oh, no rows! Sometimes that's expected and okay, sometimes
    // it is not. You decide. In this case, maybe actor_id was too
    // large?
    echo "We could not find a match for ID $aid, sorry about that. Please try again.";
    exit;
}
// Now, we know only one result will exist in this example so let's
// fetch it into an associated array where the array's keys are the
// table's column names
$actor = $result->fetch_assoc();
echo "Sometimes I see " . $actor['first_name'] . " " . $actor['last_name'] . " on TV.";
// Now, let's fetch five random actors and output their names to a list.
// We'll add less error handling here as you can do that on your own now
$sql = "SELECT actor_id, first_name, last_name FROM actor ORDER BY rand() LIMIT 5";
if (!$result = $mysqli->query($sql)) {
    echo "Sorry, the website is experiencing problems.";
    exit;
}
// Print our 5 random actors in a list, and link to each actor
echo "<ul>\n";
while ($actor = $result->fetch_assoc()) {
    echo "<li><a href='" . $_SERVER['SCRIPT_FILENAME'] . "?aid=" . $actor['actor_id'] . "'>\n";
    echo $actor['first_name'] . ' ' . $actor['last_name'];
    echo "</a></li>\n";
}
echo "</ul>\n";
// The script will automatically free the result and close the MySQL
// connection when it exits, but let's just do it anyways
$result->free();
$mysqli->close();
?>
```

7.3.9 The mysqli class

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Represents a connection between PHP and a MySQL database.

```
mysqli {
mysqli
    Properties

    int
        mysqli->affected_rows ;

    int
        mysqli->connect_errno ;

    string
        mysqli->connect_error ;

    int
        mysqli->errno ;

    array
        mysqli->error_list ;

    string
        mysqli->error ;

    int
        mysqli->field_count ;

    string
        mysqli->client_info ;

    int
        mysqli->client_version ;

    string
        mysqli->host_info ;

    string
        mysqli->protocol_version ;

    string
        mysqli->server_info ;

    int
        mysqli->server_version ;

    string
        mysqli->info ;

    mixed
        mysqli->insert_id ;

    string
        mysqli->sqlstate ;

    int
        mysqli->thread_id ;

    int
        mysqli->warning_count ;

Methods

mysqli::__construct(
    string host
        = ini_get("mysqli.default_host"),
    string username
        = ini_get("mysqli.default_user"),
    string passwd
        = ini_get("mysqli.default_pw"),
    string dbname
        = "",
    int port
        = ini_get("mysqli.default_port"),
```

```
    string socket
        = =ini_get("mysqli.default_socket"));

bool mysqli::autocommit(
    bool mode);

bool mysqli::change_user(
    string user,
    string password,
    string database);

string mysqli::character_set_name();

bool mysqli::close();

bool mysqli::commit(
    int flags
        = =0,
    string name);

void mysqli::connect(
    string host
        = =ini_get("mysqli.default_host"),
    string username
        = =ini_get("mysqli.default_user"),
    string passwd
        = =ini_get("mysqli.default_pw"),
    string dbname
        = ="",
    int port
        = =ini_get("mysqli.default_port"),
    string socket
        = =ini_get("mysqli.default_socket"));

bool mysqli::debug(
    string message);

bool mysqli::dump_debug_info();

object mysqli::get_charset();

string mysqli::get_client_info();

bool mysqli::get_connection_stats();

string mysqli_stmt::get_server_info();

mysqli_warning mysqli::get_warnings();

mysqli mysqli::init();

bool mysqli::kill(
    int processid);

bool mysqli::more_results();

bool mysqli::multi_query(
    string query);

bool mysqli::next_result();

bool mysqli::options(
    int option,
    mixed value);

bool mysqli::ping();

public static int mysqli::poll(
    array read,
    array error,
    array reject,
    int sec,
```

```
int usec
    = 0);

mysqli_stmt mysqli::prepare(
    string query);

mixed mysqli::query(
    string query,
    int resultmode
    = MYSQLI_STORE_RESULT);

bool mysqli::real_connect(
    string host,
    string username,
    string passwd,
    string dbname,
    int port,
    string socket,
    int flags);

string mysqli::escape_string(
    string escapestr);

string mysqli::real_escape_string(
    string escapestr);

bool mysqli::real_query(
    string query);

public mysqli_result mysqli::reap_async_query();

public bool mysqli::refresh(
    int options);

bool mysqli::rollback(
    int flags
    = 0,
    string name);

int mysqli::rpl_query_type(
    string query);

bool mysqli::select_db(
    string dbname);

bool mysqli::send_query(
    string query);

bool mysqli::set_charset(
    string charset);

bool mysqli::set_local_infile_handler(
    mysqli link,
    callable read_func);

bool mysqli::ssl_set(
    string key,
    string cert,
    string ca,
    string capath,
    string cipher);

string mysqli::stat();

mysqli_stmt mysqli::stmt_init();

mysqli_result mysqli::store_result(
    int option);

mysqli_result mysqli::use_result();

}
```

7.3.9.1 mysqli::\$affected_rows, mysqli_affected_rows

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- `mysqli::$affected_rows`

`mysqli_affected_rows`

Gets the number of affected rows in a previous MySQL operation

Description

Object oriented style

```
int  
    mysqli->affected_rows ;
```

Procedural style

```
int mysqli_affected_rows(  
    mysqli link);
```

Returns the number of rows affected by the last `INSERT`, `UPDATE`, `REPLACE` or `DELETE` query.

For `SELECT` statements `mysqli_affected_rows` works like `mysqli_num_rows`.

Parameters

`link`

Procedural style only: A link identifier returned by
`mysqli_connect` or `mysqli_init`

Return Values

An integer greater than zero indicates the number of rows affected or retrieved. Zero indicates that no records were updated for an `UPDATE` statement, no rows matched the `WHERE` clause in the query or that no query has yet been executed. -1 indicates that the query returned an error.

Note

If the number of affected rows is greater than the maximum integer value(
`PHP_INT_MAX`), the number of affected rows will be returned as a string.

Examples

Example 7.40 `$mysqli->affected_rows` example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", $mysqli_connect_error());  
    exit();  
}  
/* Insert rows */  
$mysqli->query("CREATE TABLE Language SELECT * from CountryLanguage");  
printf("Affected rows (INSERT): %d\n", $mysqli->affected_rows);  
$mysqli->query("ALTER TABLE Language ADD Status int default 0");  
/* update rows */  
$mysqli->query("UPDATE Language SET Status=1 WHERE Percentage > 50");  
printf("Affected rows (UPDATE): %d\n", $mysqli->affected_rows);  
/* delete rows */  
$mysqli->query("DELETE FROM Language WHERE Percentage < 50");  
printf("Affected rows (DELETE): %d\n", $mysqli->affected_rows);
```

```
/* select all rows */
$result = $mysqli->query("SELECT CountryCode FROM Language");
printf("Affected rows (SELECT): %d\n", $mysqli->affected_rows);
$result->close();
/* Delete table Language */
$mysqli->query("DROP TABLE Language");
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
if (!$link) {
    printf("Can't connect to localhost. Error: %s\n", mysqli_connect_error());
    exit();
}
/* Insert rows */
mysqli_query($link, "CREATE TABLE Language SELECT * from CountryLanguage");
printf("Affected rows (INSERT): %d\n", mysqli_affected_rows($link));
mysqli_query($link, "ALTER TABLE Language ADD Status int default 0");
/* update rows */
mysqli_query($link, "UPDATE Language SET Status=1 WHERE Percentage > 50");
printf("Affected rows (UPDATE): %d\n", mysqli_affected_rows($link));
/* delete rows */
mysqli_query($link, "DELETE FROM Language WHERE Percentage < 50");
printf("Affected rows (DELETE): %d\n", mysqli_affected_rows($link));
/* select all rows */
$result = mysqli_query($link, "SELECT CountryCode FROM Language");
printf("Affected rows (SELECT): %d\n", mysqli_affected_rows($link));
mysqli_free_result($result);
/* Delete table Language */
mysqli_query($link, "DROP TABLE Language");
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Affected rows (INSERT): 984
Affected rows (UPDATE): 168
Affected rows (DELETE): 815
Affected rows (SELECT): 169
```

See Also

[mysqli_num_rows](#)
[mysqli_info](#)

7.3.9.2 `mysqli::autocommit`, `mysqli_autocommit`

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- [mysqli::autocommit](#)

[mysqli_autocommit](#)

Turns on or off auto-committing database modifications

Description

Object oriented style

```
bool mysqli::autocommit(  
    bool mode);
```

Procedural style

```
bool mysqli_autocommit(  
    mysqli link,  
    bool mode);
```

Turns on or off auto-commit mode on queries for the database connection.

To determine the current state of autocommit use the SQL command `SELECT @@autocommit`.

Parameters

<code>link</code>	Procedural style only: A link identifier returned by <code>mysqli_connect</code> or <code>mysqli_init</code>
<code>mode</code>	Whether to turn on auto-commit or not.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Notes

Note

This function doesn't work with non transactional table types (like MyISAM or ISAM).

Examples

Example 7.41 `mysqli::autocommit` example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
/* turn autocommit on */  
$mysqli->autocommit(TRUE);  
if ($result = $mysqli->query("SELECT @@autocommit")) {  
    $row = $result->fetch_row();  
    printf("Autocommit is %s\n", $row[0]);  
    $result->free();  
}  
/* close connection */  
$mysqli->close();  
?>
```

Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
if (!$link) {  
    printf("Can't connect to localhost. Error: %s\n", mysqli_connect_error());  
    exit();  
}
```

```
/* turn autocommit on */
mysqli_autocommit($link, TRUE);
if ($result = mysqli_query($link, "SELECT @@autocommit")) {
    $row = mysqli_fetch_row($result);
    printf("Autocommit is %s\n", $row[0]);
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Autocommit is 1
```

See Also

[mysqli_begin_transaction](#)
[mysqli_commit](#)
[mysqli_rollback](#)

7.3.9.3 `mysqli::begin_transaction`, `mysqli_begin_transaction`

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- [mysqli::begin_transaction](#)

[mysqli_begin_transaction](#)

Starts a transaction

Description

Object oriented style (method):

```
public bool mysqli::begin_transaction(
    int flags
        = 0,
    string name);
```

Procedural style:

```
bool mysqli_begin_transaction(
    mysqli link,
    int flags
        = 0,
    string name);
```

Begins a transaction. Requires the InnoDB engine (it is enabled by default). For additional details about how MySQL transactions work, see <http://dev.mysql.com/doc/mysql/en/commit.html>.

Parameters

link

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

flags

Valid flags are:

- [MYSQLI_TRANS_START_READ_ONLY](#): Start the transaction as "START TRANSACTION READ ONLY". Requires MySQL 5.6 and above.

- `MYSQLI_TRANS_START_READ_WRITE`: Start the transaction as "START TRANSACTION READ WRITE". Requires MySQL 5.6 and above.
- `MYSQLI_TRANS_START_WITH_CONSISTENT_SNAPSHOT`: Start the transaction as "START TRANSACTION WITH CONSISTENT SNAPSHOT".

name

Savepoint name for the transaction.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.42 `$mysqli->begin_transaction` example

Object oriented style

```
<?php
$mysqli = new mysqli("127.0.0.1", "my_user", "my_password", "sakila");
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error);
    exit();
}
$mysqli->begin_transaction(MYSQLI_TRANS_START_READ_ONLY);
$mysqli->query("SELECT first_name, last_name FROM actor");
$mysqli->commit();
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("127.0.0.1", "my_user", "my_password", "sakila");
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
mysqli_begin_transaction($link, MYSQLI_TRANS_START_READ_ONLY);
mysqli_query($link, "SELECT first_name, last_name FROM actor LIMIT 1");
mysqli_commit($link);
mysqli_close($link);
?>
```

See Also

`mysqli_autocommit`
`mysqli_commit`
`mysqli_rollback`

7.3.9.4 `mysqli::change_user`, `mysqli_change_user`

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- `mysqli::change_user`
- `mysqli_change_user`

Changes the user of the specified database connection

Description

Object oriented style

```
bool mysqli::change_user(  
    string user,  
    string password,  
    string database);
```

Procedural style

```
bool mysqli_change_user(  
    mysqli link,  
    string user,  
    string password,  
    string database);
```

Changes the user of the specified database connection and sets the current database.

In order to successfully change users a valid *username* and *password* parameters must be provided and that user must have sufficient permissions to access the desired database. If for any reason authorization fails, the current user authentication will remain.

Parameters

<i>link</i>	Procedural style only: A link identifier returned by <code>mysqli_connect</code> or <code>mysqli_init</code>
<i>user</i>	The MySQL user name.
<i>password</i>	The MySQL password.
<i>database</i>	The database to change to. If desired, the <code>NULL</code> value may be passed resulting in only changing the user and not selecting a database. To select a database in this case use the <code>mysqli_select_db</code> function.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Notes

Note

Using this command will always cause the current database connection to behave as if it was a completely new database connection, regardless of if the operation was completed successfully. This reset includes performing a rollback on any active transactions, closing all temporary tables, and unlocking all locked tables.

Examples

Example 7.43 `mysqli::change_user` example

Object oriented style

```
<?php  
/* connect database test */  
$mysqli = new mysqli("localhost", "my_user", "my_password", "test");
```

```
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* Set Variable a */
$mysqli->query("SET @a:=1");
/* reset all and select a new database */
$mysqli->change_user("my_user", "my_password", "world");
if ($result = $mysqli->query("SELECT DATABASE()")) {
    $row = $result->fetch_row();
    printf("Default database: %s\n", $row[0]);
    $result->close();
}
if ($result = $mysqli->query("SELECT @a")) {
    $row = $result->fetch_row();
    if ($row[0] === NULL) {
        printf("Value of variable a is NULL\n");
    }
    $result->close();
}
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
/* connect database test */
$link = mysqli_connect("localhost", "my_user", "my_password", "test");
/* check connection */
if (!$link) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* Set Variable a */
mysqli_query($link, "SET @a:=1");
/* reset all and select a new database */
mysqli_change_user($link, "my_user", "my_password", "world");
if ($result = mysqli_query($link, "SELECT DATABASE()")) {
    $row = mysqli_fetch_row($result);
    printf("Default database: %s\n", $row[0]);
    mysqli_free_result($result);
}
if ($result = mysqli_query($link, "SELECT @a")) {
    $row = mysqli_fetch_row($result);
    if ($row[0] === NULL) {
        printf("Value of variable a is NULL\n");
    }
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Default database: world
Value of variable a is NULL
```

See Also

[mysqli_connect](#)

```
mysqli_select_db
```

7.3.9.5 mysqli::character_set_name, mysqli_character_set_name

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- `mysqli::character_set_name`

```
mysqli_character_set_name
```

Returns the default character set for the database connection

Description

Object oriented style

```
string mysqli::character_set_name();
```

Procedural style

```
string mysqli_character_set_name(  
    mysqli link);
```

Returns the current character set for the database connection.

Parameters

`link`

Procedural style only: A link identifier returned by
`mysqli_connect` or `mysqli_init`

Return Values

The default character set for the current connection

Examples

Example 7.44 mysqli::character_set_name example

Object oriented style

```
<?php  
/* Open a connection */  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli->connect_errno) {  
    printf("Connect failed: %s\n", $mysqli->connect_error());  
    exit();  
}  
/* Print current character set */  
$charset = $mysqli->character_set_name();  
printf ("Current character set is %s\n", $charset);  
$mysqli->close();  
?>
```

Procedural style

```
<?php  
/* Open a connection */  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (!$link) {  
    printf("Connect failed: %s\n", mysqli_connect_error());
```

```
    exit();
}
/* Print current character set */
$charset = mysqli_character_set_name($link);
printf ("Current character set is %s\n", $charset);
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Current character set is latin1_swedish_ci
```

See Also

[mysqli_set_charset](#)
[mysqli_client_encoding](#)
[mysqli_real_escape_string](#)

7.3.9.6 `mysqli::close`, `mysqli_close`

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- [mysqli::close](#)

[mysqli_close](#)

Closes a previously opened database connection

Description

Object oriented style

```
bool mysqli::close();
```

Procedural style

```
bool mysqli_close(
    mysqli link);
```

Closes a previously opened database connection.

Open non-persistent MySQL connections and result sets are automatically destroyed when a PHP script finishes its execution. So, while explicitly closing open connections and freeing result sets is optional, doing so is recommended. This will immediately return resources to PHP and MySQL, which can improve performance. For related information, see [freeing resources](#)

Parameters

`link`

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

See [mysqli_connect](#).

Notes**Note**

`mysqli_close` will not close persistent connections. For additional details, see the manual page on [persistent connections](#).

See Also

`mysqli::__construct`
`mysqli_init`
`mysqli_real_connect`
`mysqli_free_result`

7.3.9.7 `mysqli::commit`, `mysqli_commit`

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- `mysqli::commit`

`mysqli_commit`

Commits the current transaction

Description

Object oriented style

```
bool mysqli::commit(
    int flags
    = 0,
    string name);
```

Procedural style

```
bool mysqli_commit(
    mysqli link,
    int flags
    = 0,
    string name);
```

Commits the current transaction for the database connection.

Parameters

`link`

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

`flags`

A bitmask of `MYSQLI_TRANS_COR_*` constants.

`name`

If provided then `COMMIT/*name*/` is executed.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Changelog

Version	Description
5.5.0	Added <code>flags</code> and <code>name</code> parameters.

Examples

Example 7.45 `mysqli::commit` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$mysqli->query("CREATE TABLE Language LIKE CountryLanguage");
/* set autocommit to off */
$mysqli->autocommit(FALSE);
/* Insert some values */
$mysqli->query("INSERT INTO Language VALUES ('DEU', 'Bavarian', 'F', 11.2)");
$mysqli->query("INSERT INTO Language VALUES ('DEU', 'Swabian', 'F', 9.4)");
/* commit transaction */
if (!$mysqli->commit()) {
    print("Transaction commit failed\n");
    exit();
}
/* drop table */
$mysqli->query("DROP TABLE Language");
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "test");
/* check connection */
if (!$link) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* set autocommit to off */
mysqli_autocommit($link, FALSE);
mysqli_query($link, "CREATE TABLE Language LIKE CountryLanguage");
/* Insert some values */
mysqli_query($link, "INSERT INTO Language VALUES ('DEU', 'Bavarian', 'F', 11.2)");
mysqli_query($link, "INSERT INTO Language VALUES ('DEU', 'Swabian', 'F', 9.4)");
/* commit transaction */
if (!mysqli_commit($link)) {
    print("Transaction commit failed\n");
    exit();
}
/* close connection */
mysqli_close($link);
?>
```

See Also

[mysqli_autocommit](#)
[mysqli_begin_transaction](#)
[mysqli_rollback](#)
[mysqli_savepoint](#)

7.3.9.8 `mysqli::$connect_errno`, `mysqli_connect_errno`

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- [mysqli::\\$connect_errno](#)

`mysqli_connect_errno`

Returns the error code from last connect call

Description

Object oriented style

```
int  
mysqli->connect_errno ;
```

Procedural style

```
int mysqli_connect_errno();
```

Returns the last error code number from the last call to `mysqli_connect`.

Note

Client error message numbers are listed in the MySQL `errmsg.h` header file, server error message numbers are listed in `mysqld_error.h`. In the MySQL source distribution you can find a complete list of error messages and error numbers in the file `Docs/mysqld_error.txt`.

Return Values

An error code value for the last call to `mysqli_connect`, if it failed. zero means no error occurred.

Examples

Example 7.46 `$mysqli->connect_errno` example

Object oriented style

```
<?php  
$mysqli = @new mysqli('localhost', 'fake_user', 'my_password', 'my_db');  
if ($mysqli->connect_errno) {  
    die('Connect Error: ' . $mysqli->connect_errno);  
}  
?>
```

Procedural style

```
<?php  
$link = @mysqli_connect('localhost', 'fake_user', 'my_password', 'my_db');  
if (!$link) {  
    die('Connect Error: ' . mysqli_connect_errno());  
}  
?>
```

The above examples will output:

```
Connect Error: 1045
```

See Also

[mysqli_connect](#)

```
mysqli_connect_error  
mysqli_errno  
mysqli_error  
mysqli_sqlstate
```

7.3.9.9 `mysqli::$connect_error`, `mysqli_connect_error`

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- `mysqli::$connect_error`

```
mysqli_connect_error
```

Returns a string description of the last connect error

Description

Object oriented style

```
string  
mysqli->connect_error ;
```

Procedural style

```
string mysqli_connect_error();
```

Returns the last error message string from the last call to `mysqli_connect`.

Return Values

A string that describes the error. `NULL` is returned if no error occurred.

Examples

Example 7.47 `$mysqli->connect_error` example

Object oriented style

```
<?php  
$mysqli = @new mysqli('localhost', 'fake_user', 'my_password', 'my_db');  
// Works as of PHP 5.2.9 and 5.3.0.  
if ($mysqli->connect_error) {  
    die('Connect Error: ' . $mysqli->connect_error);  
}  
?>
```

Procedural style

```
<?php  
$link = @mysqli_connect('localhost', 'fake_user', 'my_password', 'my_db');  
if (!$link) {  
    die('Connect Error: ' . mysqli_connect_error());  
}  
?>
```

The above examples will output:

```
Connect Error: Access denied for user 'fake_user'@'localhost' (using password: YES)
```

Notes**Warning**

The `mysqli->connect_error` property only works properly as of PHP versions 5.2.9 and 5.3.0. Use the `mysqli_connect_error` function if compatibility with earlier PHP versions is required.

See Also

[mysqli_connect](#)
[mysqli_connect_errno](#)
[mysqli_errno](#)
[mysqli_error](#)
[mysqli_sqlstate](#)

7.3.9.10 mysqli::__construct, mysqli::connect, mysqli_connect

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- [mysqli::__construct](#)

[mysqli::connect](#)

[mysqli_connect](#)

Open a new connection to the MySQL server

Description

Object oriented style

```
mysqli::__construct(
    string host
        = =ini_get("mysqli.default_host"),
    string username
        = =ini_get("mysqli.default_user"),
    string passwd
        = =ini_get("mysqli.default_pw"),
    string dbname
        = ="",
    int port
        = =ini_get("mysqli.default_port"),
    string socket
        = =ini_get("mysqli.default_socket"));
```

```
void mysqli::connect(
    string host
        = =ini_get("mysqli.default_host"),
    string username
        = =ini_get("mysqli.default_user"),
    string passwd
        = =ini_get("mysqli.default_pw"),
    string dbname
        = ="",
    int port
        = =ini_get("mysqli.default_port"),
    string socket
        = =ini_get("mysqli.default_socket"));
```

Procedural style

```
mysqli mysqli_connect(
    string host
        = =ini_get("mysqli.default_host"),
    string username
        = =ini_get("mysqli.default_user"),
```

```

string passwd
    = ini_get("mysqli.default_pw"),
string dbname
    = "",
int port
    = ini_get("mysqli.default_port"),
string socket
    = ini_get("mysqli.default_socket"));

```

Opens a connection to the MySQL Server.

Parameters

<i>host</i>	Can be either a host name or an IP address. Passing the <code>NULL</code> value or the string "localhost" to this parameter, the local host is assumed. When possible, pipes will be used instead of the TCP/IP protocol. Prepending host by <code>p:</code> opens a persistent connection. <code>mysqli_change_user</code> is automatically called on connections opened from the connection pool.
<i>username</i>	The MySQL user name.
<i>passwd</i>	If not provided or <code>NULL</code> , the MySQL server will attempt to authenticate the user against those user records which have no password only. This allows one username to be used with different permissions (depending on if a password is provided or not).
<i>dbname</i>	If provided will specify the default database to be used when performing queries.
<i>port</i>	Specifies the port number to attempt to connect to the MySQL server.
<i>socket</i>	Specifies the socket or named pipe that should be used.

Note

Specifying the `socket` parameter will not explicitly determine the type of connection to be used when connecting to the MySQL server. How the connection is made to the MySQL database is determined by the `host` parameter.

Return Values

Returns an object which represents the connection to a MySQL Server, or `FALSE` on failure.

Changelog

Version	Description
5.3.0	Added the ability of persistent connections.

Examples

Example 7.48 `mysqli::__construct` example

Object oriented style

```
<?php
```

```
$mysqli = new mysqli('localhost', 'my_user', 'my_password', 'my_db');
/*
 * This is the "official" OO way to do it,
 * BUT $connect_error was broken until PHP 5.2.9 and 5.3.0.
 */
if ($mysqli->connect_error) {
    die('Connect Error (' . $mysqli->connect_errno . ') '
        . $mysqli->connect_error);
}
/*
 * Use this instead of $connect_error if you need to ensure
 * compatibility with PHP versions prior to 5.2.9 and 5.3.0.
 */
if (mysqli_connect_error()) {
    die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}
echo 'Success... ' . $mysqli->host_info . "\n";
$mysqli->close();
?>
```

Object oriented style when extending mysqli class

```
<?php
class foo_mysqli extends mysqli {
    public function __construct($host, $user, $pass, $db) {
        parent::__construct($host, $user, $pass, $db);
        if (mysqli_connect_error()) {
            die('Connect Error (' . mysqli_connect_errno() . ') '
                . mysqli_connect_error());
        }
    }
}
$db = new foo_mysqli('localhost', 'my_user', 'my_password', 'my_db');
echo 'Success... ' . $db->host_info . "\n";
$db->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect('localhost', 'my_user', 'my_password', 'my_db');
if (!$link) {
    die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}
echo 'Success... ' . mysqli_get_host_info($link) . "\n";
mysqli_close($link);
?>
```

The above examples will output:

```
Success... MySQL host info: localhost via TCP/IP
```

Notes

Note

MySQLnd always assumes the server default charset. This charset is sent during connection hand-shake/authentication, which mysqlnd will use.

Libmysqlclient uses the default charset set in the `my.cnf` or by an explicit call to `mysqli_options` prior to calling `mysqli_real_connect`, but after `mysqli_init`.

Note

OO syntax only: If a connection fails an object is still returned. To check if the connection failed then use either the `mysqli_connect_error` function or the `mysqli->connect_error` property as in the preceding examples.

Note

If it is necessary to set options, such as the connection timeout, `mysqli_real_connect` must be used instead.

Note

Calling the constructor with no parameters is the same as calling `mysqli_init`.

Note

Error "Can't create TCP/IP socket (10106)" usually means that the `variables_order` configuration directive doesn't contain character `E`. On Windows, if the environment is not copied the `SYSTEMROOT` environment variable won't be available and PHP will have problems loading Winsock.

See Also

`mysqli_real_connect`
`mysqli_options`
`mysqli_connect_errno`
`mysqli_connect_error`
`mysqli_close`

7.3.9.11 `mysqli::debug`, `mysqli_debug`

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- `mysqli::debug`

`mysqli_debug`

Performs debugging operations

Description

Object oriented style

```
bool mysqli::debug(  
    string message);
```

Procedural style

```
bool mysqli_debug(  
    string message);
```

Performs debugging operations using the Fred Fish debugging library.

Parameters

`message`

A string representing the debugging operation to perform

Return Values

Returns `TRUE`.

Notes

Note

To use the `mysqli_debug` function you must compile the MySQL client library to support debugging.

Examples

Example 7.49 Generating a Trace File

```
<?php
/* Create a trace file in '/tmp/client.trace' on the local (client) machine: */
mysqli_debug("d:t:o,/tmp/client.trace");
?>
```

See Also

[mysqli_dump_debug_info](#)
[mysqli_report](#)

7.3.9.12 `mysqli::dump_debug_info`, `mysqli_dump_debug_info`

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- [mysqli::dump_debug_info](#)

[mysqli_dump_debug_info](#)

Dump debugging information into the log

Description

Object oriented style

```
bool mysqli::dump_debug_info();
```

Procedural style

```
bool mysqli_dump_debug_info(
    mysqli link);
```

This function is designed to be executed by an user with the SUPER privilege and is used to dump debugging information into the log for the MySQL Server relating to the connection.

Parameters

`link`

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

Returns `TRUE` on success or `FALSE` on failure.

See Also

[mysqli_debug](#)

7.3.9.13 `mysqli::$errno`, `mysqli_errno`

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- `mysqli::$errno`
- `mysqli_errno`

Returns the error code for the most recent function call

Description

Object oriented style

```
int  
mysqli->errno ;
```

Procedural style

```
int mysqli_errno(  
    mysqli link);
```

Returns the last error code for the most recent MySQLi function call that can succeed or fail.

Client error message numbers are listed in the MySQL `errmsg.h` header file, server error message numbers are listed in `mysqld_error.h`. In the MySQL source distribution you can find a complete list of error messages and error numbers in the file `Docs/mysqld_error.txt`.

Parameters

`link`

Procedural style only: A link identifier returned by
`mysqli_connect` or `mysqli_init`

Return Values

An error code value for the last call, if it failed. zero means no error occurred.

Examples

Example 7.50 `$mysqli->errno` example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli->connect_errno) {  
    printf("Connect failed: %s\n", $mysqli->connect_error);  
    exit();  
}  
if (!$mysqli->query("SET a=1")) {  
    printf("Errorcode: %d\n", $mysqli->errno);  
}  
/* close connection */  
$mysqli->close();  
?>
```

Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */
```

```

if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
if (!mysqli_query($link, "SET a=1")) {
    printf("Errorcode: %d\n", mysqli_errno($link));
}
/* close connection */
mysqli_close($link);
?>

```

The above examples will output:

```
Errorcode: 1193
```

See Also

[mysqli_connect_errno](#)
[mysqli_connect_error](#)
[mysqli_error](#)
[mysqli_sqlstate](#)

7.3.9.14 `mysqli::$error_list`, `mysqli_error_list`

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- [mysqli::\\$error_list](#)

[mysqli_error_list](#)

Returns a list of errors from the last command executed

Description

Object oriented style

```

array
mysqli->error_list ;

```

Procedural style

```

array mysqli_error_list(
    mysqli link);

```

Returns a array of errors for the most recent MySQLi function call that can succeed or fail.

Parameters

`link`

Procedural style only: A link identifier returned by
[mysqli_connect](#) or [mysqli_init](#)

Return Values

A list of errors, each as an associative array containing the `errno`, `error`, and `sqlstate`.

Examples

Example 7.51 `$mysqli->error_list` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "nobody", "");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error());
    exit();
}
if (!$mysqli->query("SET a=1")) {
    print_r($mysqli->error_list);
}
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if ($link->connect_errno) {
    printf("Connect failed: %s\n", $link->connect_error());
    exit();
}
if (!$link->query("SET a=1")) {
    print_r(mysqli_error_list($link));
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Array
(
    [0] => Array
        (
            [errno] => 1193
            [sqlstate] => HY000
            [error] => Unknown system variable 'a'
        )
)
```

See Also

[mysqli_connect_errno](#)
[mysqli_connect_error](#)
[mysqli_error](#)
[mysqli_sqlstate](#)

7.3.9.15 `mysqli::$error`, `mysqli_error`

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- [mysqli::\\$error](#)

[mysqli_error](#)

Returns a string description of the last error

Description

Object oriented style

```
string  
    mysqli->error ;
```

Procedural style

```
string mysqli_error(  
    mysqli link);
```

Returns the last error message for the most recent MySQLi function call that can succeed or fail.

Parameters

link

Procedural style only: A link identifier returned by
`mysqli_connect` or `mysqli_init`

Return Values

A string that describes the error. An empty string if no error occurred.

Examples

Example 7.52 \$mysqli->error example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli->connect_errno) {  
    printf("Connect failed: %s\n", $mysqli->connect_error);  
    exit();  
}  
if (!$mysqli->query("SET a=1")) {  
    printf("Error message: %s\n", $mysqli->error);  
}  
/* close connection */  
$mysqli->close();  
?>
```

Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
if (!mysqli_query($link, "SET a=1")) {  
    printf("Error message: %s\n", mysqli_error($link));  
}  
/* close connection */  
mysqli_close($link);  
?>
```

The above examples will output:

```
Error message: Unknown system variable 'a'
```

See Also

```
mysqli_connect_errno  
mysqli_connect_error  
mysqli_errno  
mysqli_sqlstate
```

7.3.9.16 mysqli::\$field_count, mysqli_field_count

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- `mysqli::$field_count`

Returns the number of columns for the most recent query

Description

Object oriented style

```
int  
    mysqli->field_count ;
```

Procedural style

```
int mysqli_field_count(  
    mysqli link);
```

Returns the number of columns for the most recent query on the connection represented by the [link](#) parameter. This function can be useful when using the `mysqli_store_result` function to determine if the query should have produced a non-empty result set or not without knowing the nature of the query.

Parameters

`link` Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

An integer representing the number of fields in a result set.

Examples

Example 7.53 `$mysqli->field_count` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "test");
$mysqli->query( "DROP TABLE IF EXISTS friends");
$mysqli->query( "CREATE TABLE friends (id int, name varchar(20))");
$mysqli->query( "INSERT INTO friends VALUES (1,'Hartmut'), (2, 'Ulf')");
$mysqli->real_query("SELECT * FROM friends");
if ($mysqli->field_count) {
    /* this was a select/show or describe query */
    $result = $mysqli->store_result();
    /* process resultset */
    $row = $result->fetch_row();
    /* free resultset */
    $result->close();
}
/* close connection */
$mysqli->close();
```

```
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "test");
mysqli_query($link, "DROP TABLE IF EXISTS friends");
mysqli_query($link, "CREATE TABLE friends (id int, name varchar(20))");
mysqli_query($link, "INSERT INTO friends VALUES (1,'Hartmut'), (2, 'Ulf')");
mysqli_real_query($link, "SELECT * FROM friends");
if (mysqli_field_count($link)) {
    /* this was a select/show or describe query */
    $result = mysqli_store_result($link);
    /* process resultset */
    $row = mysqli_fetch_row($result);
    /* free resultset */
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

7.3.9.17 mysqli::get_charset, mysqli_get_charset

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- `mysqli::get_charset`

`mysqli_get_charset`

Returns a character set object

Description

Object oriented style

```
object mysqli::get_charset();
```

Procedural style

```
object mysqli_get_charset(
    mysqli link);
```

Returns a character set object providing several properties of the current active character set.

Parameters

`link`

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

The function returns a character set object with the following properties:

`charset`

Character set name

`collation`

Collation name

`dir`

Directory the charset description was fetched from (?) or "" for built-in character sets

`min_length`

Minimum character length in bytes

<i>max_length</i>	Maximum character length in bytes
<i>number</i>	Internal character set number
<i>state</i>	Character set status (?)

Examples

Example 7.54 `mysqli::get_charset` example

Object oriented style

```
<?php
$db = mysqli_init();
$db->real_connect("localhost","root","","test");
var_dump($db->get_charset());
?>
```

Procedural style

```
<?php
$db = mysqli_init();
mysqli_real_connect($db, "localhost","root","","test");
var_dump(mysqli_get_charset($db));
?>
```

The above examples will output:

```
object(stdClass)#2 (7) {
["charset"]=>
string(6) "latin1"
["collation"]=>
string(17) "latin1_swedish_ci"
["dir"]=>
string(0) ""
["min_length"]=>
int(1)
["max_length"]=>
int(1)
["number"]=>
int(8)
["state"]=>
int(801)
}
```

See Also

[mysqli_character_set_name](#)
[mysqli_set_charset](#)

7.3.9.18 `mysqli::$client_info`, `mysqli::get_client_info`, `mysqli_get_client_info`

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- [mysqli::\\$client_info](#)
- [mysqli::get_client_info](#)

mysqli_get_client_info

Get MySQL client info

Description

Object oriented style

```
string  
mysqli->client_info ;  
  
string mysqli::get_client_info();
```

Procedural style

```
string mysqli_get_client_info(  
    mysqli link  
    = =NULL);
```

Returns a string that represents the MySQL client library version.

Return Values

A string that represents the MySQL client library version

Examples**Example 7.55 mysqli_get_client_info**

```
<?php  
/* We don't need a connection to determine  
   the version of mysql client library */  
printf("Client library version: %s\n", mysqli_get_client_info());  
?>
```

See Also

[mysqli_get_client_version](#)
[mysqli_get_server_info](#)
[mysqli_get_server_version](#)

7.3.9.19 mysqli::\$client_version, mysqli_get_client_version

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- [mysqli::\\$client_version](#)

mysqli_get_client_version

Returns the MySQL client version as an integer

Description

Object oriented style

```
int  
mysqli->client_version ;
```

Procedural style

```
int mysqli_get_client_version(  
    mysqli link);
```

Returns client version number as an integer.

Return Values

A number that represents the MySQL client library version in format: `main_version*10000 + minor_version *100 + sub_version`. For example, 4.1.0 is returned as 40100.

This is useful to quickly determine the version of the client library to know if some capability exists.

Examples

Example 7.56 mysqli_get_client_version

```
<?php
/* We don't need a connection to determine
   the version of mysql client library */
printf("Client library version: %d\n", mysqli_get_client_version());
?>
```

See Also

[mysqli_get_client_info](#)
[mysqli_get_server_info](#)
[mysqli_get_server_version](#)

7.3.9.20 mysqli::get_connection_stats, mysqli_get_connection_stats

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- [mysqli::get_connection_stats](#)
[mysqli_get_connection_stats](#)

Returns statistics about the client connection

Description

Object oriented style

```
bool mysqli::get_connection_stats();
```

Procedural style

```
array mysqli_get_connection_stats(
    mysqli link);
```

Returns statistics about the client connection. Available only with [mysqlnd](#).

Parameters

`link`

Procedural style only: A link identifier returned by
[mysqli_connect](#) or [mysqli_init](#)

Return Values

Returns an array with connection stats if success, `FALSE` otherwise.

Examples

Example 7.57 A `mysqli_get_connection_stats` example

```
<?php
```

```
$link = mysqli_connect();
print_r(mysqli_get_connection_stats($link));
?>
```

The above example will output something similar to:

```
Array
(
    [bytes_sent] => 43
    [bytes_received] => 80
    [packets_sent] => 1
    [packets_received] => 2
    [protocol_overhead_in] => 8
    [protocol_overhead_out] => 4
    [bytes_received_ok_packet] => 11
    [bytes_received_eof_packet] => 0
    [bytes_received_rset_header_packet] => 0
    [bytes_received_rset_field_meta_packet] => 0
    [bytes_received_rset_row_packet] => 0
    [bytes_received_prepare_response_packet] => 0
    [bytes_received_change_user_packet] => 0
    [packets_sent_command] => 0
    [packets_received_ok] => 1
    [packets_received_eof] => 0
    [packets_received_rset_header] => 0
    [packets_received_rset_field_meta] => 0
    [packets_received_rset_row] => 0
    [packets_received_prepare_response] => 0
    [packets_received_change_user] => 0
    [result_set_queries] => 0
    [non_result_set_queries] => 0
    [no_index_used] => 0
    [bad_index_used] => 0
    [slow_queries] => 0
    [buffered_sets] => 0
    [unbuffered_sets] => 0
    [ps_buffered_sets] => 0
    [ps_unbuffered_sets] => 0
    [flushed_normal_sets] => 0
    [flushed_ps_sets] => 0
    [ps_prepared_never_executed] => 0
    [ps_prepared_once_executed] => 0
    [rows_fetched_from_server_normal] => 0
    [rows_fetched_from_server_ps] => 0
    [rows_buffered_from_client_normal] => 0
    [rows_buffered_from_client_ps] => 0
    [rows_fetched_from_client_normal_buffered] => 0
    [rows_fetched_from_client_normal_unbuffered] => 0
    [rows_fetched_from_client_ps_buffered] => 0
    [rows_fetched_from_client_ps_unbuffered] => 0
    [rows_fetched_from_client_ps_cursor] => 0
    [rows_skipped_normal] => 0
    [rows_skipped_ps] => 0
    [copy_on_write_saved] => 0
    [copy_on_write_performed] => 0
    [command_buffer_too_small] => 0
    [connect_success] => 1
    [connect_failure] => 0
    [connection_reused] => 0
    [reconnect] => 0
    [pconnect_success] => 0
    [active_connections] => 1
    [active_persistent_connections] => 0
    [explicit_close] => 0
    [implicit_close] => 0
    [disconnect_close] => 0
    [in_middle_of_command_close] => 0
    [explicit_free_result] => 0
    [implicit_free_result] => 0
)
```

```

[explicit_stmt_close] => 0
[implicit_stmt_close] => 0
[mem_emalloc_count] => 0
[mem_emalloc_ammount] => 0
[mem_ecalloc_count] => 0
[mem_ecalloc_ammount] => 0
[mem_erealloc_count] => 0
[mem_erealloc_ammount] => 0
[mem_efree_count] => 0
[mem_malloc_count] => 0
[mem_malloc_ammount] => 0
[mem_calloc_count] => 0
[mem_calloc_ammount] => 0
[mem_realloc_count] => 0
[mem_realloc_ammount] => 0
[mem_free_count] => 0
[proto_text_fetched_null] => 0
[proto_text_fetched_bit] => 0
[proto_text_fetched_tinyint] => 0
[proto_text_fetched_short] => 0
[proto_text_fetched_int24] => 0
[proto_text_fetched_int] => 0
[proto_text_fetched_bigint] => 0
[proto_text_fetched_decimal] => 0
[proto_text_fetched_float] => 0
[proto_text_fetched_double] => 0
[proto_text_fetched_date] => 0
[proto_text_fetched_year] => 0
[proto_text_fetched_time] => 0
[proto_text_fetched_datetime] => 0
[proto_text_fetched_timestamp] => 0
[proto_text_fetched_string] => 0
[proto_text_fetched_blob] => 0
[proto_text_fetched_enum] => 0
[proto_text_fetched_set] => 0
[proto_text_fetched_geometry] => 0
[proto_text_fetched_other] => 0
[proto_binary_fetched_null] => 0
[proto_binary_fetched_bit] => 0
[proto_binary_fetched_tinyint] => 0
[proto_binary_fetched_short] => 0
[proto_binary_fetched_int24] => 0
[proto_binary_fetched_int] => 0
[proto_binary_fetched_bigint] => 0
[proto_binary_fetched_decimal] => 0
[proto_binary_fetched_float] => 0
[proto_binary_fetched_double] => 0
[proto_binary_fetched_date] => 0
[proto_binary_fetched_year] => 0
[proto_binary_fetched_time] => 0
[proto_binary_fetched_datetime] => 0
[proto_binary_fetched_timestamp] => 0
[proto_binary_fetched_string] => 0
[proto_binary_fetched_blob] => 0
[proto_binary_fetched_enum] => 0
[proto_binary_fetched_set] => 0
[proto_binary_fetched_geometry] => 0
[proto_binary_fetched_other] => 0
)

```

See Also[Stats description](#)**7.3.9.21 `mysqli::$host_info`, `mysqli_get_host_info`**[Copyright 1997-2020 the PHP Documentation Group.](#)

- [`mysqli::\$host_info`](#)

`mysqli_get_host_info`

Returns a string representing the type of connection used

Description

Object oriented style

```
string  
    mysqli->host_info ;
```

Procedural style

```
string mysqli_get_host_info(  
    mysqli link);
```

Returns a string describing the connection represented by the [link](#) parameter (including the server host name).

Parameters

`link`

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

Return Values

A character string representing the server hostname and the connection type.

Examples

Example 7.58 \$mysqli->host_info example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
/* print host information */  
printf("Host info: %s\n", $mysqli->host_info);  
/* close connection */  
$mysqli->close();  
?>
```

Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
/* print host information */  
printf("Host info: %s\n", mysqli_get_host_info($link));  
/* close connection */  
mysqli_close($link);  
?>
```

The above examples will output:

```
Host info: Localhost via UNIX socket
```

See Also

[mysqli_get_proto_info](#)

7.3.9.22 `mysqli::$protocol_version`, `mysqli_get_proto_info`

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- [mysqli::\\$protocol_version](#)

[mysqli_get_proto_info](#)

Returns the version of the MySQL protocol used

Description

Object oriented style

```
string  
mysqli->protocol_version ;
```

Procedural style

```
int mysqli_get_proto_info(  
    mysqli link);
```

Returns an integer representing the MySQL protocol version used by the connection represented by the `link` parameter.

Parameters

`link`

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

Return Values

Returns an integer representing the protocol version.

Examples

Example 7.59 `$mysqli->protocol_version` example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password");  
/* check connection */  
if ($mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", $mysqli_connect_error());  
    exit();  
}  
/* print protocol version */  
printf("Protocol version: %d\n", $mysqli->protocol_version);
```

```
/* close connection */
$link->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* print protocol version */
printf("Protocol version: %d\n", mysqli_get_proto_info($link));
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Protocol version: 10
```

See Also

[mysqli_get_host_info](#)

7.3.9.23 `mysqli::$server_info`, `mysqli::get_server_info`, `mysqli_get_server_info`

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- [mysqli::\\$server_info](#)

[mysqli::get_server_info](#)

[mysqli_get_server_info](#)

Returns the version of the MySQL server

Description

Object oriented style

```
string
mysqli->server_info ;

string mysqli_stmt::get_server_info();
```

Procedural style

```
string mysqli_get_server_info(
    mysqli link);
```

Returns a string representing the version of the MySQL server that the MySQLi extension is connected to.

Parameters

[link](#)

Procedural style only: A link identifier returned by
`mysqli_connect` or `mysqli_init`

Return Values

A character string representing the server version.

Examples

Example 7.60 `$mysqli->server_info` example

Object oriented style

```
<?php
$link = new mysqli("localhost", "my_user", "my_password");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* print server version */
printf("Server version: %s\n", $mysqli->server_info);
/* close connection */
$link->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* print server version */
printf("Server version: %s\n", mysqli_get_server_info($link));
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Server version: 4.1.2-alpha-debug
```

See Also

[mysqli_get_client_info](#)
[mysqli_get_client_version](#)
[mysqli_get_server_version](#)

7.3.9.24 `mysqli::$server_version`, `mysqli_get_server_version`

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- [mysqli::\\$server_version](#)

[mysqli_get_server_version](#)

Returns the version of the MySQL server as an integer

Description

Object oriented style

```
int  
    mysqli->server_version ;
```

Procedural style

```
int mysqli_get_server_version(  
    mysqli link);
```

The `mysqli_get_server_version` function returns the version of the server connected to (represented by the `link` parameter) as an integer.

Parameters

`link`

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

An integer representing the server version.

The form of this version number is `main_version * 10000 + minor_version * 100 + sub_version` (i.e. version 4.1.0 is 40100).

Examples

Example 7.61 \$mysqli->server_version example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
/* print server version */  
printf("Server version: %d\n", $mysqli->server_version);  
/* close connection */  
$mysqli->close();  
?>
```

Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
/* print server version */  
printf("Server version: %d\n", mysqli_get_server_version($link));  
/* close connection */
```

```
mysqli_close($link);
?>
```

The above examples will output:

```
Server version: 40102
```

See Also

[mysqli_get_client_info](#)
[mysqli_get_client_version](#)
[mysqli_get_server_info](#)

7.3.9.25 `mysqli::get_warnings`, `mysqli_get_warnings`

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- [mysqli::get_warnings](#)
[mysqli_get_warnings](#)

Get result of SHOW WARNINGS

Description

Object oriented style

```
mysqli_warning mysqli::get_warnings();
```

Procedural style

```
mysqli_warning mysqli_get_warnings(
    mysqli link);
```

Warning

This function is currently not documented; only its argument list is available.

7.3.9.26 `mysqli::$info`, `mysqli_info`

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- [mysqli::\\$info](#)
[mysqli_info](#)

Retrieves information about the most recently executed query

Description

Object oriented style

```
string
mysqli->info ;
```

Procedural style

```
string mysqli_info(
```

```
mysqli link);
```

The `mysqli_info` function returns a string providing information about the last query executed. The nature of this string is provided below:

Table 7.9 Possible mysqli_info return values

Query type	Example result string
INSERT INTO...SELECT...	Records: 100 Duplicates: 0 Warnings: 0
INSERT INTO...VALUES (...),(...),(...)	Records: 3 Duplicates: 0 Warnings: 0
LOAD DATA INFILE ...	Records: 1 Deleted: 0 Skipped: 0 Warnings: 0
ALTER TABLE ...	Records: 3 Duplicates: 0 Warnings: 0
UPDATE ...	Rows matched: 40 Changed: 40 Warnings: 0

Note

Queries which do not fall into one of the preceding formats are not supported. In these situations, `mysqli_info` will return an empty string.

Parameters

`link` Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

A character string representing additional information about the most recently executed query.

Examples

Example 7.62 \$mysqli->info example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$mysqli->query("CREATE TEMPORARY TABLE t1 LIKE City");
/* INSERT INTO .. SELECT */
$mysqli->query("INSERT INTO t1 SELECT * FROM City ORDER BY ID LIMIT 150");
printf("%s\n", $mysqli->info);
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
```

```
mysqli_query($link, "CREATE TEMPORARY TABLE t1 LIKE City");
/* INSERT INTO .. SELECT */
mysqli_query($link, "INSERT INTO t1 SELECT * FROM City ORDER BY ID LIMIT 150");
printf("%s\n", mysqli_info($link));
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Records: 150  Duplicates: 0  Warnings: 0
```

See Also

[mysqli_affected_rows](#)
[mysqli_warning_count](#)
[mysqli_num_rows](#)

7.3.9.27 mysqli::init, mysqli_init

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- [mysqli::init](#)

[mysqli_init](#)

Initializes MySQL and returns a resource for use with [mysqli_real_connect\(\)](#)

Description

Object oriented style

```
mysqli mysqli::init();
```

Procedural style

```
mysqli mysqli_init();
```

Allocates or initializes a MySQL object suitable for [mysqli_options](#) and [mysqli_real_connect](#).

Note

Any subsequent calls to any mysqli function (except [mysqli_options](#)) will fail until [mysqli_real_connect](#) was called.

Return Values

Returns an object.

Examples

See [mysqli_real_connect](#).

See Also

[mysqli_options](#)
[mysqli_close](#)
[mysqli_real_connect](#)

```
mysqli_connect
```

7.3.9.28 mysqli::\$insert_id, mysqli_insert_id

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- `mysqli::$insert_id`

```
mysqli_insert_id
```

Returns the auto generated id used in the latest query

Description

Object oriented style

```
mixed
mysqli->insert_id;
```

Procedural style

```
mixed mysqli_insert_id(
    mysqli link);
```

The `mysqli_insert_id` function returns the ID generated by a query (usually INSERT) on a table with a column having the AUTO_INCREMENT attribute. If no INSERT or UPDATE statements were sent via this connection, or if the modified table does not have a column with the AUTO_INCREMENT attribute, this function will return zero.

Note

Performing an INSERT or UPDATE statement using the `LAST_INSERT_ID()` function will also modify the value returned by the `mysqli_insert_id` function.

Parameters

`link`

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

The value of the `AUTO_INCREMENT` field that was updated by the previous query. Returns zero if there was no previous query on the connection or if the query did not update an `AUTO_INCREMENT` value.

Note

If the number is greater than maximal int value, `mysqli_insert_id` will return a string.

Examples

Example 7.63 \$mysqli->insert_id example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
```

```
    exit();
}
$mysqli->query("CREATE TABLE myCity LIKE City");
$query = "INSERT INTO myCity VALUES (NULL, 'Stuttgart', 'DEU', 'Stuttgart', 617000)";
$mysqli->query($query);
printf ("New Record has id %d.\n", $mysqli->insert_id);
/* drop table */
$mysqli->query("DROP TABLE myCity");
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
mysqli_query($link, "CREATE TABLE myCity LIKE City");
$query = "INSERT INTO myCity VALUES (NULL, 'Stuttgart', 'DEU', 'Stuttgart', 617000)";
mysqli_query($link, $query);
printf ("New Record has id %d.\n", mysqli_insert_id($link));
/* drop table */
mysqli_query($link, "DROP TABLE myCity");
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
New Record has id 1.
```

7.3.9.29 `mysqli::kill`, `mysqli_kill`

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- `mysqli::kill`

```
mysqli_kill
```

Asks the server to kill a MySQL thread

Description

Object oriented style

```
bool mysqli::kill(
    int processid);
```

Procedural style

```
bool mysqli_kill(
    mysqli link,
    int processid);
```

This function is used to ask the server to kill a MySQL thread specified by the `processid` parameter. This value must be retrieved by calling the `mysqli_thread_id` function.

To stop a running query you should use the SQL command `KILL QUERY processid`.

Parameters

`link` Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.64 `mysqli::kill` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error());
    exit();
}
/* determine our thread id */
$thread_id = $mysqli->thread_id;
/* Kill connection */
$mysqli->kill($thread_id);
/* This should produce an error */
if (!$mysqli->query("CREATE TABLE myCity LIKE City")) {
    printf("Error: %s\n", $mysqli->error);
    exit();
}
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if ($link->connect_errno) {
    printf("Connect failed: %s\n", $link->connect_error());
    exit();
}
/* determine our thread id */
$thread_id = mysqli_thread_id($link);
/* Kill connection */
mysqli_kill($link, $thread_id);
/* This should produce an error */
if (!mysqli_query($link, "CREATE TABLE myCity LIKE City")) {
    printf("Error: %s\n", mysqli_error($link));
    exit();
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

Error: MySQL server has gone away

See Also

`mysqli_thread_id`

7.3.9.30 `mysqli::more_results`, `mysqli_more_results`

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- `mysqli::more_results`

Check if there are any more query results from a multi query

Description

Object oriented style

```
bool mysqli::more_results();
```

Procedural style

```
bool mysqli_more_results(  
    mysqli link);
```

Indicates if one or more result sets are available from a previous call to `mysqli_multi_query`.

Parameters

link

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

Returns `TRUE` if one or more result sets are available from a previous call to `mysqli_multi_query`, otherwise `FALSE`.

Examples

See `mysqli_multi_query`.

See Also

```
mysqli_multi_query  
mysqli_next_result  
mysqli_store_result  
mysqli_use_result
```

7.3.9.31 mysqli::multi_query, mysqli_multi_query

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- `mysqli::multi_query`

Performs a query on the database

Description

Object oriented style

```
bool mysqli::multi_query(  
    string query);
```

Procedural style

```
bool mysqli_multi_query(  
    mysqli link,  
    string query);
```

Executes one or multiple queries which are concatenated by a semicolon.

To retrieve the resultset from the first query you can use [mysqli_use_result](#) or [mysqli_store_result](#). All subsequent query results can be processed using [mysqli_more_results](#) and [mysqli_next_result](#).

Parameters

<i>link</i>	Procedural style only: A link identifier returned by mysqli_connect or mysqli_init
<i>query</i>	The query, as a string. Data inside the query should be properly escaped .

Return Values

Returns [FALSE](#) if the first statement failed. To retrieve subsequent errors from other statements you have to call [mysqli_next_result](#) first.

Examples

Example 7.65 mysqli::multi_query example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli->connect_errno) {  
    printf("Connect failed: %s\n", $mysqli->connect_error());  
    exit();  
}  
$query = "SELECT CURRENT_USER();";  
$query .= "SELECT Name FROM City ORDER BY ID LIMIT 20, 5";  
/* execute multi query */  
if ($mysqli->multi_query($query)) {  
    do {  
        /* store first result set */  
        if ($result = $mysqli->store_result()) {  
            while ($row = $result->fetch_row()) {  
                printf("%s\n", $row[0]);  
            }  
            $result->free();  
        }  
        /* print divider */  
        if ($mysqli->more_results()) {  
            printf("-----\n");  
        }  
    } while ($mysqli->next_result());  
}  
/* close connection */  
$mysqli->close();
```

```
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT CURRENT_USER();";
$query .= "SELECT Name FROM City ORDER BY ID LIMIT 20, 5";
/* execute multi query */
if (mysqli_multi_query($link, $query)) {
    do {
        /* store first result set */
        if ($result = mysqli_store_result($link)) {
            while ($row = mysqli_fetch_row($result)) {
                printf("%s\n", $row[0]);
            }
            mysqli_free_result($result);
        }
        /* print divider */
        if (mysqli_more_results($link)) {
            printf("-----\n");
        }
    } while (mysqli_next_result($link));
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output something similar to:

```
my_user@localhost
-----
Amersfoort
Maastricht
Dordrecht
Leiden
Haarlemmermeer
```

See Also

[mysqli_query](#)
[mysqli_use_result](#)
[mysqli_store_result](#)
[mysqli_next_result](#)
[mysqli_more_results](#)

7.3.9.32 `mysqli::next_result`, `mysqli_next_result`

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- [mysqli::next_result](#)

[mysqli_next_result](#)

Prepare next result from multi_query

Description

Object oriented style

```
bool mysqli::next_result();
```

Procedural style

```
bool mysqli_next_result(  
    mysqli link);
```

Prepares next result set from a previous call to [mysqli_multi_query](#) which can be retrieved by [mysqli_store_result](#) or [mysqli_use_result](#).

Parameters

link Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

Return Values

Returns [TRUE](#) on success or [FALSE](#) on failure.

Examples

See [mysqli_multi_query](#).

See Also

[mysqli_multi_query](#)
[mysqli_more_results](#)
[mysqli_store_result](#)
[mysqli_use_result](#)

7.3.9.33 mysqli::options, mysqli_options

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- [mysqli::options](#)

[mysqli_options](#)

Set options

Description

Object oriented style

```
bool mysqli::options(  
    int option,  
    mixed value);
```

Procedural style

```
bool mysqli_options(  
    mysqli link,  
    int option,  
    mixed value);
```

Used to set extra connect options and affect behavior for a connection.

This function may be called multiple times to set several options.

`mysqli_options` should be called after `mysqli_init` and before `mysqli_real_connect`.

Parameters

link

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

option

The option that you want to set. It can be one of the following values:

Table 7.10 Valid options

Name	Description
<code>MYSQLI_OPT_CONNECT_TIMEOUT</code>	connection timeout in seconds (supported on Windows with TCP/IP since PHP 5.3.1)
<code>MYSQLI_OPT_LOCAL_INFILE</code>	enable/disable use of <code>LOAD LOCAL INFILE</code>
<code>MYSQLI_INIT_COMMAND</code>	command to execute after when connecting to MySQL server
<code>MYSQLI_READ_DEFAULT_FILE</code>	Read options from named option file instead of <code>my.cnf</code>
<code>MYSQLI_READ_DEFAULT_GROUP</code>	Read options from the named group from <code>my.cnf</code> or the file specified with <code>MYSQLI_READ_DEFAULT_FILE</code> .
<code>MYSQLI_SERVER_PUBLIC_KEY</code>	RSA public key file used with the SHA-256 based authentication.
<code>MYSQLI_OPT_NET_CMD_BUFFER_SIZE</code>	The size of the internal command/network buffer. Only valid for mysqlnd.
<code>MYSQLI_OPT_NET_READ_BUFFER_SIZE</code>	Maximum read chunk size in bytes when reading the body of a MySQL command packet. Only valid for mysqlnd.
<code>MYSQLI_OPT_INT_AND_FLOAT_NATIVE</code>	Convert integer and float columns back to PHP numbers. Only valid for mysqlnd.
<code>MYSQLI_OPT_SSL_VERIFY_SERVER_CERT</code>	

value

The value for the option.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Changelog

Version	Description
5.5.0	The <code>MYSQLI_SERVER_PUBLIC_KEY</code> and <code>MYSQLI_SERVER_PUBLIC_KEY</code> options were added.
5.3.0	The <code>MYSQLI_OPT_INT_AND_FLOAT_NATIVE</code> , <code>MYSQLI_OPT_NET_CMD_BUFFER_SIZE</code> , <code>MYSQLI_OPT_NET_READ_BUFFER_SIZE</code> , and

Version	Description
	<code>MYSQLI_OPT_SSL_VERIFY_SERVER_CERT</code> options were added.

Examples

See [mysqli_real_connect](#).

Notes

Note

MySQLnd always assumes the server default charset. This charset is sent during connection hand-shake/authentication, which mysqlnd will use.

Libmysqlclient uses the default charset set in the [my.cnf](#) or by an explicit call to [mysqli_options](#) prior to calling [mysqli_real_connect](#), but after [mysqli_init](#).

See Also

[mysqli_init](#)
[mysqli_real_connect](#)

7.3.9.34 `mysqli::ping`, `mysqli_ping`

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- [mysqli::ping](#)

[mysqli_ping](#)

Pings a server connection, or tries to reconnect if the connection has gone down

Description

Object oriented style

```
bool mysqli::ping();
```

Procedural style

```
bool mysqli_ping(  
    mysqli link);
```

Checks whether the connection to the server is working. If it has gone down and global option [mysqli.reconnect](#) is enabled, an automatic reconnection is attempted.

Note

The [php.ini](#) setting `mysqli.reconnect` is ignored by the mysqlnd driver, so automatic reconnection is never attempted.

This function can be used by clients that remain idle for a long while, to check whether the server has closed the connection and reconnect if necessary.

Parameters

link

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

Return Values

Returns **TRUE** on success or **FALSE** on failure.

Examples

Example 7.66 mysqli::ping example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error);
    exit();
}
/* check if server is alive */
if ($mysqli->ping()) {
    printf ("Our connection is ok!\n");
} else {
    printf ("Error: %s\n", $mysqli->error);
}
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* check if server is alive */
if (mysqli_ping($link)) {
    printf ("Our connection is ok!\n");
} else {
    printf ("Error: %s\n", mysqli_error($link));
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Our connection is ok!
```

7.3.9.35 mysqli::poll, mysqli_poll

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- **mysqli::poll**

mysqli_poll

Poll connections

Description

Object oriented style

```
public static int mysqli::poll(
    array read,
    array error,
    array reject,
    int sec,
    int usec
        = 0);
```

Procedural style

```
int mysqli_poll(
    array read,
    array error,
    array reject,
    int sec,
    int usec
        = 0);
```

Poll connections. Available only with [mysqld](#). The method can be used as [static](#).

Parameters

<i>read</i>	List of connections to check for outstanding results that can be read.
<i>error</i>	List of connections on which an error occurred, for example, query failure or lost connection.
<i>reject</i>	List of connections rejected because no asynchronous query has been run on for which the function could poll results.
<i>sec</i>	Maximum number of seconds to wait, must be non-negative.
<i>usec</i>	Maximum number of microseconds to wait, must be non-negative.

Return Values

Returns number of ready connections upon success, [FALSE](#) otherwise.

Examples

Example 7.67 A `mysqli_poll` example

```
<?php
$link1 = mysqli_connect();
$link1->query("SELECT 'test'", MYSQLI_ASYNC);
$all_links = array($link1);
$processed = 0;
do {
    $links = $errors = $reject = array();
    foreach ($all_links as $link) {
        $links[] = $errors[] = $reject[] = $link;
    }
    if (!mysqli_poll($links, $errors, $reject, 1)) {
        continue;
    }
    foreach ($links as $link) {
        if ($result = $link->reap_async_query()) {
            print_r($result->fetch_row());
            if (is_object($result))
                mysqli_free_result($result);
        } else die(sprintf("MySQLi Error: %s", mysqli_error($link)));
        $processed++;
    }
} while ($processed < count($all_links));
?>
```

The above example will output:

```
Array
(
    [0] => test
)
```

See Also

[mysqli_query](#)
[mysqli_reap_async_query](#)

7.3.9.36 mysqli::prepare, mysqli_prepare

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- [mysqli::prepare](#)

[mysqli_prepare](#)

Prepare an SQL statement for execution

Description

Object oriented style

```
mysqli_stmt mysqli::prepare(
    string query);
```

Procedural style

```
mysqli_stmt mysqli_prepare(
    mysqli link,
    string query);
```

Prepares the SQL query, and returns a statement handle to be used for further operations on the statement. The query must consist of a single SQL statement.

The parameter markers must be bound to application variables using [mysqli_stmt_bind_param](#) and/or [mysqli_stmt_bind_result](#) before executing the statement or fetching rows.

Parameters

link

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

query

The query, as a string.

Note

You should not add a terminating semicolon or \g to the statement.

This parameter can include one or more parameter markers in the SQL statement by embedding question mark (?) characters at the appropriate positions.

Note

The markers are legal only in certain places in SQL statements. For example, they are

allowed in the `VALUES()` list of an `INSERT` statement (to specify column values for a row), or in a comparison with a column in a `WHERE` clause to specify a comparison value.

However, they are not allowed for identifiers (such as table or column names), in the select list that names the columns to be returned by a `SELECT` statement, or to specify both operands of a binary operator such as the `=` equal sign. The latter restriction is necessary because it would be impossible to determine the parameter type. It's not allowed to compare marker with `NULL` by `? IS NULL` too. In general, parameters are legal only in Data Manipulation Language (DML) statements, and not in Data Definition Language (DDL) statements.

Return Values

`mysqli_prepare` returns a statement object or `FALSE` if an error occurred.

Examples

Example 7.68 `mysqli::prepare` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$city = "Amersfoort";
/* create a prepared statement */
if ($stmt = $mysqli->prepare("SELECT District FROM City WHERE Name=?")) {
    /* bind parameters for markers */
    $stmt->bind_param("s", $city);
    /* execute query */
    $stmt->execute();
    /* bind result variables */
    $stmt->bind_result($district);
    /* fetch value */
    $stmt->fetch();
    printf("%s is in district %s\n", $city, $district);
    /* close statement */
    $stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if ($link == false) {
```

```
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$city = "Amersfoort";
/* create a prepared statement */
if ($stmt = mysqli_prepare($link, "SELECT District FROM City WHERE Name=?")) {
    /* bind parameters for markers */
    mysqli_stmt_bind_param($stmt, "s", $city);
    /* execute query */
    mysqli_stmt_execute($stmt);
    /* bind result variables */
    mysqli_stmt_bind_result($stmt, $district);
    /* fetch value */
    mysqli_stmt_fetch($stmt);
    printf("%s is in district %s\n", $city, $district);
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Amersfoort is in district Utrecht
```

See Also

[mysqli_stmt_execute](#)
[mysqli_stmt_fetch](#)
[mysqli_stmt_bind_param](#)
[mysqli_stmt_bind_result](#)
[mysqli_stmt_close](#)

7.3.9.37 `mysqli::query`, `mysqli_query`

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- [mysqli::query](#)

[mysqli_query](#)

Performs a query on the database

Description

Object oriented style

```
mixed mysqli::query(
    string query,
    int resultmode
        = MYSQLI_STORE_RESULT);
```

Procedural style

```
mixed mysqli_query(
    mysqli link,
    string query,
    int resultmode
        = MYSQLI_STORE_RESULT);
```

Performs a [query](#) against the database.

For non-DML queries (not INSERT, UPDATE or DELETE), this function is similar to calling `mysqli_real_query` followed by either `mysqli_use_result` or `mysqli_store_result`.

Note

In the case where you pass a statement to `mysqli_query` that is longer than `max_allowed_packet` of the server, the returned error codes are different depending on whether you are using MySQL Native Driver (`mysqlnd`) or MySQL Client Library (`libmysqlclient`). The behavior is as follows:

- `mysqlnd` on Linux returns an error code of 1153. The error message means “got a packet bigger than `max_allowed_packet` bytes”.
- `mysqlnd` on Windows returns an error code 2006. This error message means “server has gone away”.
- `libmysqlclient` on all platforms returns an error code 2006. This error message means “server has gone away”.

Parameters

<code>link</code>	Procedural style only: A link identifier returned by <code>mysqli_connect</code> or <code>mysqli_init</code>
<code>query</code>	The query string. Data inside the query should be properly escaped .
<code>resultmode</code>	Either the constant <code>MYSQLI_USE_RESULT</code> or <code>MYSQLI_STORE_RESULT</code> depending on the desired behavior. By default, <code>MYSQLI_STORE_RESULT</code> is used. If you use <code>MYSQLI_USE_RESULT</code> all subsequent calls will return error Commands out of sync unless you call <code>mysqli_free_result</code>
	With <code>MYSQLI_ASYNC</code> (available with mysqlnd), it is possible to perform query asynchronously. <code>mysqli_poll</code> is then used to get results from such queries.

Return Values

Returns `FALSE` on failure. For successful `SELECT`, `SHOW`, `DESCRIBE` or `EXPLAIN` queries `mysqli_query` will return a `mysqli_result` object. For other successful queries `mysqli_query` will return `TRUE`.

Changelog

Version	Description
5.3.0	Added the ability of async queries.

Examples

Example 7.69 `mysqli::query` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
```

```

if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error);
    exit();
}
/* Create table doesn't return a resultset */
if ($mysqli->query("CREATE TEMPORARY TABLE myCity LIKE City") === TRUE) {
    printf("Table myCity successfully created.\n");
}
/* Select queries return a resultset */
if ($result = $mysqli->query("SELECT Name FROM City LIMIT 10")) {
    printf("Select returned %d rows.\n", $result->num_rows);
    /* free result set */
    $result->close();
}
/* If we have to retrieve large amount of data we use MYSQLI_USE_RESULT */
if ($result = $mysqli->query("SELECT * FROM City", MYSQLI_USE_RESULT)) {
    /* Note, that we can't execute any functions which interact with the
       server until result set was closed. All calls will return an
       'out of sync' error */
    if (!$mysqli->query("SET @a:='this will not work'")) {
        printf("Error: %s\n", $mysqli->error);
    }
    $result->close();
}
$mysqli->close();
?>

```

Procedural style

```

<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* Create table doesn't return a resultset */
if (mysqli_query($link, "CREATE TEMPORARY TABLE myCity LIKE City") === TRUE) {
    printf("Table myCity successfully created.\n");
}
/* Select queries return a resultset */
if ($result = mysqli_query($link, "SELECT Name FROM City LIMIT 10")) {
    printf("Select returned %d rows.\n", mysqli_num_rows($result));
    /* free result set */
    mysqli_free_result($result);
}
/* If we have to retrieve large amount of data we use MYSQLI_USE_RESULT */
if ($result = mysqli_query($link, "SELECT * FROM City", MYSQLI_USE_RESULT)) {
    /* Note, that we can't execute any functions which interact with the
       server until result set was closed. All calls will return an
       'out of sync' error */
    if (!mysqli_query($link, "SET @a:='this will not work'")) {
        printf("Error: %s\n", mysqli_error($link));
    }
    mysqli_free_result($result);
}
mysqli_close($link);
?>

```

The above examples will output:

```

Table myCity successfully created.
Select returned 10 rows.
Error: Commands out of sync; You can't run this command now

```

See Also

[mysqli_real_query](#)
[mysqli_multi_query](#)
[mysqli_free_result](#)

7.3.9.38 `mysqli::real_connect`, `mysqli_real_connect`

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- [mysqli::real_connect](#)

[mysqli_real_connect](#)

Opens a connection to a mysql server

Description

Object oriented style

```
bool mysqli::real_connect(  
    string host,  
    string username,  
    string passwd,  
    string dbname,  
    int port,  
    string socket,  
    int flags);
```

Procedural style

```
bool mysqli_real_connect(  
    mysqli link,  
    string host,  
    string username,  
    string passwd,  
    string dbname,  
    int port,  
    string socket,  
    int flags);
```

Establish a connection to a MySQL database engine.

This function differs from [mysqli_connect](#):

- [mysqli_real_connect](#) needs a valid object which has to be created by function [mysqli_init](#).
- With the [mysqli_options](#) function you can set various options for connection.
- There is a [*flags*](#) parameter.

Parameters

link

Procedural style only: A link identifier returned by
[mysqli_connect](#) or [mysqli_init](#)

host

Can be either a host name or an IP address. Passing the [NULL](#) value or the string "localhost" to this parameter, the local host is assumed. When possible, pipes will be used instead of the TCP/IP protocol.

username

The MySQL user name.

passwd

If provided or [NULL](#), the MySQL server will attempt to authenticate the user against those user records which have no password only.

This allows one username to be used with different permissions (depending on if a password as provided or not).

dbname

If provided will specify the default database to be used when performing queries.

port

Specifies the port number to attempt to connect to the MySQL server.

socket

Specifies the socket or named pipe that should be used.

Note

Specifying the *socket* parameter will not explicitly determine the type of connection to be used when connecting to the MySQL server. How the connection is made to the MySQL database is determined by the *host* parameter.

flags

With the parameter *flags* you can set different connection options:

Table 7.11 Supported flags

Name	Description
<code>MYSQLI_CLIENT_COMPRESS</code>	Use compression protocol
<code>MYSQLI_CLIENT_FOUND_ROWS</code>	return number of matched rows, not the number of affected rows
<code>MYSQLI_CLIENT_IGNORE_SPACE</code>	Allow spaces after function names. Makes all function names reserved words.
<code>MYSQLI_CLIENT_INTERACTIVE</code>	Allow <code>interactive_timeout</code> seconds (instead of <code>wait_timeout</code> seconds) of inactivity before closing the connection
<code>MYSQLI_CLIENT_SSL</code>	Use SSL (encryption)
<code>MYSQLI_CLIENT_SSL_DONT_VERIFY_SERVER_CERT</code>	Like <code>MYSQLI_CLIENT_SSL</code> , but disables validation of the provided SSL certificate. This is only for installations using MySQL Native Driver and MySQL 5.6 or later.

Note

For security reasons the `MULTI_STATEMENT` flag is not supported in PHP. If you want to execute multiple queries use the `mysqli_multi_query` function.

Changelog

Version	Description
5.6.16	Added the <code>MYSQLI_CLIENT_SSL_DONT_VERIFY_SERVER_CERT</code> flag for MySQL Native Driver

Return Values

Returns **TRUE** on success or **FALSE** on failure.

Examples

Example 7.70 mysqli::real_connect example

Object oriented style

```
<?php
$mysqli = mysqli_init();
if (!$mysqli) {
    die('mysqli_init failed');
}
if (!$mysqli->options(MYSQLI_INIT_COMMAND, 'SET AUTOCOMMIT = 0')) {
    die('Setting MYSQLI_INIT_COMMAND failed');
}
if (!$mysqli->options(MYSQLI_OPT_CONNECT_TIMEOUT, 5)) {
    die('Setting MYSQLI_OPT_CONNECT_TIMEOUT failed');
}
if (!$mysqli->real_connect('localhost', 'my_user', 'my_password', 'my_db')) {
    die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}
echo 'Success... ' . $mysqli->host_info . "\n";
$mysqli->close();
?>
```

Object oriented style when extending mysqli class

```
<?php
class foo_mysqli extends mysqli {
    public function __construct($host, $user, $pass, $db) {
        parent::__construct($host, $user, $pass, $db);
        if (!parent::options(MYSQLI_INIT_COMMAND, 'SET AUTOCOMMIT = 0')) {
            die('Setting MYSQLI_INIT_COMMAND failed');
        }
        if (!parent::options(MYSQLI_OPT_CONNECT_TIMEOUT, 5)) {
            die('Setting MYSQLI_OPT_CONNECT_TIMEOUT failed');
        }
        if (!parent::real_connect($host, $user, $pass, $db)) {
            die('Connect Error (' . mysqli_connect_errno() . ') '
                . mysqli_connect_error());
        }
    }
}
$db = new foo_mysqli('localhost', 'my_user', 'my_password', 'my_db');
echo 'Success... ' . $db->host_info . "\n";
$db->close();
?>
```

Procedural style

```
<?php
$link = mysqli_init();
if (!$link) {
    die('mysqli_init failed');
}
if (!mysqli_options($link, MYSQLI_INIT_COMMAND, 'SET AUTOCOMMIT = 0')) {
    die('Setting MYSQLI_INIT_COMMAND failed');
}
if (!mysqli_options($link, MYSQLI_OPT_CONNECT_TIMEOUT, 5)) {
```

```
    die('Setting MYSQLI_OPT_CONNECT_TIMEOUT failed');
}
if (!mysqli_real_connect($link, 'localhost', 'my_user', 'my_password', 'my_db')) {
    die('Connect Error (' . mysqli_connect_errno() . ') '
        . mysqli_connect_error());
}
echo 'Success... ' . mysqli_get_host_info($link) . "\n";
mysqli_close($link);
?>
```

The above examples will output:

```
Success... MySQL host info: localhost via TCP/IP
```

Notes

Note

MySQLnd always assumes the server default charset. This charset is sent during connection hand-shake/authentication, which mysqld will use.

Libmysqlclient uses the default charset set in the [my.cnf](#) or by an explicit call to [mysqli_options](#) prior to calling [mysqli_real_connect](#), but after [mysqli_init](#).

See Also

[mysqli_connect](#)
[mysqli_init](#)
[mysqli_options](#)
[mysqli_ssl_set](#)
[mysqli_close](#)

7.3.9.39 [mysqli::real_escape_string](#), [mysqli::escape_string](#), [mysqli_real_escape_string](#)

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- [mysqli::real_escape_string](#)

[mysqli::escape_string](#)

[mysqli_real_escape_string](#)

Escapes special characters in a string for use in an SQL statement, taking into account the current charset of the connection

Description

Object oriented style

```
string mysqli::escape_string(
    string escapestr);
```

```
string mysqli::real_escape_string(
    string escapestr);
```

Procedural style

```
string mysqli_real_escape_string(
```

```
mysqli_link,
string escapestr);
```

This function is used to create a legal SQL string that you can use in an SQL statement. The given string is encoded to an escaped SQL string, taking into account the current character set of the connection.

Security: the default character set

The character set must be set either at the server level, or with the API function `mysqli_set_charset` for it to affect `mysqli_real_escape_string`. See the concepts section on [character sets](#) for more information.

Parameters

<code>link</code>	Procedural style only: A link identifier returned by <code>mysqli_connect</code> or <code>mysqli_init</code>
<code>escapestr</code>	The string to be escaped. Characters encoded are <code>NUL</code> (ASCII 0), <code>\n</code> , <code>\r</code> , <code>\</code> , <code>'</code> , <code>"</code> , and <code>Control-Z</code> .

Return Values

Returns an escaped string.

Errors/Exceptions

Executing this function without a valid MySQLi connection passed in will return `NULL` and emit `E_WARNING` level errors.

Examples

Example 7.71 `mysqli::real_escape_string` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error());
    exit();
}
$mysqli->query("CREATE TEMPORARY TABLE myCity LIKE City");
$city = "'s Hertogenbosch";
/* this query will fail, cause we didn't escape $city */
if (!$mysqli->query("INSERT into myCity (Name) VALUES ('$city')")) {
    printf("Error: %s\n", $mysqli->sqlstate);
}
$city = $mysqli->real_escape_string($city);
/* this query with escaped $city will work */
if ($mysqli->query("INSERT into myCity (Name) VALUES ('$city')")) {
    printf("%d Row inserted.\n", $mysqli->affected_rows);
}
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
mysqli_query($link, "CREATE TEMPORARY TABLE myCity LIKE City");
$city = "'s Hertogenbosch";
/* this query will fail, cause we didn't escape $city */
if (!mysqli_query($link, "INSERT into myCity (Name) VALUES ('$city')")) {
    printf("Error: %s\n", mysqli_sqlstate($link));
}
$city = mysqli_real_escape_string($link, $city);
/* this query with escaped $city will work */
if (mysqli_query($link, "INSERT into myCity (Name) VALUES ('$city')")) {
    printf("%d Row inserted.\n", mysqli_affected_rows($link));
}
mysqli_close($link);
?>
```

The above examples will output:

```
Error: 42000
1 Row inserted.
```

Notes

Note

For those accustomed to using `mysql_real_escape_string`, note that the arguments of `mysqli_real_escape_string` differ from what `mysql_real_escape_string` expects. The `link` identifier comes first in `mysqli_real_escape_string`, whereas the string to be escaped comes first in `mysql_real_escape_string`.

See Also

[mysqli_set_charset](#)
[mysqli_character_set_name](#)

7.3.9.40 `mysqli::real_query`, `mysqli_real_query`

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- [mysqli::real_query](#)

[mysqli_real_query](#)

Execute an SQL query

Description

Object oriented style

```
bool mysqli::real_query(
    string query);
```

Procedural style

```
bool mysqli_real_query(
```

```
mysqli link,  
string query);
```

Executes a single query against the database whose result can then be retrieved or stored using the [mysqli_store_result](#) or [mysqli_use_result](#) functions.

In order to determine if a given query should return a result set or not, see [mysqli_field_count](#).

Parameters

<code>link</code>	Procedural style only: A link identifier returned by mysqli_connect or mysqli_init
<code>query</code>	The query, as a string. Data inside the query should be properly escaped .

Return Values

Returns [TRUE](#) on success or [FALSE](#) on failure.

See Also

[mysqli_query](#)
[mysqli_store_result](#)
[mysqli_use_result](#)

7.3.9.41 `mysqli::reap_async_query`, `mysqli_reap_async_query`

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- [mysqli::reap_async_query](#)

[mysqli_reap_async_query](#)

Get result from async query

Description

Object oriented style

```
public mysqli_result mysqli::reap_async_query();
```

Procedural style

```
mysqli_result mysqli_reap_async_query(  
    mysqli link);
```

Get result from async query. Available only with [mysqlnd](#).

Parameters

<code>link</code>	Procedural style only: A link identifier returned by mysqli_connect or mysqli_init
-------------------	--

Return Values

Returns [mysqli_result](#) in success, [FALSE](#) otherwise.

See Also

[mysqli_poll](#)

7.3.9.42 mysqli::refresh, mysqli_refresh

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- `mysqli::refresh`

`mysqli_refresh`

Refreshes

Description

Object oriented style

```
public bool mysqli::refresh(  
    int options);
```

Procedural style

```
bool mysqli_refresh(  
    resource link,  
    int options);
```

Flushes tables or caches, or resets the replication server information.

Parameters

`link`

Procedural style only: A link identifier returned by
`mysqli_connect` or `mysqli_init`

`options`

The options to refresh, using the `MYSQLI_REFRESH_*` constants
as documented within the [MySQLi constants](#) documentation.

See also the official [MySQL Refresh](#) documentation.

Return Values

`TRUE` if the refresh was a success, otherwise `FALSE`

See Also

`mysqli_poll`

7.3.9.43 mysqli::release_savepoint, mysqli_release_savepoint

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- `mysqli::release_savepoint`

`mysqli_release_savepoint`

Removes the named savepoint from the set of savepoints of the current transaction

Description

Object oriented style (method):

```
public bool mysqli::release_savepoint(  
    string name);
```

Procedural style:

```
bool mysqli_release_savepoint(
```

```
mysqli link,  
string name);
```

Warning

This function is currently not documented; only its argument list is available.

Parameters

link

Procedural style only: A link identifier returned by
`mysqli_connect` or `mysqli_init`

name

Return Values

Returns `TRUE` on success or `FALSE` on failure.

See Also

`mysqli_rollback`

7.3.9.44 `mysqli::rollback`, `mysqli_rollback`

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• `mysqli::rollback`

`mysqli_rollback`

Rolls back current transaction

Description

Object oriented style

```
bool mysqli::rollback(  
    int flags  
    = 0,  
    string name);
```

Procedural style

```
bool mysqli_rollback(  
    mysqli link,  
    int flags  
    = 0,  
    string name);
```

Rollbacks the current transaction for the database.

Parameters

link

Procedural style only: A link identifier returned by
`mysqli_connect` or `mysqli_init`

flags

A bitmask of `MYSQLI_TRANS_COR_*` constants.

name

If provided then `ROLLBACK /*name*/` is executed.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Changelog

Version	Description
5.5.0	Added <code>flags</code> and <code>name</code> parameters.

Examples

Example 7.72 mysqli::rollback example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* disable autocommit */
$mysqli->autocommit(FALSE);
$mysqli->query("CREATE TABLE myCity LIKE City");
$mysqli->query("ALTER TABLE myCity Type=InnoDB");
$mysqli->query("INSERT INTO myCity SELECT * FROM City LIMIT 50");
/* commit insert */
$mysqli->commit();
/* delete all rows */
$mysqli->query("DELETE FROM myCity");
if ($result = $mysqli->query("SELECT COUNT(*) FROM myCity")) {
    $row = $result->fetch_row();
    printf("%d rows in table myCity.\n", $row[0]);
    /* Free result */
    $result->close();
}
/* Rollback */
$mysqli->rollback();
if ($result = $mysqli->query("SELECT COUNT(*) FROM myCity")) {
    $row = $result->fetch_row();
    printf("%d rows in table myCity (after rollback).\n", $row[0]);
    /* Free result */
    $result->close();
}
/* Drop table myCity */
$mysqli->query("DROP TABLE myCity");
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* disable autocommit */
mysqli_autocommit($link, FALSE);
mysqli_query($link, "CREATE TABLE myCity LIKE City");
mysqli_query($link, "ALTER TABLE myCity Type=InnoDB");
mysqli_query($link, "INSERT INTO myCity SELECT * FROM City LIMIT 50");
/* commit insert */
mysqli_commit($link);
/* delete all rows */
mysqli_query($link, "DELETE FROM myCity");
if ($result = mysqli_query($link, "SELECT COUNT(*) FROM myCity")) {
```

```

$row = mysqli_fetch_row($result);
printf("%d rows in table myCity.\n", $row[0]);
/* Free result */
mysqli_free_result($result);
}
/* Rollback */
mysqli_rollback($link);
if ($result = mysqli_query($link, "SELECT COUNT(*) FROM myCity")) {
    $row = mysqli_fetch_row($result);
    printf("%d rows in table myCity (after rollback).\n", $row[0]);
    /* Free result */
    mysqli_free_result($result);
}
/* Drop table myCity */
mysqli_query($link, "DROP TABLE myCity");
mysqli_close($link);
?>

```

The above examples will output:

```

0 rows in table myCity.
50 rows in table myCity (after rollback).

```

See Also

[mysqli_begin_transaction](#)
[mysqli_commit](#)
[mysqli_autocommit](#)
[mysqli_release_savepoint](#)

7.3.9.45 `mysqli::rpl_query_type`, `mysqli_rpl_query_type`

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- [mysqli::rpl_query_type](#)

[mysqli_rpl_query_type](#)

Returns RPL query type

Description

Object oriented style

```

int mysqli::rpl_query_type(
    string query);

```

Procedural style

```

int mysqli_rpl_query_type(
    mysqli link,
    string query);

```

Returns [MYSQLI_RPL_MASTER](#), [MYSQLI_RPL_SLAVE](#) or [MYSQLI_RPL_ADMIN](#) depending on a query type. [INSERT](#), [UPDATE](#) and similar are *master* queries, [SELECT](#) is *slave*, and [FLUSH](#), [REPAIR](#) and similar are *admin*.

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.9.46 mysqli::savepoint, mysqli_savepoint

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- `mysqli::savepoint`

`mysqli_savepoint`

Set a named transaction savepoint

Description

Object oriented style (method):

```
public bool mysqli::savepoint(  
    string name);
```

Procedural style:

```
bool mysqli_savepoint(  
    mysqli link,  
    string name);
```

Warning

This function is currently not documented; only its argument list is available.

Parameters

`link` Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

`name`

Return Values

Returns `TRUE` on success or `FALSE` on failure.

See Also

`mysqli_commit`

7.3.9.47 mysqli::select_db, mysqli_select_db

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- `mysqli::select_db`

`mysqli_select_db`

Selects the default database for database queries

Description

Object oriented style

```
bool mysqli::select_db(
```

```
    string dbname);
```

Procedural style

```
bool mysqli_select_db(  
    mysqli link,  
    string dbname);
```

Selects the default database to be used when performing queries against the database connection.

Note

This function should only be used to change the default database for the connection. You can select the default database with 4th parameter in [mysqli_connect](#).

Parameters

link Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

dbname The database name.

Return Values

Returns [TRUE](#) on success or [FALSE](#) on failure.

Examples

Example 7.73 `mysqli::select_db` example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "test");  
/* check connection */  
if ($mysqli->connect_errno) {  
    printf("Connect failed: %s\n", $mysqli->connect_error());  
    exit();  
}  
/* return name of current default database */  
if ($result = $mysqli->query("SELECT DATABASE()")) {  
    $row = $result->fetch_row();  
    printf("Default database is %s.\n", $row[0]);  
    $result->close();  
}  
/* change db to world db */  
$mysqli->select_db("world");  
/* return name of current default database */  
if ($result = $mysqli->query("SELECT DATABASE()")) {  
    $row = $result->fetch_row();  
    printf("Default database is %s.\n", $row[0]);  
    $result->close();  
}  
$mysqli->close();  
?>
```

Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "test");  
/* check connection */
```

```
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* return name of current default database */
if ($result = mysqli_query($link, "SELECT DATABASE()")) {
    $row = mysqli_fetch_row($result);
    printf("Default database is %s.\n", $row[0]);
    mysqli_free_result($result);
}
/* change db to world db */
mysqli_select_db($link, "world");
/* return name of current default database */
if ($result = mysqli_query($link, "SELECT DATABASE()")) {
    $row = mysqli_fetch_row($result);
    printf("Default database is %s.\n", $row[0]);
    mysqli_free_result($result);
}
mysqli_close($link);
?>
```

The above examples will output:

```
Default database is test.
Default database is world.
```

See Also

[mysqli_connect](#)
[mysqli_real_connect](#)

7.3.9.48 `mysqli::send_query`, `mysqli_send_query`

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- [mysqli::send_query](#)

[mysqli_send_query](#)

Send the query and return

Description

Object oriented style

```
bool mysqli::send_query(
    string query);
```

Procedural style

```
bool mysqli_send_query(
    mysqli link,
    string query);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.9.49 `mysqli::set_charset`, `mysqli_set_charset`

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- `mysqli::set_charset`

`mysqli_set_charset`

Sets the default client character set

Description

Object oriented style

```
bool mysqli::set_charset(
    string charset);
```

Procedural style

```
bool mysqli_set_charset(
    mysqli link,
    string charset);
```

Sets the default character set to be used when sending data from and to the database server.

Parameters

`link`

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

`charset`

The charset to be set as default.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Notes

Note

To use this function on a Windows platform you need MySQL client library version 4.1.11 or above (for MySQL 5.0 you need 5.0.6 or above).

Note

This is the preferred way to change the charset. Using `mysqli_query` to set it (such as `SET NAMES utf8`) is not recommended. See the [MySQL character set concepts](#) section for more information.

Examples

Example 7.74 `mysqli::set_charset` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "test");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
printf("Initial character set: %s\n", $mysqli->character_set_name());
/* change character set to utf8 */
```

```
if (!mysqli->set_charset("utf8")) {
    printf("Error loading character set utf8: %s\n", $mysqli->error);
    exit();
} else {
    printf("Current character set: %s\n", $mysqli->character_set_name());
}
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect('localhost', 'my_user', 'my_password', 'test');
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
printf("Initial character set: %s\n", mysqli_character_set_name($link));
/* change character set to utf8 */
if (!mysqli_set_charset($link, "utf8")) {
    printf("Error loading character set utf8: %s\n", mysqli_error($link));
    exit();
} else {
    printf("Current character set: %s\n", mysqli_character_set_name($link));
}
mysqli_close($link);
?>
```

The above examples will output something similar to:

```
Initial character set: latin1
Current character set: utf8
```

See Also

[mysqli_character_set_name](#)
[mysqli_real_escape_string](#)
[MySQL character set concepts](#)
[List of character sets that MySQL supports](#)

7.3.9.50 `mysqli::set_local_infile_default`, `mysqli_set_local_infile_default`

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- [mysqli::set_local_infile_default](#)
[mysqli_set_local_infile_default](#)

Unsets user defined handler for load local infile command

Description

```
void mysqli_set_local_infile_default(
    mysqli link);
```

Deactivates a `LOAD DATA INFILE LOCAL` handler previously set with
[mysqli_set_local_infile_handler](#).

Parameters

<code>link</code>	Procedural style only: A link identifier returned by <code>mysqli_connect</code> or <code>mysqli_init</code>
-------------------	--

Return Values

No value is returned.

Examples

See `mysqli_set_local_infile_handler` examples

See Also

`mysqli_set_local_infile_handler`

7.3.9.51 `mysqli::set_local_infile_handler`, `mysqli_set_local_infile_handler`

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- `mysqli::set_local_infile_handler`
- `mysqli_set_local_infile_handler`

Set callback function for LOAD DATA LOCAL INFILE command

Description

Object oriented style

```
bool mysqli::set_local_infile_handler(  
    mysqli link,  
    callable read_func);
```

Procedural style

```
bool mysqli_set_local_infile_handler(  
    mysqli link,  
    callable read_func);
```

Set callback function for LOAD DATA LOCAL INFILE command

The callbacks task is to read input from the file specified in the `LOAD DATA LOCAL INFILE` and to reformat it into the format understood by `LOAD DATA INFILE`.

The returned data needs to match the format specified in the `LOAD DATA`

Parameters

<code>link</code>	Procedural style only: A link identifier returned by <code>mysqli_connect</code> or <code>mysqli_init</code>
<code>read_func</code>	A callback function or object method taking the following parameters:
<code>stream</code>	A PHP stream associated with the SQL commands INFILE
<code>&buffer</code>	A string buffer to store the rewritten input into

buflen

The maximum number of characters to be stored in the buffer

&errmsg

If an error occurs you can store an error message in here

The callback function should return the number of characters stored in the *buffer* or a negative value if an error occurred.

Return Values

Returns **TRUE** on success or **FALSE** on failure.

Examples

Example 7.75 `mysqli::set_local_infile_handler` example

Object oriented style

```
<?php
$db = mysqli_init();
$db->real_connect("localhost","root","","test");
function callme($stream, &$buffer, $buflen, &$errmsg)
{
    $buffer = fgets($stream);
    echo $buffer;
    // convert to upper case and replace "," delimiter with [TAB]
    $buffer = strtoupper(str_replace(",", "\t", $buffer));
    return strlen($buffer);
}
echo "Input:\n";
$db->set_local_infile_handler("callme");
$db->query("LOAD DATA LOCAL INFILE 'input.txt' INTO TABLE t1");
$db->set_local_infile_default();
$res = $db->query("SELECT * FROM t1");
echo "\nResult:\n";
while ($row = $res->fetch_assoc()) {
    echo join(", ", $row)."\n";
}
?>
```

Procedural style

```
<?php
$db = mysqli_init();
mysqli_real_connect($db, "localhost","root","","test");
function callme($stream, &$buffer, $buflen, &$errmsg)
{
    $buffer = fgets($stream);
    echo $buffer;
    // convert to upper case and replace "," delimiter with [TAB]
    $buffer = strtoupper(str_replace(",", "\t", $buffer));
    return strlen($buffer);
}
echo "Input:\n";
mysqli_set_local_infile_handler($db, "callme");
mysqli_query($db, "LOAD DATA LOCAL INFILE 'input.txt' INTO TABLE t1");
mysqli_set_local_infile_default($db);
$res = mysqli_query($db, "SELECT * FROM t1");
echo "\nResult:\n";
while ($row = mysqli_fetch_assoc($res)) {
    echo join(", ", $row)."\n";
```

```
    }  
?>
```

The above examples will output:

```
Input:  
23,foo  
42,bar  
Output:  
23,FOO  
42,BAR
```

See Also

[mysqli_set_local_infile_default](#)

7.3.9.52 `mysqli::$sqlstate`, `mysqli_sqlstate`

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- [mysqli::\\$sqlstate](#)
- [mysqli_sqlstate](#)

Returns the SQLSTATE error from previous MySQL operation

Description

Object oriented style

```
string  
mysqli->sqlstate ;
```

Procedural style

```
string mysqli_sqlstate(  
    mysqli link);
```

Returns a string containing the SQLSTATE error code for the last error. The error code consists of five characters. '[00000](#)' means no error. The values are specified by ANSI SQL and ODBC. For a list of possible values, see <http://dev.mysql.com/doc/mysql/en/error-handling.html>.

Note

Note that not all MySQL errors are yet mapped to SQLSTATE's. The value [HY000](#) (general error) is used for unmapped errors.

Parameters

[link](#)

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

Return Values

Returns a string containing the SQLSTATE error code for the last error. The error code consists of five characters. '[00000](#)' means no error.

Examples

Example 7.76 \$mysqli->sqlstate example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
/* Table City already exists, so we should get an error */
if (!$mysqli->query("CREATE TABLE City (ID INT, Name VARCHAR(30))")) {
    printf("Error - SQLSTATE %s.\n", $mysqli->sqlstate);
}
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
/* Table City already exists, so we should get an error */
if (!mysqli_query($link, "CREATE TABLE City (ID INT, Name VARCHAR(30))")) {
    printf("Error - SQLSTATE %s.\n", $mysqli_sqlstate($link));
}
mysqli_close($link);
?>
```

The above examples will output:

```
Error - SQLSTATE 42S01.
```

See Also

[mysqli_errno](#)
[mysqli_error](#)

7.3.9.53 mysqli::ssl_set, mysqli_ssl_set

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- [mysqli::ssl_set](#)

[mysqli_ssl_set](#)

Used for establishing secure connections using SSL

Description

Object oriented style

```
bool mysqli::ssl_set(
    string key,
```

```
    string cert,  
    string ca,  
    string capath,  
    string cipher);
```

Procedural style

```
bool mysqli_ssl_set(  
    mysqli link,  
    string key,  
    string cert,  
    string ca,  
    string capath,  
    string cipher);
```

Used for establishing secure connections using SSL. It must be called before [mysqli_real_connect](#). This function does nothing unless OpenSSL support is enabled.

Note that MySQL Native Driver does not support SSL before PHP 5.3.3, so calling this function when using MySQL Native Driver will result in an error. MySQL Native Driver is enabled by default on Microsoft Windows from PHP version 5.3 onwards.

Parameters

<i>link</i>	Procedural style only: A link identifier returned by mysqli_connect or mysqli_init
<i>key</i>	The path name to the key file.
<i>cert</i>	The path name to the certificate file.
<i>ca</i>	The path name to the certificate authority file.
<i>capath</i>	The pathname to a directory that contains trusted SSL CA certificates in PEM format.
<i>cipher</i>	A list of allowable ciphers to use for SSL encryption.

Return Values

This function always returns [TRUE](#) value. If SSL setup is incorrect [mysqli_real_connect](#) will return an error when you attempt to connect.

See Also

[mysqli_options](#)
[mysqli_real_connect](#)

7.3.9.54 [mysqli::stat](#), [mysqli_stat](#)

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- [mysqli::stat](#)

[mysqli_stat](#)

Gets the current system status

Description

Object oriented style

```
string mysqli::stat();
```

Procedural style

```
string mysqli_stat(  
    mysqli link);
```

`mysqli_stat` returns a string containing information similar to that provided by the 'mysqladmin status' command. This includes uptime in seconds and the number of running threads, questions, reloads, and open tables.

Parameters

`link` Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

A string describing the server status. `FALSE` if an error occurred.

Examples

Example 7.77 `mysqli::stat` example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli->connect_errno) {  
    printf("Connect failed: %s\n", $mysqli->connect_error());  
    exit();  
}  
printf ("System status: %s\n", $mysqli->stat());  
$mysqli->close();  
?>
```

Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($link->connect_errno) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
printf ("System status: %s\n", mysqli_stat($link));  
mysqli_close($link);  
?>
```

The above examples will output:

```
System status: Uptime: 272 Threads: 1 Questions: 5340 Slow queries: 0  
Opens: 13 Flush tables: 1 Open tables: 0 Queries per second avg: 19.632  
Memory in use: 8496K Max memory used: 8560K
```

See Also

[mysqli_get_server_info](#)

7.3.9.55 mysqli::stmt_init, mysqli_stmt_init

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- [mysqli::stmt_init](#)

[mysqli_stmt_init](#)

Initializes a statement and returns an object for use with [mysqli_stmt_prepare](#)

Description

Object oriented style

```
mysqli_stmt mysqli::stmt_init();
```

Procedural style

```
mysqli_stmt mysqli_stmt_init(
    mysqli link);
```

Allocates and initializes a statement object suitable for [mysqli_stmt_prepare](#).

Note

Any subsequent calls to any [mysqli_stmt](#) function will fail until [mysqli_stmt_prepare](#) was called.

Parameters

link

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

Return Values

Returns an object.

See Also

[mysqli_stmt_prepare](#)

7.3.9.56 mysqli::store_result, mysqli_store_result

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- [mysqli::store_result](#)

[mysqli_store_result](#)

Transfers a result set from the last query

Description

Object oriented style

```
mysqli_result mysqli::store_result(
    int option);
```

Procedural style

```
mysqli_result mysqli_store_result(
    mysqli link,
```

```
int option);
```

Transfers the result set from the last query on the database connection represented by the [link](#) parameter to be used with the [mysqli_data_seek](#) function.

Parameters

[link](#)

Procedural style only: A link identifier returned by [mysqli_connect](#) or [mysqli_init](#)

[option](#)

The option that you want to set. It can be one of the following values:

Table 7.12 Valid options

Name	Description
MYSQLI_STORE_RESULT_COPY_ID	Copy results from the internal mysqld buffer into the PHP variables fetched. By default, mysqld will use a reference logic to avoid copying and duplicating results held in memory. For certain result sets, for example, result sets with many small rows, the copy approach can reduce the overall memory usage because PHP variables holding results may be released earlier (available with mysqld only, since PHP 5.6.0)

Return Values

Returns a buffered result object or [FALSE](#) if an error occurred.

Note

[mysqli_store_result](#) returns [FALSE](#) in case the query didn't return a result set (if the query was, for example an INSERT statement). This function also returns [FALSE](#) if the reading of the result set failed. You can check if you have got an error by checking if [mysqli_error](#) doesn't return an empty string, if [mysqli_errno](#) returns a non zero value, or if [mysqli_field_count](#) returns a non zero value. Also possible reason for this function returning [FALSE](#) after successful call to [mysqli_query](#) can be too large result set (memory for it cannot be allocated). If [mysqli_field_count](#) returns a non-zero value, the statement should have produced a non-empty result set.

Notes

Note

Although it is always good practice to free the memory used by the result of a query using the [mysqli_free_result](#) function, when transferring large result sets using the [mysqli_store_result](#) this becomes particularly important.

Examples

See [mysqli_multi_query](#).

See Also

```
mysqli_real_query  
mysqli_use_result
```

7.3.9.57 mysqli::\$thread_id, mysqli_thread_id

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- `mysqli::$thread_id`

```
mysqli_thread_id
```

Returns the thread ID for the current connection

Description

Object oriented style

```
int  
mysqli->thread_id ;
```

Procedural style

```
int mysqli_thread_id(  
    mysqli link);
```

The `mysqli_thread_id` function returns the thread ID for the current connection which can then be killed using the `mysqli_kill` function. If the connection is lost and you reconnect with `mysqli_ping`, the thread ID will be other. Therefore you should get the thread ID only when you need it.

Note

The thread ID is assigned on a connection-by-connection basis. Hence, if the connection is broken and then re-established a new thread ID will be assigned.

To kill a running query you can use the SQL command `KILL QUERY processid`.

Parameters

`link`

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

Returns the Thread ID for the current connection.

Examples

Example 7.78 \$mysqli->thread_id example

Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
/* determine our thread id */  
$thread_id = $mysqli->thread_id;  
/* Kill connection */
```

```
$mysqli->kill($thread_id);
/* This should produce an error */
if (!$mysqli->query("CREATE TABLE myCity LIKE City")) {
    printf("Error: %s\n", $mysqli->error);
    exit;
}
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* determine our thread id */
$thread_id = mysqli_thread_id($link);
/* Kill connection */
mysqli_kill($link, $thread_id);
/* This should produce an error */
if (!mysqli_query($link, "CREATE TABLE myCity LIKE City")) {
    printf("Error: %s\n", mysqli_error($link));
    exit();
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Error: MySQL server has gone away
```

See Also

[mysqli_kill](#)

7.3.9.58 `mysqli::thread_safe`, `mysqli_thread_safe`

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- [mysqli::thread_safe](#)

[mysqli_thread_safe](#)

Returns whether thread safety is given or not

Description

Procedural style

```
bool mysqli_thread_safe();
```

Tells whether the client library is compiled as thread-safe.

Return Values

`TRUE` if the client library is thread-safe, otherwise `FALSE`.

7.3.9.59 `mysqli::use_result`, `mysqli_use_result`

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- `mysqli::use_result`

`mysqli_use_result`

Initiate a result set retrieval

Description

Object oriented style

```
mysqli_result mysqli::use_result();
```

Procedural style

```
mysqli_result mysqli_use_result(
    mysqli link);
```

Used to initiate the retrieval of a result set from the last query executed using the `mysqli_real_query` function on the database connection.

Either this or the `mysqli_store_result` function must be called before the results of a query can be retrieved, and one or the other must be called to prevent the next query on that database connection from failing.

Note

The `mysqli_use_result` function does not transfer the entire result set from the database and hence cannot be used functions such as `mysqli_data_seek` to move to a particular row within the set. To use this functionality, the result set must be stored using `mysqli_store_result`. One should not use `mysqli_use_result` if a lot of processing on the client side is performed, since this will tie up the server and prevent other threads from updating any tables from which the data is being fetched.

Return Values

Returns an unbuffered result object or `FALSE` if an error occurred.

Examples

Example 7.79 `mysqli::use_result` example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT CURRENT_USER();";
$query .= "SELECT Name FROM City ORDER BY ID LIMIT 20, 5";
/* execute multi query */
if ($mysqli->multi_query($query)) {
```

```
do {
    /* store first result set */
    if ($result = $mysqli->use_result()) {
        while ($row = $result->fetch_row()) {
            printf("%s\n", $row[0]);
        }
        $result->close();
    }
    /* print divider */
    if ($mysqli->more_results()) {
        printf("-----\n");
    }
} while ($mysqli->next_result());
/* close connection */
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT CURRENT_USER();";
$query .= "SELECT Name FROM City ORDER BY ID LIMIT 20, 5";
/* execute multi query */
if (mysqli_multi_query($link, $query)) {
    do {
        /* store first result set */
        if ($result = mysqli_use_result($link)) {
            while ($row = mysqli_fetch_row($result)) {
                printf("%s\n", $row[0]);
            }
            mysqli_free_result($result);
        }
        /* print divider */
        if (mysqli_more_results($link)) {
            printf("-----\n");
        }
    } while (mysqli_next_result($link));
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
my_user@localhost
-----
Amersfoort
Maastricht
Dordrecht
Leiden
Haarlemmermeer
```

See Also

[mysqli_real_query](#)
[mysqli_store_result](#)

7.3.9.60 mysqli::\$warning_count, mysqli_warning_count

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- `mysqli::$warning_count`
- `mysqli_warning_count`

Returns the number of warnings from the last query for the given link

Description

Object oriented style

```
int
mysqli->warning_count ;
```

Procedural style

```
int mysqli_warning_count(
    mysqli link);
```

Returns the number of warnings from the last query in the connection.

Note

For retrieving warning messages you can use the SQL command `SHOW WARNINGS [limit row_count]`.

Parameters

`link`

Procedural style only: A link identifier returned by `mysqli_connect` or `mysqli_init`

Return Values

Number of warnings or zero if there are no warnings.

Examples

Example 7.80 \$mysqli->warning_count example

Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$mysqli->query("CREATE TABLE myCity LIKE City");
/* a remarkable city in Wales */
$query = "INSERT INTO myCity (CountryCode, Name) VALUES('GBR',
    'Llanfairpwllgwyngyllgogerychwyrndrobwllllantysiliogogogoch')";
$mysqli->query($query);
if ($mysqli->warning_count) {
    if ($result = $mysqli->query("SHOW WARNINGS")) {
        $row = $result->fetch_row();
        printf("%s (%d): %s\n", $row[0], $row[1], $row[2]);
        $result->close();
    }
}
/* close connection */
```

```
$mysqli->close();
?>
```

Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
mysqli_query($link, "CREATE TABLE myCity LIKE City");
/* a remarkable long city name in Wales */
$query = "INSERT INTO myCity (CountryCode, Name) VALUES('GBR',
    'Llanfairpwllgwyngyllgogerychwyrndrobwllllantysiliogogogoch')";
mysqli_query($link, $query);
if (mysqli_warning_count($link)) {
    if ($result = mysqli_query($link, "SHOW WARNINGS")) {
        $row = mysqli_fetch_row($result);
        printf("%s (%d): %s\n", $row[0], $row[1], $row[2]);
        mysqli_free_result($result);
    }
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Warning (1264): Data truncated for column 'Name' at row 1
```

See Also

[mysqli_errno](#)
[mysqli_error](#)
[mysqli_sqlstate](#)

7.3.10 The mysqli_stmt class

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Represents a prepared statement.

```
mysqli_stmt {
    mysqli_stmt
        Properties

        int
            mysqli_stmt->affected_rows ;

        int
            mysqli_stmt->errno ;

        array
            mysqli_stmt->error_list ;

        string
```

```
mysqli_stmt->error ;  
  
int  
    mysqli_stmt->field_count ;  
  
int  
    mysqli_stmt->insert_id ;  
  
int  
    mysqli_stmt->num_rows ;  
  
int  
    mysqli_stmt->param_count ;  
  
string  
    mysqli_stmt->sqlstate ;  
  
Methods  
  
mysqli_stmt::__construct(  
    mysqli link,  
    string query);  
  
int mysqli_stmt::attr_get(  
    int attr);  
  
bool mysqli_stmt::attr_set(  
    int attr,  
    int mode);  
  
bool mysqli_stmt::bind_param(  
    string types,  
    mixed var1,  
    mixed ...);  
  
bool mysqli_stmt::bind_result(  
    mixed var1,  
    mixed ...);  
  
bool mysqli_stmt::close();  
  
void mysqli_stmt::data_seek(  
    int offset);  
  
bool mysqli_stmt::execute();  
  
bool mysqli_stmt::fetch();  
  
void mysqli_stmt::free_result();  
  
mysqli_result mysqli_stmt::get_result();  
  
object mysqli_stmt::get_warnings();  
  
int mysqli_stmt::num_rows();  
  
mixed mysqli_stmt::prepare(  
    string query);  
  
bool mysqli_stmt::reset();  
  
mysqli_result mysqli_stmt::result_metadata();  
  
bool mysqli_stmt::send_long_data(  
    int param_nr,  
    string data);  
  
bool mysqli_stmt::store_result();  
}
```

7.3.10.1 mysqli_stmt::\$affected_rows, mysqli_stmt_affected_rows

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- `mysqli_stmt::$affected_rows`

`mysqli_stmt_affected_rows`

Returns the total number of rows changed, deleted, or inserted by the last executed statement

Description

Object oriented style

```
int
mysqli_stmt->affected_rows ;
```

Procedural style

```
int mysqli_stmt_affected_rows(
    mysqli_stmt stmt);
```

Returns the number of rows affected by [INSERT](#), [UPDATE](#), or [DELETE](#) query.

This function only works with queries which update a table. In order to get the number of rows from a [SELECT](#) query, use `mysqli_stmt_num_rows` instead.

Parameters

<code>stmt</code>	Procedural style only: A statement identifier returned by <code>mysqli_stmt_init</code> .
-------------------	--

Return Values

An integer greater than zero indicates the number of rows affected or retrieved. Zero indicates that no records were updated for an UPDATE/DELETE statement, no rows matched the WHERE clause in the query or that no query has yet been executed. -1 indicates that the query has returned an error. NULL indicates an invalid argument was supplied to the function.

Note

If the number of affected rows is greater than maximal PHP int value, the number of affected rows will be returned as a string value.

Examples

Example 7.81 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* create temp table */
$query = "CREATE TEMPORARY TABLE myCountry LIKE Country";
$code = "INSERT INTO myCountry SELECT * FROM Country WHERE Code LIKE ?";
/* prepare statement */
$stmt = $mysqli->prepare($query);
/* Bind variable for placeholder */
$code = 'A%';
$stmt->bind_param("s", $code);
```

```
/* execute statement */
$stmt->execute();
printf("rows inserted: %d\n", $stmt->affected_rows);
/* close statement */
$stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.82 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* create temp table */
mysqli_query($link, "CREATE TEMPORARY TABLE myCountry LIKE Country");
$query = "INSERT INTO myCountry SELECT * FROM Country WHERE Code LIKE ?";
/* prepare statement */
if ($stmt = mysqli_prepare($link, $query)) {
    /* Bind variable for placeholder */
    $code = 'A%';
    mysqli_stmt_bind_param($stmt, "s", $code);
    /* execute statement */
    mysqli_stmt_execute($stmt);
    printf("rows inserted: %d\n", mysqli_stmt_affected_rows($stmt));
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
rows inserted: 17
```

See Also

[mysqli_stmt_num_rows](#)
[mysqli_prepare](#)

7.3.10.2 `mysqli_stmt::attr_get`, `mysqli_stmt_attr_get`

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- [mysqli_stmt::attr_get](#)

[mysqli_stmt_attr_get](#)

Used to get the current value of a statement attribute

Description

Object oriented style

```
int mysqli_stmt::attr_get(  
    int attr);
```

Procedural style

```
int mysqli_stmt_attr_get(  
    mysqli_stmt stmt,  
    int attr);
```

Gets the current value of a statement attribute.

Parameters

stmt Procedural style only: A statement identifier returned by `mysqli_stmt_init`.

attr The attribute that you want to get.

Return Values

Returns `FALSE` if the attribute is not found, otherwise returns the value of the attribute.

7.3.10.3 `mysqli_stmt::attr_set`, `mysqli_stmt_attr_set`

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- `mysqli_stmt::attr_set`

```
mysqli_stmt_attr_set
```

Used to modify the behavior of a prepared statement

Description

Object oriented style

```
bool mysqli_stmt::attr_set(  
    int attr,  
    int mode);
```

Procedural style

```
bool mysqli_stmt_attr_set(  
    mysqli_stmt stmt,  
    int attr,  
    int mode);
```

Used to modify the behavior of a prepared statement. This function may be called multiple times to set several attributes.

Parameters

stmt Procedural style only: A statement identifier returned by `mysqli_stmt_init`.

attr The attribute that you want to set. It can have one of the following values:

Table 7.13 Attribute values

Character	Description
MYSQLI_STMT_ATTR_UPDATE	<code>MAX_LENGTH</code> causes <code>mysqli_stmt_store_result</code>

Character	Description
	to update the metadata <code>MYSQLI_FIELD->max_length</code> value.
<code>MYSQLI_STMT_ATTR_CURSOR_TYPE</code>	<code>TYPE</code> of cursor to open for statement when <code>mysqli_stmt_execute</code> is invoked. <code>mode</code> can be <code>MYSQLI_CURSOR_TYPE_NO_CURSOR</code> (the default) or <code>MYSQLI_CURSOR_TYPE_READ_ONLY</code> .
<code>MYSQLI_STMT_ATTR_PREFETCH_ROWS</code>	<code>ROWS</code> rows to fetch from server at a time when using a cursor. <code>mode</code> can be in the range from 1 to the maximum value of unsigned long. The default is 1.

If you use the `MYSQLI_STMT_ATTR_CURSOR_TYPE` option with `MYSQLI_CURSOR_TYPE_READ_ONLY`, a cursor is opened for the statement when you invoke `mysqli_stmt_execute`. If there is already an open cursor from a previous `mysqli_stmt_execute` call, it closes the cursor before opening a new one. `mysqli_stmt_reset` also closes any open cursor before preparing the statement for re-execution. `mysqli_stmt_free_result` closes any open cursor.

If you open a cursor for a prepared statement, `mysqli_stmt_store_result` is unnecessary.

`mode`

The value to assign to the attribute.

See Also

[Connector/MySQL `mysql_stmt_attr_set\(\)`](#)

7.3.10.4 `mysqli_stmt::bind_param`, `mysqli_stmt_bind_param`

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- `mysqli_stmt::bind_param`

`mysqli_stmt_bind_param`

Binds variables to a prepared statement as parameters

Description

Object oriented style

```
bool mysqli_stmt::bind_param(
    string types,
    mixed var1,
    mixed ...);
```

Procedural style

```
bool mysqli_stmt_bind_param(
    mysqli_stmt stmt,
    string types,
    mixed var1,
```

```
mixed ...);
```

Bind variables for the parameter markers in the SQL statement that was passed to [mysqli_prepare](#).

Note

If data size of a variable exceeds max. allowed packet size (`max_allowed_packet`), you have to specify `b` in `types` and use `mysqli_stmt_send_long_data` to send the data in packets.

Note

Care must be taken when using `mysqli_stmt_bind_param` in conjunction with `call_user_func_array`. Note that `mysqli_stmt_bind_param` requires parameters to be passed by reference, whereas `call_user_func_array` can accept as a parameter a list of variables that can represent references or values.

Parameters

<code>stmt</code>	Procedural style only: A statement identifier returned by <code>mysqli_stmt_init</code> .
<code>types</code>	A string that contains one or more characters which specify the types for the corresponding bind variables:

Table 7.14 Type specification chars

Character	Description
i	corresponding variable has type integer
d	corresponding variable has type double
s	corresponding variable has type string
b	corresponding variable is a blob and will be sent in packets

`var1`

The number of variables and length of string `types` must match the parameters in the statement.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.83 Object oriented style

```
<?php
$mysqli = new mysqli('localhost', 'my_user', 'my_password', 'world');
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$stmt = $mysqli->prepare("INSERT INTO CountryLanguage VALUES (?, ?, ?, ?, ?)");
$stmt->bind_param('sssd', $code, $language, $official, $percent);
$code = 'DEU';
$language = 'Bavarian';
$official = "F";
```

```
$percent = 11.2;
/* execute prepared statement */
$stmt->execute();
printf("%d Row inserted.\n", $stmt->affected_rows);
/* close statement and connection */
$stmt->close();
/* Clean up table CountryLanguage */
$mysqli->query("DELETE FROM CountryLanguage WHERE Language='Bavarian'");
printf("%d Row deleted.\n", $mysqli->affected_rows);
/* close connection */
$mysqli->close();
?>
```

Example 7.84 Procedural style

```
<?php
$link = mysqli_connect('localhost', 'my_user', 'my_password', 'world');
/* check connection */
if (!$link) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$stmt = mysqli_prepare($link, "INSERT INTO CountryLanguage VALUES (?, ?, ?, ?, ?)");
mysqli_stmt_bind_param($stmt, 'sssd', $code, $language, $official, $percent);
$code = 'DEU';
$language = 'Bavarian';
$official = "F";
$percent = 11.2;
/* execute prepared statement */
mysqli_stmt_execute($stmt);
printf("%d Row inserted.\n", mysqli_stmt_affected_rows($stmt));
/* close statement and connection */
mysqli_stmt_close($stmt);
/* Clean up table CountryLanguage */
mysqli_query($link, "DELETE FROM CountryLanguage WHERE Language='Bavarian'");
printf("%d Row deleted.\n", mysqli_affected_rows($link));
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
1 Row inserted.
1 Row deleted.
```

See Also

[mysqli_stmt_bind_result](#)
[mysqli_stmt_execute](#)
[mysqli_stmt_fetch](#)
[mysqli_prepare](#)
[mysqli_stmt_send_long_data](#)
[mysqli_stmt_errno](#)
[mysqli_stmt_error](#)

7.3.10.5 [mysqli_stmt::bind_result](#), [mysqli_stmt_bind_result](#)

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- [mysqli_stmt::bind_result](#)

mysqli_stmt_bind_result

Binds variables to a prepared statement for result storage

Description

Object oriented style

```
bool mysqli_stmt::bind_result(  
    mixed var1,  
    mixed ...);
```

Procedural style

```
bool mysqli_stmt_bind_result(  
    mysqli_stmt stmt,  
    mixed var1,  
    mixed ...);
```

Binds columns in the result set to variables.

When [mysqli_stmt_fetch](#) is called to fetch data, the MySQL client/server protocol places the data for the bound columns into the specified variables `var1`,

Note

Note that all columns must be bound after [mysqli_stmt_execute](#) and prior to calling [mysqli_stmt_fetch](#). Depending on column types bound variables can silently change to the corresponding PHP type.

A column can be bound or rebound at any time, even after a result set has been partially retrieved. The new binding takes effect the next time [mysqli_stmt_fetch](#) is called.

Parameters

`stmt` Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

`var1` The variable to be bound.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples**Example 7.85 Object oriented style**

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
if ($mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", $mysqli_connect_error());  
    exit();  
}  
/* prepare statement */  
if ($stmt = $mysqli->prepare("SELECT Code, Name FROM Country ORDER BY Name LIMIT 5")) {  
    $stmt->execute();  
    /* bind variables to prepared statement */  
    $stmt->bind_result($col1, $col2);  
    /* fetch values */  
    while ($stmt->fetch()) {  
        printf("%s %s\n", $col1, $col2);  
    }  
}
```

```
    }
    /* close statement */
    $stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.86 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (!$link) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* prepare statement */
if ($stmt = mysqli_prepare($link, "SELECT Code, Name FROM Country ORDER BY Name LIMIT 5")) {
    mysqli_stmt_execute($stmt);
    /* bind variables to prepared statement */
    mysqli_stmt_bind_result($stmt, $col1, $col2);
    /* fetch values */
    while (mysqli_stmt_fetch($stmt)) {
        printf("%s %s\n", $col1, $col2);
    }
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
AFG Afghanistan
ALB Albania
DZA Algeria
ASM American Samoa
AND Andorra
```

See Also

[mysqli_stmt_get_result](#)
[mysqli_stmt_bind_param](#)
[mysqli_stmt_execute](#)
[mysqli_stmt_fetch](#)
[mysqli_prepare](#)
[mysqli_stmt_prepare](#)
[mysqli_stmt_init](#)
[mysqli_stmt_errno](#)
[mysqli_stmt_error](#)

7.3.10.6 `mysqli_stmt::close`, `mysqli_stmt_close`

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- [mysqli_stmt::close](#)
- [mysqli_stmt_close](#)

Closes a prepared statement

Description

Object oriented style

```
bool mysqli_stmt::close();
```

Procedural style

```
bool mysqli_stmt_close(
    mysqli_stmt stmt);
```

Closes a prepared statement. `mysqli_stmt_close` also deallocates the statement handle. If the current statement has pending or unread results, this function cancels them so that the next query can be executed.

Parameters

<i>stmt</i>	Procedural style only: A statement identifier returned by <code>mysqli_stmt_init</code> .
-------------	---

Return Values

Returns `TRUE` on success or `FALSE` on failure.

See Also

`mysqli_prepare`

7.3.10.7 `mysqli_stmt::__construct`

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- `mysqli_stmt::__construct`

Constructs a new `mysqli_stmt` object

Description

```
mysqli_stmt::__construct(
    mysqli link,
    string query);
```

This method constructs a new `mysqli_stmt` object.

Note

In general, you should use either `mysqli_prepare` or `mysqli_stmt_init` to create a `mysqli_stmt` object, rather than directly instantiating the object with `new mysqli_stmt`. This method (and the ability to directly instantiate `mysqli_stmt` objects) may be deprecated and removed in the future.

Parameters

<i>link</i>	Procedural style only: A link identifier returned by <code>mysqli_connect</code> or <code>mysqli_init</code>
-------------	--

<i>query</i>	The query, as a string. If this parameter is omitted, then the constructor behaves identically to <code>mysqli_stmt_init</code> , if provided, then it behaves as per <code>mysqli_prepare</code> .
--------------	---

See Also

[mysqli_prepare](#)
[mysqli_stmt_init](#)

7.3.10.8 `mysqli_stmt::data_seek`, `mysqli_stmt_data_seek`

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- [mysqli_stmt::data_seek](#)

[mysqli_stmt_data_seek](#)

Seeks to an arbitrary row in statement result set

Description

Object oriented style

```
void mysqli_stmt::data_seek(  
    int offset);
```

Procedural style

```
void mysqli_stmt_data_seek(  
    mysqli_stmt stmt,  
    int offset);
```

Seeks to an arbitrary result pointer in the statement result set.

[mysqli_stmt_store_result](#) must be called prior to [mysqli_stmt_data_seek](#).

Parameters

stmt Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

offset Must be between zero and the total number of rows minus one (0..
[mysqli_stmt_num_rows](#) - 1).

Return Values

No value is returned.

Examples

Example 7.87 Object oriented style

```
<?php  
/* Open a connection */  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
$query = "SELECT Name, CountryCode FROM City ORDER BY Name";  
if ($stmt = $mysqli->prepare($query)) {  
    /* execute query */  
    $stmt->execute();  
    /* bind result variables */  
    $stmt->bind_result($name, $code);  
    /* store result */  
    $stmt->store_result();
```

```
/* seek to row no. 400 */
$stmt->data_seek(399);
/* fetch values */
$stmt->fetch();
printf ("City: %s Countrycode: %s\n", $name, $code);
/* close statement */
$stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.88 Procedural style

```
<?php
/* Open a connection */
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER BY Name";
if ($stmt = mysqli_prepare($link, $query)) {
    /* execute query */
    mysqli_stmt_execute($stmt);
    /* bind result variables */
    mysqli_stmt_bind_result($stmt, $name, $code);
    /* store result */
    mysqli_stmt_store_result($stmt);
    /* seek to row no. 400 */
    mysqli_stmt_data_seek($stmt, 399);
    /* fetch values */
    mysqli_stmt_fetch($stmt);
    printf ("City: %s Countrycode: %s\n", $name, $code);
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
City: Benin City Countrycode: NGA
```

See Also

[mysqli_prepare](#)

7.3.10.9 `mysqli_stmt::$errno`, `mysqli_stmt_errno`

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- [mysqli_stmt::\\$errno](#)

[mysqli_stmt_errno](#)

Returns the error code for the most recent statement call

Description

Object oriented style

```
int  
mysqli_stmt->errno ;
```

Procedural style

```
int mysqli_stmt_errno(  
    mysqli_stmt stmt);
```

Returns the error code for the most recently invoked statement function that can succeed or fail.

Client error message numbers are listed in the MySQL [errmsg.h](#) header file, server error message numbers are listed in [mysqld_error.h](#). In the MySQL source distribution you can find a complete list of error messages and error numbers in the file [Docs/mysqld_error.txt](#).

Parameters

stmt Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

Return Values

An error code value. Zero means no error occurred.

Examples

Example 7.89 Object oriented style

```
<?php  
/* Open a connection */  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
$mysqli->query("CREATE TABLE myCountry LIKE Country");  
$mysqli->query("INSERT INTO myCountry SELECT * FROM Country");  
$query = "SELECT Name, Code FROM myCountry ORDER BY Name";  
if ($stmt = $mysqli->prepare($query)) {  
    /* drop table */  
    $mysqli->query("DROP TABLE myCountry");  
    /* execute query */  
    $stmt->execute();  
    printf("Error: %d.\n", $stmt->errno);  
    /* close statement */  
    $stmt->close();  
}  
/* close connection */  
$mysqli->close();  
?>
```

Example 7.90 Procedural style

```
<?php  
/* Open a connection */  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}
```

```

}
mysqli_query($link, "CREATE TABLE myCountry LIKE Country");
mysqli_query($link, "INSERT INTO myCountry SELECT * FROM Country");
$query = "SELECT Name, Code FROM myCountry ORDER BY Name";
if ($stmt = mysqli_prepare($link, $query)) {
    /* drop table */
    mysqli_query($link, "DROP TABLE myCountry");
    /* execute query */
    mysqli_stmt_execute($stmt);
    printf("Error: %d.\n", mysqli_stmt_errno($stmt));
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>

```

The above examples will output:

```
Error: 1146.
```

See Also

[mysqli_stmt_error](#)
[mysqli_stmt_sqlstate](#)

7.3.10.10 mysqli_stmt::\$error_list, mysqli_stmt_error_list

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- [mysqli_stmt::\\$error_list](#)
[mysqli_stmt_error_list](#)

Returns a list of errors from the last statement executed

Description

Object oriented style

```
array
mysqli_stmt->error_list ;
```

Procedural style

```
array mysqli_stmt_error_list(
    mysqli_stmt stmt);
```

Returns an array of errors for the most recently invoked statement function that can succeed or fail.

Parameters

<i>stmt</i>	Procedural style only: A statement identifier returned by mysqli_stmt_init .
-------------	---

Return Values

A list of errors, each as an associative array containing the *errno*, *error*, and *sqlstate*.

Examples

Example 7.91 Object oriented style

```
<?php
/* Open a connection */
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$mysqli->query("CREATE TABLE myCountry LIKE Country");
$mysqli->query("INSERT INTO myCountry SELECT * FROM Country");
$query = "SELECT Name, Code FROM myCountry ORDER BY Name";
if ($stmt = $mysqli->prepare($query)) {
    /* drop table */
    $mysqli->query("DROP TABLE myCountry");
    /* execute query */
    $stmt->execute();

    echo "Error:\n";
    print_r($stmt->error_list);
    /* close statement */
    $stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.92 Procedural style

```
<?php
/* Open a connection */
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if ($link === false) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
mysqli_query($link, "CREATE TABLE myCountry LIKE Country");
mysqli_query($link, "INSERT INTO myCountry SELECT * FROM Country");
$query = "SELECT Name, Code FROM myCountry ORDER BY Name";
if ($stmt = mysqli_prepare($link, $query)) {
    /* drop table */
    mysqli_query($link, "DROP TABLE myCountry");
    /* execute query */
    mysqli_stmt_execute($stmt);

    echo "Error:\n";
    print_r(mysqli_stmt_error_list($stmt));
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Array
(
    [0] => Array
        (
            [errno] => 1146
            [sqlstate] => 42S02
```

```
        [error] => Table 'world.myCountry' doesn't exist
    )
)
```

See Also

[mysqli_stmt_error](#)
[mysqli_stmt_errno](#)
[mysqli_stmt_sqlstate](#)

7.3.10.11 mysqli_stmt::\$error, mysqli_stmt_error

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- [mysqli_stmt::\\$error](#)

[mysqli_stmt_error](#)

Returns a string description for last statement error

Description

Object oriented style

```
string
mysqli_stmt->error ;
```

Procedural style

```
string mysqli_stmt_error(
    mysqli_stmt stmt);
```

Returns a string containing the error message for the most recently invoked statement function that can succeed or fail.

Parameters

[stmt](#)

Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

Return Values

A string that describes the error. An empty string if no error occurred.

Examples

Example 7.93 Object oriented style

```
<?php
/* Open a connection */
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$mysqli->query("CREATE TABLE myCountry LIKE Country");
$mysqli->query("INSERT INTO myCountry SELECT * FROM Country");
$query = "SELECT Name, Code FROM myCountry ORDER BY Name";
if ($stmt = $mysqli->prepare($query)) {
    /* drop table */
```

```
$mysqli->query( "DROP TABLE myCountry" );
/* execute query */
$stmt->execute();
printf("Error: %s.\n", $stmt->error);
/* close statement */
$stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.94 Procedural style

```
<?php
/* Open a connection */
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
mysqli_query($link, "CREATE TABLE myCountry LIKE Country");
mysqli_query($link, "INSERT INTO myCountry SELECT * FROM Country");
$query = "SELECT Name, Code FROM myCountry ORDER BY Name";
if ($stmt = mysqli_prepare($link, $query)) {
    /* drop table */
    mysqli_query($link, "DROP TABLE myCountry");
    /* execute query */
    mysqli_stmt_execute($stmt);
    printf("Error: %s.\n", mysqli_stmt_error($stmt));
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Error: Table 'world.myCountry' doesn't exist.
```

See Also

[mysqli_stmt_errno](#)
[mysqli_stmt_sqlstate](#)

7.3.10.12 `mysqli_stmt::execute`, `mysqli_stmt_execute`

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- [mysqli_stmt::execute](#)

[mysqli_stmt_execute](#)

Executes a prepared Query

Description

Object oriented style

```
bool mysqli_stmt::execute();
```

Procedural style

```
bool mysqli_stmt_execute(  
    mysqli_stmt stmt);
```

Executes a query that has been previously prepared using the `mysqli_prepare` function. When executed any parameter markers which exist will automatically be replaced with the appropriate data.

If the statement is `UPDATE`, `DELETE`, or `INSERT`, the total number of affected rows can be determined by using the `mysqli_stmt_affected_rows` function. Likewise, if the query yields a result set the `mysqli_stmt_fetch` function is used.

Note

When using `mysqli_stmt_execute`, the `mysqli_stmt_fetch` function must be used to fetch the data prior to performing any additional queries.

Parameters

stmt

Procedural style only: A statement identifier returned by `mysqli_stmt_init`.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.95 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$mysqli->query("CREATE TABLE myCity LIKE City");
/* Prepare an insert statement */
$query = "INSERT INTO myCity (Name, CountryCode, District) VALUES (?,?,?,?)";
$stmt = $mysqli->prepare($query);
$stmt->bind_param("sss", $val1, $val2, $val3);
$val1 = 'Stuttgart';
$val2 = 'DEU';
$val3 = 'Baden-Wuerttemberg';
/* Execute the statement */
$stmt->execute();
$val1 = 'Bordeaux';
$val2 = 'FRA';
$val3 = 'Aquitaine';
/* Execute the statement */
$stmt->execute();
/* close statement */
$stmt->close();
/* retrieve all rows from myCity */
$query = "SELECT Name, CountryCode, District FROM myCity";
if ($result = $mysqli->query($query)) {
    while ($row = $result->fetch_row()) {
        printf("%s (%s,%s)\n", $row[0], $row[1], $row[2]);
    }
    /* free result set */
    $result->close();
}
```

```
/* remove table */
$mysqli->query("DROP TABLE myCity");
/* close connection */
$mysqli->close();
?>
```

Example 7.96 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
mysqli_query($link, "CREATE TABLE myCity LIKE City");
/* Prepare an insert statement */
$query = "INSERT INTO myCity (Name, CountryCode, District) VALUES (?, ?, ?)";
$stmt = mysqli_prepare($link, $query);
mysqli_stmt_bind_param($stmt, "sss", $val1, $val2, $val3);
$val1 = 'Stuttgart';
$val2 = 'DEU';
$val3 = 'Baden-Wuerttemberg';
/* Execute the statement */
mysqli_stmt_execute($stmt);
$val1 = 'Bordeaux';
$val2 = 'FRA';
$val3 = 'Aquitaine';
/* Execute the statement */
mysqli_stmt_execute($stmt);
/* close statement */
mysqli_stmt_close($stmt);
/* retrieve all rows from myCity */
$query = "SELECT Name, CountryCode, District FROM myCity";
if ($result = mysqli_query($link, $query)) {
    while ($row = mysqli_fetch_row($result)) {
        printf("%s (%s,%s)\n", $row[0], $row[1], $row[2]);
    }
    /* free result set */
    mysqli_free_result($result);
}
/* remove table */
mysqli_query($link, "DROP TABLE myCity");
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Stuttgart (DEU,Baden-Wuerttemberg)
Bordeaux (FRA,Aquitaine)
```

See Also

[mysqli_prepare](#)
[mysqli_stmt_bind_param](#)
[mysqli_stmt_get_result](#)

7.3.10.13 mysqli_stmt::fetch, mysqli_stmt_fetch

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- `mysqli_stmt::fetch`

`mysqli_stmt_fetch`

Fetch results from a prepared statement into the bound variables

Description

Object oriented style

```
bool mysqli_stmt::fetch();
```

Procedural style

```
bool mysqli_stmt_fetch(
    mysqli_stmt stmt);
```

Fetch the result from a prepared statement into the variables bound by `mysqli_stmt_bind_result`.

Note

Note that all columns must be bound by the application before calling `mysqli_stmt_fetch`.

Note

Data are transferred unbuffered without calling `mysqli_stmt_store_result` which can decrease performance (but reduces memory cost).

Parameters

`stmt`

Procedural style only: A statement identifier returned by `mysqli_stmt_init`.

Return Values

Table 7.15 Return Values

Value	Description
<code>TRUE</code>	Success. Data has been fetched
<code>FALSE</code>	Error occurred
<code>NULL</code>	No more rows/data exists or data truncation occurred

Examples

Example 7.97 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER by ID DESC LIMIT 150,5";
if ($stmt = $mysqli->prepare($query)) {
    /* execute statement */
    $stmt->execute();
    /* bind result variables */
}
```

```
$stmt->bind_result($name, $code);
/* fetch values */
while ($stmt->fetch()) {
    printf ("%s (%s)\n", $name, $code);
}
/* close statement */
$stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.98 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER by ID DESC LIMIT 150,5";
if ($stmt = mysqli_prepare($link, $query)) {
    /* execute statement */
    mysqli_stmt_execute($stmt);
    /* bind result variables */
    mysqli_stmt_bind_result($stmt, $name, $code);
    /* fetch values */
    while (mysqli_stmt_fetch($stmt)) {
        printf ("%s (%s)\n", $name, $code);
    }
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Rockford (USA)
Tallahassee (USA)
Salinas (USA)
Santa Clarita (USA)
Springfield (USA)
```

See Also

[mysqli_prepare](#)
[mysqli_stmt_errno](#)
[mysqli_stmt_error](#)
[mysqli_stmt_bind_result](#)

7.3.10.14 [mysqli_stmt:::\\$field_count](#), [mysqli_stmt_field_count](#)

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- [mysqli_stmt:::\\$field_count](#)

[mysqli_stmt_field_count](#)

Returns the number of field in the given statement

Description

Object oriented style

```
int  
mysqli_stmt->field_count ;
```

Procedural style

```
int mysqli_stmt_field_count(  
    mysqli_stmt stmt);
```

Warning

This function is currently not documented; only its argument list is available.

7.3.10.15 mysqli_stmt::free_result, mysqli_stmt_free_result

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- [mysqli_stmt::free_result](#)
[mysqli_stmt_free_result](#)

Frees stored result memory for the given statement handle

Description

Object oriented style

```
void mysqli_stmt::free_result();
```

Procedural style

```
void mysqli_stmt_free_result(  
    mysqli_stmt stmt);
```

Frees the result memory associated with the statement, which was allocated by [mysqli_stmt_store_result](#).

Parameters

stmt Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

Return Values

No value is returned.

See Also

[mysqli_stmt_store_result](#)

7.3.10.16 mysqli_stmt::get_result, mysqli_stmt_get_result

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- [mysqli_stmt::get_result](#)
[mysqli_stmt_get_result](#)

Gets a result set from a prepared statement

Description

Object oriented style

```
mysqli_result mysqli_stmt::get_result();
```

Procedural style

```
mysqli_result mysqli_stmt_get_result(  
    mysqli_stmt stmt);
```

Call to return a result set from a prepared statement query.

Parameters

stmt Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

Return Values

Returns a resultset for successful SELECT queries, or [FALSE](#) for other DML queries or on failure. The [mysqli_errno](#) function can be used to distinguish between the two types of failure.

MySQL Native Driver Only

Available only with [mysqlnd](#).

Examples

Example 7.99 Object oriented style

```
<?php  
$mysqli = new mysqli("127.0.0.1", "user", "password", "world");  
if($mysqli->connect_error)  
{  
    die("$mysqli->connect_errno: $mysqli->connect_error");  
}  
$query = "SELECT Name, Population, Continent FROM Country WHERE Continent=? ORDER BY Name LIMIT 1";  
$stmt = $mysqli->stmt_init();  
if(!$stmt->prepare($query))  
{  
    print "Failed to prepare statement\n";  
}  
else  
{  
    $stmt->bind_param("s", $continent);  
    $continent_array = array('Europe','Africa','Asia','North America');  
    foreach($continent_array as $continent)  
    {  
        $stmt->execute();  
        $result = $stmt->get_result();  
        while ($row = $result->fetch_array(MYSQLI_NUM))  
        {  
            foreach ($row as $r)  
            {  
                print "$r ";  
            }  
            print "\n";  
        }  
    }  
}  
$stmt->close();  
$mysqli->close();
```

```
?>
```

Example 7.100 Procedural style

```
<?php
$link = mysqli_connect("127.0.0.1", "user", "password", "world");
if (!$link)
{
    $error = mysqli_connect_error();
    $errno = mysqli_connect_errno();
    print "$errno: $error\n";
    exit();
}
$query = "SELECT Name, Population, Continent FROM Country WHERE Continent=? ORDER BY Name LIMIT 1";
$stmt = mysqli_stmt_init($link);
if (!mysqli_stmt_prepare($stmt, $query))
{
    print "Failed to prepare statement\n";
}
else
{
    mysqli_stmt_bind_param($stmt, "s", $continent);
    $continent_array = array('Europe','Africa','Asia','North America');
    foreach($continent_array as $continent)
    {
        mysqli_stmt_execute($stmt);
        $result = mysqli_stmt_get_result($stmt);
        while ($row = mysqli_fetch_array($result, MYSQLI_NUM))
        {
            foreach ($row as $r)
            {
                print "$r ";
            }
            print "\n";
        }
    }
}
mysqli_stmt_close($stmt);
mysqli_close($link);
?>
```

The above examples will output:

```
Albania 3401200 Europe
Algeria 31471000 Africa
Afghanistan 22720000 Asia
Anguilla 8000 North America
```

See Also

[mysqli_prepare](#)
[mysqli_stmt_result_metadata](#)
[mysqli_stmt_fetch](#)
[mysqli_fetch_array](#)
[mysqli_stmt_store_result](#)
[mysqli_errno](#)

7.3.10.17 [mysqli_stmt::get_warnings](#), [mysqli_stmt_get_warnings](#)

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- `mysqli_stmt::get_warnings`

```
mysqli_stmt_get_warnings
```

Get result of SHOW WARNINGS

Description

Object oriented style

```
object mysqli_stmt::get_warnings();
```

Procedural style

```
object mysqli_stmt_get_warnings(  
    mysqli_stmt stmt);
```

Warning

This function is currently not documented; only its argument list is available.

7.3.10.18 `mysqli_stmt::$insert_id`, `mysqli_stmt_insert_id`

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- `mysqli_stmt::$insert_id`

```
mysqli_stmt_insert_id
```

Get the ID generated from the previous INSERT operation

Description

Object oriented style

```
int  
mysqli_stmt->insert_id ;
```

Procedural style

```
mixed mysqli_stmt_insert_id(  
    mysqli_stmt stmt);
```

Warning

This function is currently not documented; only its argument list is available.

7.3.10.19 `mysqli_stmt::more_results`, `mysqli_stmt_more_results`

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- `mysqli_stmt::more_results`

```
mysqli_stmt_more_results
```

Check if there are more query results from a multiple query

Description

Object oriented style (method):

```
public bool mysqli_stmt::more_results();
```

Procedural style:

```
bool mysqli_stmt_more_results(  
    mysqli_stmt stmt);
```

Checks if there are more query results from a multiple query.

Parameters

stmt Procedural style only: A statement identifier returned by `mysqli_stmt_init`.

Return Values

Returns `TRUE` if more results exist, otherwise `FALSE`.

MySQL Native Driver Only

Available only with `mysqlnd`.

See Also

`mysqli_stmt::next_result`
`mysqli::multi_query`

7.3.10.20 `mysqli_stmt::next_result`, `mysqli_stmt_next_result`

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- `mysqli_stmt::next_result`
- `mysqli_stmt_next_result`

Reads the next result from a multiple query

Description

Object oriented style (method):

```
public bool mysqli_stmt::next_result();
```

Procedural style:

```
bool mysqli_stmt_next_result(  
    mysqli_stmt stmt);
```

Reads the next result from a multiple query.

Parameters

stmt Procedural style only: A statement identifier returned by `mysqli_stmt_init`.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Errors/Exceptions

Emits an `E_STRICT` level error if a result set does not exist, and suggests using `mysqli_stmt::more_results` in these cases, before calling `mysqli_stmt::next_result`.

MySQL Native Driver Only

Available only with [mysqlnd](#).

See Also

[mysqli_stmt::more_results](#)
[mysqli::multi_query](#)

7.3.10.21 [mysqli_stmt::\\$num_rows](#), [mysqli_stmt::num_rows](#), [mysqli_stmt_num_rows](#)

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- [mysqli_stmt::\\$num_rows](#)

```
mysqli_stmt::num_rows  
mysqli_stmt_num_rows
```

Return the number of rows in statements result set

Description

Object oriented style

```
int  
mysqli_stmt->num_rows ;  
  
int mysqli_stmt::num_rows();
```

Procedural style

```
int mysqli_stmt_num_rows(  
    mysqli_stmt stmt);
```

Returns the number of rows in the result set. The use of [mysqli_stmt_num_rows](#) depends on whether or not you used [mysqli_stmt_store_result](#) to buffer the entire result set in the statement handle.

If you use [mysqli_stmt_store_result](#), [mysqli_stmt_num_rows](#) may be called immediately.

Parameters

stmt Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

Return Values

An integer representing the number of rows in result set.

Examples

Example 7.101 Object oriented style

```
<?php  
/* Open a connection */  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli_connect_errno()) {
```

```
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER BY Name LIMIT 20";
if ($stmt = $mysqli->prepare($query)) {
    /* execute query */
    $stmt->execute();
    /* store result */
    $stmt->store_result();
    printf("Number of rows: %d.\n", $stmt->num_rows);
    /* close statement */
    $stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.102 Procedural style

```
<?php
/* Open a connection */
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER BY Name LIMIT 20";
if ($stmt = mysqli_prepare($link, $query)) {
    /* execute query */
    mysqli_stmt_execute($stmt);
    /* store result */
    mysqli_stmt_store_result($stmt);
    printf("Number of rows: %d.\n", mysqli_stmt_num_rows($stmt));
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Number of rows: 20.
```

See Also

[mysqli_stmt_affected_rows](#)
[mysqli_prepare](#)
[mysqli_stmt_store_result](#)

7.3.10.22 `mysqli_stmt::$param_count`, `mysqli_stmt_param_count`

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- [mysqli_stmt::\\$param_count](#)

[mysqli_stmt_param_count](#)

Returns the number of parameter for the given statement

Description

Object oriented style

```
int  
mysqli_stmt->param_count ;
```

Procedural style

```
int mysqli_stmt_param_count(  
    mysqli_stmt stmt);
```

Returns the number of parameter markers present in the prepared statement.

Parameters

stmt Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

Return Values

Returns an integer representing the number of parameters.

Examples

Example 7.103 Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
if ($stmt = $mysqli->prepare("SELECT Name FROM Country WHERE Name=? OR Code=?")) {  
    $marker = $stmt->param_count;  
    printf("Statement has %d markers.\n", $marker);  
    /* close statement */  
    $stmt->close();  
}  
/* close connection */  
$mysqli->close();  
?>
```

Example 7.104 Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
if ($stmt = mysqli_prepare($link, "SELECT Name FROM Country WHERE Name=? OR Code=?")) {  
    $marker = mysqli_stmt_param_count($stmt);  
    printf("Statement has %d markers.\n", $marker);  
    /* close statement */  
    mysqli_stmt_close($stmt);  
}  
/* close connection */  
mysqli_close($link);  
?>
```

The above examples will output:

```
Statement has 2 markers.
```

See Also

[mysqli_prepare](#)

7.3.10.23 mysqli_stmt::prepare, mysqli_stmt_prepare

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- [mysqli_stmt::prepare](#)

[mysqli_stmt_prepare](#)

Prepare an SQL statement for execution

Description

Object oriented style

```
mixed mysqli_stmt::prepare(
    string query);
```

Procedural style

```
bool mysqli_stmt_prepare(
    mysqli_stmt stmt,
    string query);
```

Prepares the SQL query pointed to by the null-terminated string query.

The parameter markers must be bound to application variables using [mysqli_stmt_bind_param](#) and/or [mysqli_stmt_bind_result](#) before executing the statement or fetching rows.

Note

In the case where you pass a statement to [mysqli_stmt_prepare](#) that is longer than [max_allowed_packet](#) of the server, the returned error codes are different depending on whether you are using MySQL Native Driver ([mysqld](#)) or MySQL Client Library ([libmysqlclient](#)). The behavior is as follows:

- [mysqld](#) on Linux returns an error code of 1153. The error message means “got a packet bigger than [max_allowed_packet](#) bytes”.
- [mysqld](#) on Windows returns an error code 2006. This error message means “server has gone away”.
- [libmysqlclient](#) on all platforms returns an error code 2006. This error message means “server has gone away”.

Parameters

stmt

Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

query

The query, as a string. It must consist of a single SQL statement.

You can include one or more parameter markers in the SQL statement by embedding question mark (?) characters at the appropriate positions.

Note

You should not add a terminating semicolon or \g to the statement.

Note

The markers are legal only in certain places in SQL statements. For example, they are allowed in the VALUES() list of an INSERT statement (to specify column values for a row), or in a comparison with a column in a WHERE clause to specify a comparison value.

However, they are not allowed for identifiers (such as table or column names), in the select list that names the columns to be returned by a SELECT statement), or to specify both operands of a binary operator such as the = equal sign. The latter restriction is necessary because it would be impossible to determine the parameter type. In general, parameters are legal only in Data Manipulation Language (DML) statements, and not in Data Definition Language (DDL) statements.

Return Values

Returns TRUE on success or FALSE on failure.

Examples

Example 7.105 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$city = "Amersfoort";
/* create a prepared statement */
$stmt = $mysqli->stmt_init();
if ($stmt->prepare("SELECT District FROM City WHERE Name=?")) {
    /* bind parameters for markers */
    $stmt->bind_param("s", $city);
    /* execute query */
    $stmt->execute();
    /* bind result variables */
    $stmt->bind_result($district);
    /* fetch value */
    $stmt->fetch();
    printf("%s is in district %s\n", $city, $district);
    /* close statement */
    $stmt->close();
}
```

```
}
```

```
/* close connection */
```

```
$mysqli->close();
```

```
?>
```

Example 7.106 Procedural style

```
<?php
```

```
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
```

```
/* check connection */
```

```
if (mysqli_connect_errno()) {
```

```
    printf("Connect failed: %s\n", mysqli_connect_error());
```

```
    exit();
```

```
}
```

```
$city = "Amersfoort";
```

```
/* create a prepared statement */
```

```
$stmt = mysqli_stmt_init($link);
```

```
if (mysqli_stmt_prepare($stmt, 'SELECT District FROM City WHERE Name=?')) {
```

```
    /* bind parameters for markers */
```

```
    mysqli_stmt_bind_param($stmt, "s", $city);
```

```
    /* execute query */
```

```
    mysqli_stmt_execute($stmt);
```

```
    /* bind result variables */
```

```
    mysqli_stmt_bind_result($stmt, $district);
```

```
    /* fetch value */
```

```
    mysqli_stmt_fetch($stmt);
```

```
    printf("%s is in district %s\n", $city, $district);
```

```
    /* close statement */
```

```
    mysqli_stmt_close($stmt);
```

```
}
```

```
/* close connection */
```

```
mysqli_close($link);
```

```
?>
```

The above examples will output:

```
Amersfoort is in district Utrecht
```

See Also

[mysqli_stmt_init](#)
[mysqli_stmt_execute](#)
[mysqli_stmt_fetch](#)
[mysqli_stmt_bind_param](#)
[mysqli_stmt_bind_result](#)
[mysqli_stmt_get_result](#)
[mysqli_stmt_close](#)

7.3.10.24 `mysqli_stmt::reset`, `mysqli_stmt_reset`

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- [mysqli_stmt::reset](#)

[mysqli_stmt_reset](#)

Resets a prepared statement

Description

Object oriented style

```
bool mysqli_stmt::reset();
```

Procedural style

```
bool mysqli_stmt_reset(  
    mysqli_stmt stmt);
```

Resets a prepared statement on client and server to state after prepare.

It resets the statement on the server, data sent using `mysqli_stmt_send_long_data`, unbuffered result sets and current errors. It does not clear bindings or stored result sets. Stored result sets will be cleared when executing the prepared statement (or closing it).

To prepare a statement with another query use function `mysqli_stmt_prepare`.

Parameters

`stmt` Procedural style only: A statement identifier returned by `mysqli_stmt_init`.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

See Also

[mysqli_prepare](#)

7.3.10.25 `mysqli_stmt::result_metadata`, `mysqli_stmt_result_metadata`

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- `mysqli_stmt::result_metadata`

`mysqli_stmt_result_metadata`

Returns result set metadata from a prepared statement

Description

Object oriented style

```
mysqli_result mysqli_stmt::result_metadata();
```

Procedural style

```
mysqli_result mysqli_stmt_result_metadata(  
    mysqli_stmt stmt);
```

If a statement passed to `mysqli_prepare` is one that produces a result set, `mysqli_stmt_result_metadata` returns the result object that can be used to process the meta information such as total number of fields and individual field information.

Note

This result set pointer can be passed as an argument to any of the field-based functions that process result set metadata, such as:

- `mysqli_num_fields`

- `mysqli_fetch_field`
- `mysqli_fetch_field_direct`
- `mysqli_fetch_fields`
- `mysqli_field_count`
- `mysqli_field_seek`
- `mysqli_field_tell`
- `mysqli_free_result`

The result set structure should be freed when you are done with it, which you can do by passing it to `mysqli_free_result`

Note

The result set returned by `mysqli_stmt_result_metadata` contains only metadata. It does not contain any row results. The rows are obtained by using the statement handle with `mysqli_stmt_fetch`.

Parameters

<code>stmt</code>	Procedural style only: A statement identifier returned by <code>mysqli_stmt_init</code> .
-------------------	---

Return Values

Returns a result object or `FALSE` if an error occurred.

Examples

Example 7.107 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "test");
$mysqli->query("DROP TABLE IF EXISTS friends");
$mysqli->query("CREATE TABLE friends (id int, name varchar(20))");
$mysqli->query("INSERT INTO friends VALUES (1,'Hartmut'), (2, 'Ulf')");
$stmt = $mysqli->prepare("SELECT id, name FROM friends");
$stmt->execute();
/* get resultset for metadata */
$result = $stmt->result_metadata();
/* retrieve field information from metadata result set */
$field = $result->fetch_field();
printf("Fieldname: %s\n", $field->name);
/* close resultset */
$result->close();
/* close connection */
$mysqli->close();
?>
```

Example 7.108 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "test");
mysqli_query($link, "DROP TABLE IF EXISTS friends");
```

```
mysqli_query($link, "CREATE TABLE friends (id int, name varchar(20))");
mysqli_query($link, "INSERT INTO friends VALUES (1,'Hartmut'), (2, 'Ulf')");
$stmt = mysqli_prepare($link, "SELECT id, name FROM friends");
mysqli_stmt_execute($stmt);
/* get resultset for metadata */
$result = mysqli_stmt_result_metadata($stmt);
/* retrieve field information from metadata result set */
$field = mysqli_fetch_field($result);
printf("Fieldname: %s\n", $field->name);
/* close resultset */
mysqli_free_result($result);
/* close connection */
mysqli_close($link);
?>
```

See Also

[mysqli_prepare](#)
[mysqli_free_result](#)

7.3.10.26 mysqli_stmt::send_long_data, mysqli_stmt_send_long_data

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- [mysqli_stmt::send_long_data](#)

[mysqli_stmt_send_long_data](#)

Send data in blocks

Description

Object oriented style

```
bool mysqli_stmt::send_long_data(
    int param_nr,
    string data);
```

Procedural style

```
bool mysqli_stmt_send_long_data(
    mysqli_stmt stmt,
    int param_nr,
    string data);
```

Allows to send parameter data to the server in pieces (or chunks), e.g. if the size of a blob exceeds the size of [max_allowed_packet](#). This function can be called multiple times to send the parts of a character or binary data value for a column, which must be one of the TEXT or BLOB datatypes.

Parameters

stmt Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

param_nr Indicates which parameter to associate the data with. Parameters are numbered beginning with 0.

data A string containing data to be sent.

Return Values

Returns [TRUE](#) on success or [FALSE](#) on failure.

Examples

Example 7.109 Object oriented style

```
<?php
$stmt = $mysqli->prepare("INSERT INTO messages (message) VALUES (?)");
$stmt->bind_param("b", $null);
$fp = fopen("messages.txt", "r");
while (!feof($fp)) {
    $stmt->send_long_data(0, fread($fp, 8192));
}
fclose($fp);
$stmt->execute();
?>
```

See Also

[mysqli_prepare](#)
[mysqli_stmt_bind_param](#)

7.3.10.27 mysqli_stmt::\$sqlstate, mysqli_stmt_sqlstate

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- [mysqli_stmt::\\$sqlstate](#)

[mysqli_stmt_sqlstate](#)

Returns SQLSTATE error from previous statement operation

Description

Object oriented style

```
string
mysqli_stmt->sqlstate ;
```

Procedural style

```
string mysqli_stmt_sqlstate(
    mysqli_stmt stmt);
```

Returns a string containing the SQLSTATE error code for the most recently invoked prepared statement function that can succeed or fail. The error code consists of five characters. '00000' means no error. The values are specified by ANSI SQL and ODBC. For a list of possible values, see <http://dev.mysql.com/doc/mysql/en/error-handling.html>.

Parameters

stmt Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

Return Values

Returns a string containing the SQLSTATE error code for the last error. The error code consists of five characters. '00000' means no error.

Notes

Note

Note that not all MySQL errors are yet mapped to SQLSTATE's. The value **HY000** (general error) is used for unmapped errors.

Examples**Example 7.110 Object oriented style**

```
<?php
/* Open a connection */
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error());
    exit();
}
$mysqli->query("CREATE TABLE myCountry LIKE Country");
$mysqli->query("INSERT INTO myCountry SELECT * FROM Country");
$query = "SELECT Name, Code FROM myCountry ORDER BY Name";
if ($stmt = $mysqli->prepare($query)) {
    /* drop table */
    $mysqli->query("DROP TABLE myCountry");
    /* execute query */
    $stmt->execute();
    printf("Error: %s.\n", $stmt->sqlstate);
    /* close statement */
    $stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.111 Procedural style

```
<?php
/* Open a connection */
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
mysqli_query($link, "CREATE TABLE myCountry LIKE Country");
mysqli_query($link, "INSERT INTO myCountry SELECT * FROM Country");
$query = "SELECT Name, Code FROM myCountry ORDER BY Name";
if ($stmt = mysqli_prepare($link, $query)) {
    /* drop table */
    mysqli_query($link, "DROP TABLE myCountry");
    /* execute query */
    mysqli_stmt_execute($stmt);
    printf("Error: %s.\n", mysqli_stmt_sqlstate($stmt));
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Error: 42S02.
```

See Also

[mysqli_stmt_errno](#)
[mysqli_stmt_error](#)

7.3.10.28 mysqli_stmt::store_result, mysqli_stmt_store_result

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- [mysqli_stmt::store_result](#)

[mysqli_stmt_store_result](#)

Transfers a result set from a prepared statement

Description

Object oriented style

```
bool mysqli_stmt::store_result();
```

Procedural style

```
bool mysqli_stmt_store_result(
    mysqli_stmt stmt);
```

You must call [mysqli_stmt_store_result](#) for every query that successfully produces a result set ([SELECT](#), [SHOW](#), [DESCRIBE](#), [EXPLAIN](#)), if and only if you want to buffer the complete result set by the client, so that the subsequent [mysqli_stmt_fetch](#) call returns buffered data.

Note

It is unnecessary to call [mysqli_stmt_store_result](#) for other queries, but if you do, it will not harm or cause any notable performance loss in all cases. You can detect whether the query produced a result set by checking if [mysqli_stmt_result_metadata](#) returns [FALSE](#).

Parameters

stmt

Procedural style only: A statement identifier returned by [mysqli_stmt_init](#).

Return Values

Returns [TRUE](#) on success or [FALSE](#) on failure.

Examples**Example 7.112 Object oriented style**

```
<?php
/* Open a connection */
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER BY Name LIMIT 20";
```

```
if ($stmt = $mysqli->prepare($query)) {
    /* execute query */
    $stmt->execute();
    /* store result */
    $stmt->store_result();
    printf("Number of rows: %d.\n", $stmt->num_rows);
    /* free result */
    $stmt->free_result();
    /* close statement */
    $stmt->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.113 Procedural style

```
<?php
/* Open a connection */
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER BY Name LIMIT 20";
if ($stmt = mysqli_prepare($link, $query)) {
    /* execute query */
    mysqli_stmt_execute($stmt);
    /* store result */
    mysqli_stmt_store_result($stmt);
    printf("Number of rows: %d.\n", mysqli_stmt_num_rows($stmt));
    /* free result */
    mysqli_stmt_free_result($stmt);
    /* close statement */
    mysqli_stmt_close($stmt);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Number of rows: 20.
```

See Also

[mysqli_prepare](#)
[mysqli_stmt_result_metadata](#)
[mysqli_stmt_fetch](#)

7.3.11 The mysqli_result class

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Represents the result set obtained from a query against the database.

Changelog

Table 7.16 Changelog

Version	Description
5.4.0	<code>Iterator</code> support was added, as <code>mysqli_result</code> now implements <code>Traversable</code> .

```

mysqli_result {
    mysqli_result
        Traversable
    Properties

    int
        mysqli_result->current_field ;

    int
        mysqli_result->field_count ;

    array
        mysqli_result->lengths ;

    int
        mysqli_result->num_rows ;

Methods

    bool mysqli_result::data_seek(
        int offset);

    mixed mysqli_result::fetch_all(
        int resulttype
        = MYSQLI_NUM);

    mixed mysqli_result::fetch_array(
        int resulttype
        = MYSQLI_BOTH);

    array mysqli_result::fetch_assoc();

    object mysqli_result::fetch_field_direct(
        int fieldnr);

    object mysqli_result::fetch_field();

    array mysqli_result::fetch_fields();

    object mysqli_result::fetch_object(
        string class_name
        = "stdClass",
        array params);

    mixed mysqli_result::fetch_row();

    bool mysqli_result::field_seek(
        int fieldnr);

    void mysqli_result::free();

}

```

7.3.11.1 `mysqli_result::$current_field`, `mysqli_field_tell`

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- `mysqli_result::$current_field`
- `mysqli_field_tell`

Get current field offset of a result pointer

Description

Object oriented style

```
int  
mysqli_result->current_field ;
```

Procedural style

```
int mysqli_field_tell(  
    mysqli_result result);
```

Returns the position of the field cursor used for the last `mysqli_fetch_field` call. This value can be used as an argument to `mysqli_field_seek`.

Parameters

`result`

Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

Return Values

Returns current offset of field cursor.

Examples

Example 7.114 Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
$query = "SELECT Name, SurfaceArea from Country ORDER BY Code LIMIT 5";  
if ($result = $mysqli->query($query)) {  
    /* Get field information for all columns */  
    while ($finfo = $result->fetch_field()) {  
        /* get fieldpointer offset */  
        $currentfield = $result->current_field;  
        printf("Column %d:\n", $currentfield);  
        printf("Name:      %s\n", $finfo->name);  
        printf("Table:     %s\n", $finfo->table);  
        printf("max. Len: %d\n", $finfo->max_length);  
        printf("Flags:     %d\n", $finfo->flags);  
        printf("Type:      %d\n\n", $finfo->type);  
    }  
    $result->close();  
}  
/* close connection */  
$mysqli->close();  
?>
```

Example 7.115 Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */
```

```
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, SurfaceArea from Country ORDER BY Code LIMIT 5";
if ($result = mysqli_query($link, $query)) {
    /* Get field information for all fields */
    while ($finfo = mysqli_fetch_field($result)) {
        /* get fieldpointer offset */
        $currentfield = mysqli_field_tell($result);
        printf("Column %d:\n", $currentfield);
        printf("Name:      %s\n", $finfo->name);
        printf("Table:     %s\n", $finfo->table);
        printf("max. Len:  %d\n", $finfo->max_length);
        printf("Flags:     %d\n", $finfo->flags);
        printf("Type:      %d\n\n", $finfo->type);
    }
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Column 1:
Name:      Name
Table:     Country
max. Len:  11
Flags:     1
Type:      254
Column 2:
Name:      SurfaceArea
Table:     Country
max. Len:  10
Flags:     32769
Type:      4
```

See Also

[mysqli_fetch_field](#)
[mysqli_field_seek](#)

7.3.11.2 `mysqli_result::data_seek`, `mysqli_data_seek`

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- [mysqli_result::data_seek](#)

[mysqli_data_seek](#)

Adjusts the result pointer to an arbitrary row in the result

Description

Object oriented style

```
bool mysqli_result::data_seek(
    int offset);
```

Procedural style

```
bool mysqli_data_seek(
```

```
mysqli_result result,  
int offset);
```

The `mysqli_data_seek` function seeks to an arbitrary result pointer specified by the `offset` in the result set.

Parameters

`result` Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

`offset` The field offset. Must be between zero and the total number of rows minus one (0..`mysqli_num_rows` - 1).

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Notes

Note

This function can only be used with buffered results attained from the use of the `mysqli_store_result` or `mysqli_query` functions.

Examples

Example 7.116 Object oriented style

```
<?php  
/* Open a connection */  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli->connect_errno) {  
    printf("Connect failed: %s\n", $mysqli->connect_error());  
    exit();  
}  
$query = "SELECT Name, CountryCode FROM City ORDER BY Name";  
if ($result = $mysqli->query($query)) {  
    /* seek to row no. 400 */  
    $result->data_seek(399);  
    /* fetch row */  
    $row = $result->fetch_row();  
    printf ("City: %s Countrycode: %s\n", $row[0], $row[1]);  
    /* free result set*/  
    $result->close();  
}  
/* close connection */  
$mysqli->close();  
?>
```

Example 7.117 Procedural style

```
<?php  
/* Open a connection */  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (!$link) {  
    printf("Connect failed: %s\n", mysqli_connect_error());  
    exit();  
}  
$query = "SELECT Name, CountryCode FROM City ORDER BY Name";
```

```
if ($result = mysqli_query($link, $query)) {
    /* seek to row no. 400 */
    mysqli_data_seek($result, 399);
    /* fetch row */
    $row = mysqli_fetch_row($result);
    printf ("City: %s Countrycode: %s\n", $row[0], $row[1]);
    /* free result set*/
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
City: Benin City Countrycode: NGA
```

See Also

[mysqli_store_result](#)
[mysqli_fetch_row](#)
[mysqli_fetch_array](#)
[mysqli_fetch_assoc](#)
[mysqli_fetch_object](#)
[mysqli_query](#)
[mysqli_num_rows](#)

7.3.11.3 `mysqli_result::fetch_all`, `mysqli_fetch_all`

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- [mysqli_result::fetch_all](#)

[mysqli_fetch_all](#)

Fetches all result rows as an associative array, a numeric array, or both

Description

Object oriented style

```
mixed mysqli_result::fetch_all(
    int resulttype
        = MYSQLI_NUM);
```

Procedural style

```
mixed mysqli_fetch_all(
    mysqli_result result,
    int resulttype
        = MYSQLI_NUM);
```

[mysqli_fetch_all](#) fetches all result rows and returns the result set as an associative array, a numeric array, or both.

Parameters

result

Procedural style only: A result set identifier returned by [mysqli_query](#), [mysqli_store_result](#) or [mysqli_use_result](#).

<code>resulttype</code>	This optional parameter is a constant indicating what type of array should be produced from the current row data. The possible values for this parameter are the constants <code>MYSQLI_ASSOC</code> , <code>MYSQLI_NUM</code> , or <code>MYSQLI_BOTH</code> .
-------------------------	--

Return Values

Returns an array of associative or numeric arrays holding result rows.

MySQL Native Driver Only

Available only with `mysqlnd`.

As `mysqli_fetch_all` returns all the rows as an array in a single step, it may consume more memory than some similar functions such as `mysqli_fetch_array`, which only returns one row at a time from the result set. Further, if you need to iterate over the result set, you will need a looping construct that will further impact performance. For these reasons `mysqli_fetch_all` should only be used in those situations where the fetched result set will be sent to another layer for processing.

See Also

`mysqli_fetch_array`
`mysqli_query`

7.3.11.4 `mysqli_result::fetch_array`, `mysqli_fetch_array`

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- `mysqli_result::fetch_array`

`mysqli_fetch_array`

Fetch a result row as an associative, a numeric array, or both

Description

Object oriented style

```
mixed mysqli_result::fetch_array(
    int resulttype
    = MYSQLI_BOTH);
```

Procedural style

```
mixed mysqli_fetch_array(
    mysqli_result result,
    int resulttype
    = MYSQLI_BOTH);
```

Returns an array that corresponds to the fetched row or `NULL` if there are no more rows for the resultset represented by the `result` parameter.

`mysqli_fetch_array` is an extended version of the `mysqli_fetch_row` function. In addition to storing the data in the numeric indices of the result array, the `mysqli_fetch_array` function can also store the data in associative indices, using the field names of the result set as keys.

Note

Field names returned by this function are *case-sensitive*.

Note

This function sets NULL fields to the PHP `NULL` value.

If two or more columns of the result have the same field names, the last column will take precedence and overwrite the earlier data. In order to access multiple columns with the same name, the numerically indexed version of the row must be used.

Parameters

`result`

Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

`resulttype`

This optional parameter is a constant indicating what type of array should be produced from the current row data. The possible values for this parameter are the constants `MYSQLI_ASSOC`, `MYSQLI_NUM`, or `MYSQLI_BOTH`.

By using the `MYSQLI_ASSOC` constant this function will behave identically to the `mysqli_fetch_assoc`, while `MYSQLI_NUM` will behave identically to the `mysqli_fetch_row` function. The final option `MYSQLI_BOTH` will create a single array with the attributes of both.

Return Values

Returns an array of strings that corresponds to the fetched row or `NULL` if there are no more rows in resultset.

Examples

Example 7.118 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error);
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER by ID LIMIT 3";
$result = $mysqli->query($query);
/* numeric array */
$row = $result->fetch_array(MYSQLI_NUM);
printf ("%s (%s)\n", $row[0], $row[1]);
/* associative array */
$row = $result->fetch_array(MYSQLI_ASSOC);
printf ("%s (%s)\n", $row["Name"], $row["CountryCode"]);
/* associative and numeric array */
$row = $result->fetch_array(MYSQLI_BOTH);
printf ("%s (%s)\n", $row[0], $row["CountryCode"]);
/* free result set */
$result->free();
/* close connection */
$mysqli->close();
?>
```

Example 7.119 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
```

```
printf("Connect failed: %s\n", mysqli_connect_error());
exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER by ID LIMIT 3";
$result = mysqli_query($link, $query);
/* numeric array */
$row = mysqli_fetch_array($result, MYSQLI_NUM);
printf ("%s (%s)\n", $row[0], $row[1]);
/* associative array */
$row = mysqli_fetch_array($result, MYSQLI_ASSOC);
printf ("%s (%s)\n", $row["Name"], $row["CountryCode"]);
/* associative and numeric array */
$row = mysqli_fetch_array($result, MYSQLI_BOTH);
printf ("%s (%s)\n", $row[0], $row["CountryCode"]);
/* free result set */
mysqli_free_result($result);
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Kabul (AFG)
Qandahar (AFG)
Herat (AFG)
```

See Also

[mysqli_fetch_assoc](#)
[mysqli_fetch_row](#)
[mysqli_fetch_object](#)
[mysqli_query](#)
[mysqli_data_seek](#)

7.3.11.5 `mysqli_result::fetch_assoc`, `mysqli_fetch_assoc`

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- [mysqli_result::fetch_assoc](#)

[mysqli_fetch_assoc](#)

Fetch a result row as an associative array

Description

Object oriented style

```
array mysqli_result::fetch_assoc();
```

Procedural style

```
array mysqli_fetch_assoc(
    mysqli_result result);
```

Returns an associative array that corresponds to the fetched row or [NULL](#) if there are no more rows.

Note

Field names returned by this function are *case-sensitive*.

Note

This function sets NULL fields to the PHP `NULL` value.

Parameters

`result` Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

Return Values

Returns an associative array of strings representing the fetched row in the result set, where each key in the array represents the name of one of the result set's columns or `NULL` if there are no more rows in resultset.

If two or more columns of the result have the same field names, the last column will take precedence. To access the other column(s) of the same name, you either need to access the result with numeric indices by using `mysqli_fetch_row` or add alias names.

Examples**Example 7.120 Object oriented style**

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error);
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER by ID DESC LIMIT 50,5";
if ($result = $mysqli->query($query)) {
    /* fetch associative array */
    while ($row = $result->fetch_assoc()) {
        printf ("%s (%s)\n", $row["Name"], $row["CountryCode"]);
    }
    /* free result set */
    $result->free();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.121 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER by ID DESC LIMIT 50,5";
if ($result = mysqli_query($link, $query)) {
    /* fetch associative array */
    while ($row = mysqli_fetch_assoc($result)) {
        printf ("%s (%s)\n", $row["Name"], $row["CountryCode"]);
    }
    /* free result set */
    mysqli_free_result($result);
}
/* close connection */
```

```
mysqli_close($link);
?>
```

The above examples will output:

```
Pueblo (USA)
Arvada (USA)
Cape Coral (USA)
Green Bay (USA)
Santa Clara (USA)
```

Example 7.122 A `mysqli_result` example comparing iterator usage

```
<?php
$c = mysqli_connect('127.0.0.1','user', 'pass');
// Using iterators (support was added with PHP 5.4)
foreach ( $c->query('SELECT user,host FROM mysql.user') as $row ) {
    printf("%s@%s\n", $row['user'], $row['host']);
}
echo "=====";
// Not using iterators
$result = $c->query('SELECT user,host FROM mysql.user');
while ($row = $result->fetch_assoc()) {
    printf("%s@%s\n", $row['user'], $row['host']);
}
?>
```

The above example will output something similar to:

```
'root'@'192.168.1.1'
'root'@'127.0.0.1'
'dude'@'localhost'
'lebowski'@'localhost'
=====
'root'@'192.168.1.1'
'root'@'127.0.0.1'
'dude'@'localhost'
'lebowski'@'localhost'
```

See Also

[mysqli_fetch_array](#)
[mysqli_fetch_row](#)
[mysqli_fetch_object](#)
[mysqli_query](#)
[mysqli_data_seek](#)

7.3.11.6 `mysqli_result::fetch_field_direct`, `mysqli_fetch_field_direct`

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- [mysqli_result::fetch_field_direct](#)

[mysqli_fetch_field_direct](#)

Fetch meta-data for a single field

Description

Object oriented style

```
object mysqli_result::fetch_field_direct(
    int fieldnr);
```

Procedural style

```
object mysqli_fetch_field_direct(
    mysqli_result result,
    int fieldnr);
```

Returns an object which contains field definition information from the specified result set.

Parameters

result

Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

fieldnr

The field number. This value must be in the range from `0` to `number of fields - 1`.

Return Values

Returns an object which contains field definition information or `FALSE` if no field information for specified `fieldnr` is available.

Table 7.17 Object attributes

Attribute	Description
<code>name</code>	The name of the column
<code>orgname</code>	Original column name if an alias was specified
<code>table</code>	The name of the table this field belongs to (if not calculated)
<code>orgtable</code>	Original table name if an alias was specified
<code>def</code>	The default value for this field, represented as a string
<code>max_length</code>	The maximum width of the field for the result set.
<code>length</code>	The width of the field, as specified in the table definition.
<code>charsetnr</code>	The character set number for the field.
<code>flags</code>	An integer representing the bit-flags for the field.
<code>type</code>	The data type used for this field
<code>decimals</code>	The number of decimals used (for numeric fields)

Examples

Example 7.123 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
```

```
}

$query = "SELECT Name, SurfaceArea from Country ORDER BY Name LIMIT 5";
if ($result = $mysqli->query($query)) {
    /* Get field information for column 'SurfaceArea' */
    $finfo = $result->fetch_field_direct(1);
    printf("Name:      %s\n", $finfo->name);
    printf("Table:     %s\n", $finfo->table);
    printf("max. Len:  %d\n", $finfo->max_length);
    printf("Flags:     %d\n", $finfo->flags);
    printf("Type:      %d\n", $finfo->type);
    $result->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.124 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, SurfaceArea from Country ORDER BY Name LIMIT 5";
if ($result = mysqli_query($link, $query)) {
    /* Get field information for column 'SurfaceArea' */
    $finfo = mysqli_fetch_field_direct($result, 1);
    printf("Name:      %s\n", $finfo->name);
    printf("Table:     %s\n", $finfo->table);
    printf("max. Len:  %d\n", $finfo->max_length);
    printf("Flags:     %d\n", $finfo->flags);
    printf("Type:      %d\n", $finfo->type);
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Name:      SurfaceArea
Table:     Country
max. Len:  10
Flags:     32769
Type:      4
```

See Also

[mysqli_num_fields](#)
[mysqli_fetch_field](#)
[mysqli_fetch_fields](#)

7.3.11.7 [mysqli_result::fetch_field](#), [mysqli_fetch_field](#)

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- [mysqli_result::fetch_field](#)

[mysqli_fetch_field](#)

Returns the next field in the result set

Description

Object oriented style

```
object mysqli_result::fetch_field();
```

Procedural style

```
object mysqli_fetch_field(  
    mysqli_result result);
```

Returns the definition of one column of a result set as an object. Call this function repeatedly to retrieve information about all columns in the result set.

Parameters

result

Procedural style only: A result set identifier returned by [mysqli_query](#), [mysqli_store_result](#) or [mysqli_use_result](#).

Return Values

Returns an object which contains field definition information or [FALSE](#) if no field information is available.

Table 7.18 Object properties

Property	Description
name	The name of the column
orgname	Original column name if an alias was specified
table	The name of the table this field belongs to (if not calculated)
orgtable	Original table name if an alias was specified
def	Reserved for default value, currently always ""
db	Database (since PHP 5.3.6)
catalog	The catalog name, always "def" (since PHP 5.3.6)
max_length	The maximum width of the field for the result set.
length	The width of the field, as specified in the table definition.
charsetnr	The character set number for the field.
flags	An integer representing the bit-flags for the field.
type	The data type used for this field
decimals	The number of decimals used (for integer fields)

Examples

Example 7.125 Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if (mysqli_connect_errno()) {
```

```
printf("Connect failed: %s\n", mysqli_connect_error());
exit();
}
$query = "SELECT Name, SurfaceArea from Country ORDER BY Code LIMIT 5";
if ($result = $mysqli->query($query)) {
    /* Get field information for all columns */
    while ($finfo = $result->fetch_field()) {
        printf("Name:      %s\n", $finfo->name);
        printf("Table:     %s\n", $finfo->table);
        printf("max. Len:  %d\n", $finfo->max_length);
        printf("Flags:     %d\n", $finfo->flags);
        printf("Type:      %d\n\n", $finfo->type);
    }
    $result->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.126 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, SurfaceArea from Country ORDER BY Code LIMIT 5";
if ($result = mysqli_query($link, $query)) {
    /* Get field information for all fields */
    while ($finfo = mysqli_fetch_field($result)) {
        printf("Name:      %s\n", $finfo->name);
        printf("Table:     %s\n", $finfo->table);
        printf("max. Len:  %d\n", $finfo->max_length);
        printf("Flags:     %d\n", $finfo->flags);
        printf("Type:      %d\n\n", $finfo->type);
    }
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Name:      Name
Table:     Country
max. Len:  11
Flags:     1
Type:      254
Name:      SurfaceArea
Table:     Country
max. Len:  10
Flags:     32769
Type:      4
```

See Also

[mysqli_num_fields](#)
[mysqli_fetch_field_direct](#)
[mysqli_fetch_fields](#)

`mysqli_field_seek`

7.3.11.8 `mysqli_result::fetch_fields`, `mysqli_fetch_fields`

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- `mysqli_result::fetch_fields`

`mysqli_fetch_fields`

Returns an array of objects representing the fields in a result set

Description

Object oriented style

```
array mysqli_result::fetch_fields();
```

Procedural style

```
array mysqli_fetch_fields(
    mysqli_result result);
```

This function serves an identical purpose to the `mysqli_fetch_field` function with the single difference that, instead of returning one object at a time for each field, the columns are returned as an array of objects.

Parameters

`result`

Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

Return Values

Returns an array of objects which contains field definition information or `FALSE` if no field information is available.

Table 7.19 Object properties

Property	Description
<code>name</code>	The name of the column
<code>orgname</code>	Original column name if an alias was specified
<code>table</code>	The name of the table this field belongs to (if not calculated)
<code>orgtable</code>	Original table name if an alias was specified
<code>max_length</code>	The maximum width of the field for the result set.
<code>length</code>	The width of the field, in bytes, as specified in the table definition. Note that this number (bytes) might differ from your table definition value (characters), depending on the character set you use. For example, the character set utf8 has 3 bytes per character, so varchar(10) will return a length of 30 for utf8 (10×3), but return 10 for latin1 (10×1).
<code>charsetnr</code>	The character set number (id) for the field.
<code>flags</code>	An integer representing the bit-flags for the field.
<code>type</code>	The data type used for this field

Property	Description
decimals	The number of decimals used (for integer fields)

Examples

Example 7.127 Object oriented style

```
<?php
$mysqli = new mysqli("127.0.0.1", "root", "foofoo", "sakila");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error);
    exit();
}
foreach (array('latin1', 'utf8') as $charset) {
    // Set character set, to show its impact on some values (e.g., length in bytes)
    $mysqli->set_charset($charset);
    $query = "SELECT actor_id, last_name from actor ORDER BY actor_id";
    echo "======\n";
    echo "Character Set: $charset\n";
    echo "======\n";

    if ($result = $mysqli->query($query)) {
        /* Get field information for all columns */
        $finfo = $result->fetch_fields();
        foreach ($finfo as $val) {
            printf("Name:      %s\n", $val->name);
            printf("Table:     %s\n", $val->table);
            printf("Max. Len:  %d\n", $val->max_length);
            printf("Length:    %d\n", $val->length);
            printf("charsetnr: %d\n", $val->charsetnr);
            printf("Flags:     %d\n", $val->flags);
            printf("Type:      %d\n\n", $val->type);
        }
        $result->free();
    }
}
$mysqli->close();
?>
```

Example 7.128 Procedural style

```
<?php
$link = mysqli_connect("127.0.0.1", "my_user", "my_password", "sakila");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
foreach (array('latin1', 'utf8') as $charset) {
    // Set character set, to show its impact on some values (e.g., length in bytes)
    mysqli_set_charset($link, $charset);
    $query = "SELECT actor_id, last_name from actor ORDER BY actor_id";
    echo "======\n";
    echo "Character Set: $charset\n";
    echo "======\n";
    if ($result = mysqli_query($link, $query)) {
        /* Get field information for all columns */
        $finfo = mysqli_fetch_fields($result);
        foreach ($finfo as $val) {
            printf("Name:      %s\n", $val->name);
            printf("Table:     %s\n", $val->table);
            printf("Max. Len:  %d\n", $val->max_length);
            printf("Length:    %d\n", $val->length);
            printf("charsetnr: %d\n", $val->charsetnr);
        }
    }
}
```

```
        printf("Flags:      %d\n",    $val->flags);
        printf("Type:       %d\n\n",   $val->type);
    }
    mysqli_free_result($result);
}
mysqli_close($link);
?>
```

The above examples will output:

```
=====
Character Set: latin1
=====
Name:      actor_id
Table:     actor
Max. Len:  3
Length:    5
charsetnr: 63
Flags:     49699
Type:      2
Name:      last_name
Table:     actor
Max. Len: 12
Length:   45
charsetnr: 8
Flags:     20489
Type:      253
=====
Character Set: utf8
=====
Name:      actor_id
Table:     actor
Max. Len:  3
Length:    5
charsetnr: 63
Flags:     49699
Type:      2
Name:      last_name
Table:     actor
Max. Len: 12
Length:   135
charsetnr: 33
Flags:     20489
```

See Also

[mysqli_num_fields](#)
[mysqli_fetch_field_direct](#)
[mysqli_fetch_field](#)

7.3.11.9 `mysqli_result::fetch_object`, `mysqli_fetch_object`

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- [mysqli_result::fetch_object](#)
[mysqli_fetch_object](#)

Returns the current row of a result set as an object

Description

Object oriented style

```
object mysqli_result::fetch_object(
    string class_name
        = "stdClass",
    array params);
```

Procedural style

```
object mysqli_fetch_object(
    mysqli_result result,
    string class_name
        = "stdClass",
    array params);
```

The `mysqli_fetch_object` will return the current row result set as an object where the attributes of the object represent the names of the fields found within the result set.

Note that `mysqli_fetch_object` sets the properties of the object before calling the object constructor.

Parameters

`result` Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

`class_name` The name of the class to instantiate, set the properties of and return. If not specified, a `stdClass` object is returned.

`params` An optional array of parameters to pass to the constructor for `class_name` objects.

Return Values

Returns an object with string properties that corresponds to the fetched row or `NULL` if there are no more rows in resultset.

Note

Field names returned by this function are *case-sensitive*.

Note

This function sets NULL fields to the PHP `NULL` value.

Examples

Example 7.129 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}

$query = "SELECT Name, CountryCode FROM City ORDER by ID DESC LIMIT 50,5";
if ($result = $mysqli->query($query)) {
    /* fetch object array */
    while ($obj = $result->fetch_object()) {
        printf ("%s (%s)\n", $obj->Name, $obj->CountryCode);
    }
    /* free result set */
    $result->close();
}
```

```
}
```

```
/* close connection */
```

```
$mysqli->close();
```

```
?>
```

Example 7.130 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, CountryCode FROM City ORDER by ID DESC LIMIT 50,5";
if ($result = mysqli_query($link, $query)) {
    /* fetch associative array */
    while ($obj = mysqli_fetch_object($result)) {
        printf ("%s (%s)\n", $obj->Name, $obj->CountryCode);
    }
    /* free result set */
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Pueblo (USA)
Arvada (USA)
Cape Coral (USA)
Green Bay (USA)
Santa Clara (USA)
```

See Also

[mysqli_fetch_array](#)
[mysqli_fetch_assoc](#)
[mysqli_fetch_row](#)
[mysqli_query](#)
[mysqli_data_seek](#)

7.3.11.10 [mysqli_result::fetch_row](#), [mysqli_fetch_row](#)

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- [mysqli_result::fetch_row](#)
- [mysqli_fetch_row](#)

Get a result row as an enumerated array

Description

Object oriented style

```
mixed mysqli_result::fetch_row();
```

Procedural style

```
mixed mysqli_fetch_row(  
    mysqli_result result);
```

Fetches one row of data from the result set and returns it as an enumerated array, where each column is stored in an array offset starting from 0 (zero). Each subsequent call to this function will return the next row within the result set, or [NULL](#) if there are no more rows.

Parameters

result Procedural style only: A result set identifier returned by [mysqli_query](#), [mysqli_store_result](#) or [mysqli_use_result](#).

Return Values

[mysqli_fetch_row](#) returns an array of strings that corresponds to the fetched row or [NULL](#) if there are no more rows in result set.

Note

This function sets NULL fields to the PHP [NULL](#) value.

Examples

Example 7.131 Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", $mysqli_connect_error());  
    exit();  
}  
$query = "SELECT Name, CountryCode FROM City ORDER by ID DESC LIMIT 50,5";  
if ($result = $mysqli->query($query)) {  
    /* fetch object array */  
    while ($row = $result->fetch_row()) {  
        printf ("%s (%s)\n", $row[0], $row[1]);  
    }  
    /* free result set */  
    $result->close();  
}  
/* close connection */  
$mysqli->close();  
?>
```

Example 7.132 Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", $mysqli_connect_error());  
    exit();  
}  
$query = "SELECT Name, CountryCode FROM City ORDER by ID DESC LIMIT 50,5";  
if ($result = mysqli_query($link, $query)) {  
    /* fetch associative array */  
    while ($row = mysqli_fetch_row($result)) {  
        printf ("%s (%s)\n", $row[0], $row[1]);  
    }  
}
```

```
    }
    /* free result set */
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Pueblo (USA)
Arvada (USA)
Cape Coral (USA)
Green Bay (USA)
Santa Clara (USA)
```

See Also

[mysqli_fetch_array](#)
[mysqli_fetch_assoc](#)
[mysqli_fetch_object](#)
[mysqli_query](#)
[mysqli_data_seek](#)

7.3.11.11 mysqli_result::\$field_count, mysqli_num_fields

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- [mysqli_result::\\$field_count](#)
[mysqli_num_fields](#)

Get the number of fields in a result

Description

Object oriented style

```
int
mysqli_result->field_count ;
```

Procedural style

```
int mysqli_num_fields(
    mysqli_result result);
```

Returns the number of fields from specified result set.

Parameters

result

Procedural style only: A result set identifier returned by [mysqli_query](#), [mysqli_store_result](#) or [mysqli_use_result](#).

Return Values

The number of fields from a result set.

Examples

Example 7.133 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli->connect_errno) {
    printf("Connect failed: %s\n", $mysqli->connect_error());
    exit();
}
if ($result = $mysqli->query("SELECT * FROM City ORDER BY ID LIMIT 1")) {
    /* determine number of fields in result set */
    $field_cnt = $result->field_count;
    printf("Result set has %d fields.\n", $field_cnt);
    /* close result set */
    $result->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.134 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if ($link->connect_errno) {
    printf("Connect failed: %s\n", $link->connect_error());
    exit();
}
if ($result = mysqli_query($link, "SELECT * FROM City ORDER BY ID LIMIT 1")) {
    /* determine number of fields in result set */
    $field_cnt = mysqli_num_fields($result);
    printf("Result set has %d fields.\n", $field_cnt);
    /* close result set */
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Result set has 5 fields.
```

See Also

[mysqli_fetch_field](#)

7.3.11.12 `mysqli_result::field_seek`, `mysqli_field_seek`

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- [mysqli_result::field_seek](#)

[mysqli_field_seek](#)

Set result pointer to a specified field offset

Description

Object oriented style

```
bool mysqli_result::field_seek(  
    int fieldnr);
```

Procedural style

```
bool mysqli_field_seek(  
    mysqli_result result,  
    int fieldnr);
```

Sets the field cursor to the given offset. The next call to [mysqli_fetch_field](#) will retrieve the field definition of the column associated with that offset.

Note

To seek to the beginning of a row, pass an offset value of zero.

Parameters

result

Procedural style only: A result set identifier returned by [mysqli_query](#), [mysqli_store_result](#) or [mysqli_use_result](#).

fieldnr

The field number. This value must be in the range from `0` to `number of fields - 1`.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.135 Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli->connect_errno) {  
    printf("Connect failed: %s\n", $mysqli->connect_error());  
    exit();  
}  
$query = "SELECT Name, SurfaceArea from Country ORDER BY Code LIMIT 5";  
if ($result = $mysqli->query($query)) {  
    /* Get field information for 2nd column */  
    $result->field_seek(1);  
    $finfo = $result->fetch_field();  
    printf("Name:      %s\n", $finfo->name);  
    printf("Table:     %s\n", $finfo->table);  
    printf("max. Len:  %d\n", $finfo->max_length);  
    printf("Flags:     %d\n", $finfo->flags);  
    printf("Type:      %d\n", $finfo->type);  
    $result->close();  
}  
/* close connection */  
$mysqli->close();  
?>
```

Example 7.136 Procedural style

```
<?php  
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
```

```
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
$query = "SELECT Name, SurfaceArea from Country ORDER BY Code LIMIT 5";
if ($result = mysqli_query($link, $query)) {
    /* Get field information for 2nd column */
    mysqli_field_seek($result, 1);
    $finfo = mysqli_fetch_field($result);
    printf("Name:      %s\n", $finfo->name);
    printf("Table:     %s\n", $finfo->table);
    printf("max. Len:  %d\n", $finfo->max_length);
    printf("Flags:     %d\n", $finfo->flags);
    printf("Type:      %d\n", $finfo->type);
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Name:      SurfaceArea
Table:     Country
max. Len:  10
Flags:     32769
Type:      4
```

See Also

[mysqli_fetch_field](#)

7.3.11.13 [mysqli_result::free](#), [mysqli_result::close](#), [mysqli_result::free_result](#), [mysqli_free_result](#)

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- [mysqli_result::free](#)

[mysqli_result::close](#)

[mysqli_result::free_result](#)

[mysqli_free_result](#)

Frees the memory associated with a result

Description

Object oriented style

```
void mysqli_result::free();
void mysqli_result::close();
void mysqli_result::free_result();
```

Procedural style

```
void mysqli_free_result(
    mysqli_result result);
```

Frees the memory associated with the result.

Note

You should always free your result with `mysqli_free_result`, when your result object is not needed anymore.

Parameters

`result`

Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

Return Values

No value is returned.

See Also

`mysqli_query`
`mysqli_stmt_store_result`
`mysqli_store_result`
`mysqli_use_result`

7.3.11.14 `mysqli_result::$lengths`, `mysqli_fetch_lengths`

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- `mysqli_result::$lengths`
- `mysqli_fetch_lengths`

Returns the lengths of the columns of the current row in the result set

Description

Object oriented style

```
array  
mysqli_result->lengths ;
```

Procedural style

```
array mysqli_fetch_lengths(  
    mysqli_result result);
```

The `mysqli_fetch_lengths` function returns an array containing the lengths of every column of the current row within the result set.

Parameters

`result`

Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

Return Values

An array of integers representing the size of each column (not including any terminating null characters). `FALSE` if an error occurred.

`mysqli_fetch_lengths` is valid only for the current row of the result set. It returns `FALSE` if you call it before calling `mysqli_fetch_row`/`array`/`object` or after retrieving all rows in the result.

Examples

Example 7.137 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$query = "SELECT * from Country ORDER BY Code LIMIT 1";
if ($result = $mysqli->query($query)) {
    $row = $result->fetch_row();
    /* display column lengths */
    foreach ($result->lengths as $i => $val) {
        printf("Field %2d has Length %2d\n", $i+1, $val);
    }
    $result->close();
}
/* close connection */
$mysqli->close();
?>
```

Example 7.138 Procedural style

```
<?php
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if ($mysqli_connect_errno()) {
    printf("Connect failed: %s\n", $mysqli_connect_error());
    exit();
}
$query = "SELECT * from Country ORDER BY Code LIMIT 1";
if ($result = mysqli_query($link, $query)) {
    $row = mysqli_fetch_row($result);
    /* display column lengths */
    foreach (mysqli_fetch_lengths($result) as $i => $val) {
        printf("Field %2d has Length %2d\n", $i+1, $val);
    }
    mysqli_free_result($result);
}
/* close connection */
mysqli_close($link);
?>
```

The above examples will output:

```
Field 1 has Length 3
Field 2 has Length 5
Field 3 has Length 13
Field 4 has Length 9
Field 5 has Length 6
Field 6 has Length 1
Field 7 has Length 6
Field 8 has Length 4
Field 9 has Length 6
Field 10 has Length 6
Field 11 has Length 5
Field 12 has Length 44
Field 13 has Length 7
Field 14 has Length 3
Field 15 has Length 2
```

7.3.11.15 mysqli_result::\$num_rows, mysqli_num_rows

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- `mysqli_result::$num_rows`

`mysqli_num_rows`

Gets the number of rows in a result

Description

Object oriented style

```
int  
    mysqli_result->num_rows ;
```

Procedural style

```
int mysqli_num_rows(  
    mysqli_result result);
```

Returns the number of rows in the result set.

The behaviour of `mysqli_num_rows` depends on whether buffered or unbuffered result sets are being used. For unbuffered result sets, `mysqli_num_rows` will not return the correct number of rows until all the rows in the result have been retrieved.

Parameters

`result`

Procedural style only: A result set identifier returned by `mysqli_query`, `mysqli_store_result` or `mysqli_use_result`.

Return Values

Returns number of rows in the result set.

Note

If the number of rows is greater than `PHP_INT_MAX`, the number will be returned as a string.

Examples

Example 7.139 Object oriented style

```
<?php  
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");  
/* check connection */  
if ($mysqli_connect_errno()) {  
    printf("Connect failed: %s\n", $mysqli_connect_error());  
    exit();  
}  
if ($result = $mysqli->query("SELECT Code, Name FROM Country ORDER BY Name")) {  
    /* determine number of rows result set */  
    $row_cnt = $result->num_rows;  
    printf("Result set has %d rows.\n", $row_cnt);  
    /* close result set */  
    $result->close();
```

```
}
```

```
/* close connection */
```

```
$mysqli->close();
```

```
?>
```

Example 7.140 Procedural style

```
<?php
```

```
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
```

```
/* check connection */
```

```
if (mysqli_connect_errno()) {
```

```
    printf("Connect failed: %s\n", mysqli_connect_error());
```

```
    exit();
```

```
}
```

```
if ($result = mysqli_query($link, "SELECT Code, Name FROM Country ORDER BY Name")) {
```

```
    /* determine number of rows result set */
```

```
    $row_cnt = mysqli_num_rows($result);
```

```
    printf("Result set has %d rows.\n", $row_cnt);
```

```
    /* close result set */
```

```
    mysqli_free_result($result);
```

```
}
```

```
/* close connection */
```

```
mysqli_close($link);
```

```
?>
```

The above examples will output:

```
Result set has 239 rows.
```

See Also

[mysqli_affected_rows](#)
[mysqli_store_result](#)
[mysqli_use_result](#)
[mysqli_query](#)

7.3.12 The mysqli_driver class

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The `mysqli_driver` class is an instance of the monostate pattern, i.e. there is only one driver which can be accessed through an arbitrary amount of `mysqli_driver` instances.

```
mysqli_driver {
```

```
    mysqli_driver
```

```
        Properties
```

```
        public readonly string
```

```
            client_info ;
```

```
        public readonly string
```

```
            client_version ;
```

```
        public readonly string
```

```
            driver_version ;
```

```
        public readonly string
```

```
    embedded ;  
  
    public bool  
        reconnect ;  
  
    public int  
        report_mode ;  
  
Methods  
  
    void mysqli_driver::embedded_server_end();  
  
    bool mysqli_driver::embedded_server_start(  
        int start,  
        array arguments,  
        array groups);  
}
```

client_info	The Client API header version
client_version	The Client version
driver_version	The MySQLi Driver version
embedded	Whether MySQLi Embedded support is enabled
reconnect	Allow or prevent reconnect (see the mysqli.reconnect INI directive)
report_mode	Set to MYSQLI_REPORT_OFF , MYSQLI_REPORT_ALL or any combination of MYSQLI_REPORT_STRICT (throw Exceptions for errors), MYSQLI_REPORT_ERROR (report errors) and MYSQLI_REPORT_INDEX (errors regarding indexes). See also mysqli_report .

7.3.12.1 [mysqli_driver::embedded_server_end](#), [mysqli_embedded_server_end](#)

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- [mysqli_driver::embedded_server_end](#)
[mysqli_embedded_server_end](#)
Stop embedded server

Description

Object oriented style

```
void mysqli_driver::embedded_server_end();
```

Procedural style

```
void mysqli_embedded_server_end();
```

Warning

This function is currently not documented; only its argument list is available.

7.3.12.2 [mysqli_driver::embedded_server_start](#), [mysqli_embedded_server_start](#)

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- `mysqli_driver::embedded_server_start`

```
mysqli_embedded_server_start
```

Initialize and start embedded server

Description

Object oriented style

```
bool mysqli_driver::embedded_server_start(
    int start,
    array arguments,
    array groups);
```

Procedural style

```
bool mysqli_embedded_server_start(
    int start,
    array arguments,
    array groups);
```

Warning

This function is currently not documented; only its argument list is available.

7.3.12.3 `mysqli_driver::$report_mode`, `mysqli_report`

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- `mysqli_driver::$report_mode`

```
mysqli_report
```

Enables or disables internal report functions

Description

Object oriented style

```
int
mysqli_driver->report_mode ;
```

Procedural style

```
bool mysqli_report(
    int flags);
```

A function helpful in improving queries during code development and testing. Depending on the flags, it reports errors from mysqli function calls or queries that don't use an index (or use a bad index).

Parameters

flags

Table 7.20 Supported flags

Name	Description
<code>MYSQLI_REPORT_OFF</code>	Turns reporting off
<code>MYSQLI_REPORT_ERROR</code>	Report errors from mysqli function calls
<code>MYSQLI_REPORT_STRICT</code>	Throw <code>mysqli_sql_exception</code> for errors instead of warnings

Name	Description
MYSQLI_REPORT_INDEX	Report if no index or bad index was used in a query
MYSQLI_REPORT_ALL	Set all options (report all)

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Changelog

Version	Description
5.3.4	Changing the reporting mode is now be per-request, rather than per-process.
5.2.15	Changing the reporting mode is now be per-request, rather than per-process.

Examples

Example 7.141 Object oriented style

```
<?php
$mysqli = new mysqli("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* activate reporting */
$driver = new mysqli_driver();
$driver->report_mode = MYSQLI_REPORT_ALL;
try {
    /* this query should report an error */
    $result = $mysqli->query("SELECT Name FROM Nonexistingtable WHERE population > 50000");
    /* this query should report a bad index */
    $result = $mysqli->query("SELECT Name FROM City WHERE population > 50000");
    $result->close();
    $mysqli->close();
} catch (mysqli_sql_exception $e) {
    echo $e->__toString();
}
?>
```

Example 7.142 Procedural style

```
<?php
/* activate reporting */
mysqli_report(MYSQLI_REPORT_ALL);
$link = mysqli_connect("localhost", "my_user", "my_password", "world");
/* check connection */
if (mysqli_connect_errno()) {
    printf("Connect failed: %s\n", mysqli_connect_error());
    exit();
}
/* this query should report an error */
$result = mysqli_query("SELECT Name FROM Nonexistingtable WHERE population > 50000");
/* this query should report a bad index */
$result = mysqli_query("SELECT Name FROM City WHERE population > 50000");
mysqli_free_result($result);
mysqli_close($link);
?>
```

See Also

[mysqli_debug](#)
[mysqli_dump_debug_info](#)
[mysqli_sql_exception](#)
[set_exception_handler](#)
[error_reporting](#)

7.3.13 The mysqli_warning class

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Represents a MySQL warning.

```
mysqli_warning {
    Properties
        public
            message ;
        public
            sqlstate ;
        public
            errno ;
    Methods
        protected mysqli_warning::__construct();
        public bool mysqli_warning::next();
}
```

<code>message</code>	Message string
<code>sqlstate</code>	SQL state
<code>errno</code>	Error number

7.3.13.1 mysqli_warning::__construct

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- [mysqli_warning::__construct](#)

The __construct purpose

Description

```
protected mysqli_warning::__construct();
```

Warning

This function is currently not documented; only its argument list is available.

Parameters

This function has no parameters.

Return Values

7.3.13.2 mysqli_warning::next

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- `mysqli_warning::next`

Fetch next warning

Description

```
public bool mysqli_warning::next();
```

Change warning information to the next warning if possible.

Once the warning has been set to the next warning, new values of properties `message`, `sqlstate` and `errno` of `mysqli_warning` are available.

Parameters

This function has no parameters.

Return Values

Returns `TRUE` if next warning was fetched successfully. If there are no more warnings, it will return `FALSE`.

7.3.14 The mysqli_sql_exception class

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The mysqli exception handling class.

```
mysqli_sql_exception {
    mysqli_sql_exception extends RuntimeException
    Properties

    protected string
        sqlstate;

    Inherited properties

    protected string
        message;

    protected int
        code;

    protected string
        file;

    protected int
        line;
}
```

`sqlstate`

The sql state with the error.

7.3.15 Aliases and deprecated Mysqli Functions

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7.3.15.1 [mysqli_bind_param](#)

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- [mysqli_bind_param](#)

Alias for [mysqli_stmt_bind_param](#)

Description

This function is an alias of: [mysqli_stmt_bind_param](#).

Warning

This function has been *DEPRECATED* as of PHP 5.3.0 and *REMOVED* as of PHP 5.4.0.

See Also

[mysqli_stmt_bind_param](#)

7.3.15.2 [mysqli_bind_result](#)

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- [mysqli_bind_result](#)

Alias for [mysqli_stmt_bind_result](#)

Description

This function is an alias of: [mysqli_stmt_bind_result](#).

Warning

This function has been *DEPRECATED* as of PHP 5.3.0 and *REMOVED* as of PHP 5.4.0.

See Also

[mysqli_stmt_bind_result](#)

7.3.15.3 [mysqli_client_encoding](#)

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- [mysqli_client_encoding](#)

Alias of [mysqli_character_set_name](#)

Description

This function is an alias of: [mysqli_character_set_name](#).

Warning

This function has been *DEPRECATED* as of PHP 5.3.0 and *REMOVED* as of PHP 5.4.0.

See Also

[mysqli_real_escape_string](#)

7.3.15.4 `mysqli_connect`

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- [mysqli_connect](#)

Alias of [mysqli::__construct](#)

Description

This function is an alias of: [mysqli::__construct](#)

Although the [mysqli::__construct](#) documentation also includes procedural examples that use the [mysqli_connect](#) function, here is a short example:

Examples

Example 7.143 `mysqli_connect` example

```
<?php
$link = mysqli_connect("127.0.0.1", "my_user", "my_password", "my_db");
if (!$link) {
    echo "Error: Unable to connect to MySQL." . PHP_EOL;
    echo "Debugging errno: " . mysqli_connect_errno() . PHP_EOL;
    echo "Debugging error: " . mysqli_connect_error() . PHP_EOL;
    exit;
}
echo "Success: A proper connection to MySQL was made! The my_db database is great." . PHP_EOL;
echo "Host information: " . mysqli_get_host_info($link) . PHP_EOL;
mysqli_close($link);
?>
```

The above examples will output something similar to:

```
Success: A proper connection to MySQL was made! The my_db database is great.
Host information: localhost via TCP/IP
```

7.3.15.5 `mysqli::disable_reads_from_master`, `mysqli_disable_reads_from_master`

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- [mysqli::disable_reads_from_master](#)

[mysqli_disable_reads_from_master](#)

Disable reads from master

Description

Object oriented style

```
void mysqli::disable_reads_from_master();
```

Procedural style

```
bool mysqli_disable_reads_from_master(  
    mysqli link);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.15.6 mysqli_disable_rpl_parse

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- [mysqli_disable_rpl_parse](#)

Disable RPL parse

Description

```
bool mysqli_disable_rpl_parse(  
    mysqli link);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.15.7 mysqli_enable_reads_from_master

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- [mysqli_enable_reads_from_master](#)

Enable reads from master

Description

```
bool mysqli_enable_reads_from_master(  
    mysqli link);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.15.8 mysqli_enable_rpl_parse

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- [mysqli_enable_rpl_parse](#)

Enable RPL parse

Description

```
bool mysqli_enable_rpl_parse(  
    mysqli link);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.15.9 [mysqli_escape_string](#)

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- [mysqli_escape_string](#)

Alias of [mysqli_real_escape_string](#)

Description

This function is an alias of: [mysqli_real_escape_string](#).

7.3.15.10 [mysqli_execute](#)

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- [mysqli_execute](#)

Alias for [mysqli_stmt_execute](#)

Description

This function is an alias of: [mysqli_stmt_execute](#).

Notes

Note

[mysqli_execute](#) is deprecated and will be removed.

See Also

[mysqli_stmt_execute](#)

7.3.15.11 [mysqli_fetch](#)

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- [mysqli_fetch](#)

Alias for [mysqli_stmt_fetch](#)

Description

This function is an alias of: [mysqli_stmt_fetch](#).

Warning

This function has been *DEPRECATED* as of PHP 5.3.0 and *REMOVED* as of PHP 5.4.0.

See Also

[mysqli_stmt_fetch](#)

7.3.15.12 mysqli_get_cache_stats

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- [mysqli_get_cache_stats](#)

Returns client Zval cache statistics

Warning

This function has been *REMOVED* as of PHP 5.4.0.

Description

```
array mysqli_get_cache_stats();
```

Returns an empty array. Available only with [mysqld](#).

Parameters

Return Values

Returns an empty array on success, [FALSE](#) otherwise.

Changelog

Version	Description
5.4.0	The mysqli_get_cache_stats was removed.
5.3.0	The mysqli_get_cache_stats was added as stub.

7.3.15.13 mysqli_get_client_stats

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- [mysqli_get_client_stats](#)

Returns client per-process statistics

Description

```
array mysqli_get_client_stats();
```

Returns client per-process statistics. Available only with [mysqld](#).

Parameters

Return Values

Returns an array with client stats if success, [FALSE](#) otherwise.

Examples

Example 7.144 A mysqli_get_client_stats example

```
<?php
```

```
$link = mysqli_connect();
print_r(mysqli_get_client_stats());
?>
```

The above example will output something similar to:

```
Array
(
    [bytes_sent] => 43
    [bytes_received] => 80
    [packets_sent] => 1
    [packets_received] => 2
    [protocol_overhead_in] => 8
    [protocol_overhead_out] => 4
    [bytes_received_ok_packet] => 11
    [bytes_received_eof_packet] => 0
    [bytes_received_rset_header_packet] => 0
    [bytes_received_rset_field_meta_packet] => 0
    [bytes_received_rset_row_packet] => 0
    [bytes_received_prepare_response_packet] => 0
    [bytes_received_change_user_packet] => 0
    [packets_sent_command] => 0
    [packets_received_ok] => 1
    [packets_received_eof] => 0
    [packets_received_rset_header] => 0
    [packets_received_rset_field_meta] => 0
    [packets_received_rset_row] => 0
    [packets_received_prepare_response] => 0
    [packets_received_change_user] => 0
    [result_set_queries] => 0
    [non_result_set_queries] => 0
    [no_index_used] => 0
    [bad_index_used] => 0
    [slow_queries] => 0
    [buffered_sets] => 0
    [unbuffered_sets] => 0
    [ps_buffered_sets] => 0
    [ps_unbuffered_sets] => 0
    [flushed_normal_sets] => 0
    [flushed_ps_sets] => 0
    [ps_prepared_never_executed] => 0
    [ps_prepared_once_executed] => 0
    [rows_fetched_from_server_normal] => 0
    [rows_fetched_from_server_ps] => 0
    [rows_buffered_from_client_normal] => 0
    [rows_buffered_from_client_ps] => 0
    [rows_fetched_from_client_normal_buffered] => 0
    [rows_fetched_from_client_normal_unbuffered] => 0
    [rows_fetched_from_client_ps_buffered] => 0
    [rows_fetched_from_client_ps_unbuffered] => 0
    [rows_fetched_from_client_ps_cursor] => 0
    [rows_skipped_normal] => 0
    [rows_skipped_ps] => 0
    [copy_on_write_saved] => 0
    [copy_on_write_performed] => 0
    [command_buffer_too_small] => 0
    [connect_success] => 1
    [connect_failure] => 0
    [connection_reused] => 0
    [reconnect] => 0
    [pconnect_success] => 0
    [active_connections] => 1
    [active_persistent_connections] => 0
    [explicit_close] => 0
    [implicit_close] => 0
    [disconnect_close] => 0
    [in_middle_of_command_close] => 0
    [explicit_free_result] => 0
    [implicit_free_result] => 0
```

```
[explicit_stmt_close] => 0
[implicit_stmt_close] => 0
[mem_emalloc_count] => 0
[mem_emalloc_ammount] => 0
[mem_ecalloc_count] => 0
[mem_ecalloc_ammount] => 0
[mem_erealloc_count] => 0
[mem_erealloc_ammount] => 0
[mem_efree_count] => 0
[mem_malloc_count] => 0
[mem_malloc_ammount] => 0
[mem_calloc_count] => 0
[mem_calloc_ammount] => 0
[mem_realloc_count] => 0
[mem_realloc_ammount] => 0
[mem_free_count] => 0
[proto_text_fetched_null] => 0
[proto_text_fetched_bit] => 0
[proto_text_fetched_tinyint] => 0
[proto_text_fetched_short] => 0
[proto_text_fetched_int24] => 0
[proto_text_fetched_int] => 0
[proto_text_fetched_bigint] => 0
[proto_text_fetched_decimal] => 0
[proto_text_fetched_float] => 0
[proto_text_fetched_double] => 0
[proto_text_fetched_date] => 0
[proto_text_fetched_year] => 0
[proto_text_fetched_time] => 0
[proto_text_fetched_datetime] => 0
[proto_text_fetched_timestamp] => 0
[proto_text_fetched_string] => 0
[proto_text_fetched_blob] => 0
[proto_text_fetched_enum] => 0
[proto_text_fetched_set] => 0
[proto_text_fetched_geometry] => 0
[proto_text_fetched_other] => 0
[proto_binary_fetched_null] => 0
[proto_binary_fetched_bit] => 0
[proto_binary_fetched_tinyint] => 0
[proto_binary_fetched_short] => 0
[proto_binary_fetched_int24] => 0
[proto_binary_fetched_int] => 0
[proto_binary_fetched_bigint] => 0
[proto_binary_fetched_decimal] => 0
[proto_binary_fetched_float] => 0
[proto_binary_fetched_double] => 0
[proto_binary_fetched_date] => 0
[proto_binary_fetched_year] => 0
[proto_binary_fetched_time] => 0
[proto_binary_fetched_datetime] => 0
[proto_binary_fetched_timestamp] => 0
[proto_binary_fetched_string] => 0
[proto_binary_fetched_blob] => 0
[proto_binary_fetched_enum] => 0
[proto_binary_fetched_set] => 0
[proto_binary_fetched_geometry] => 0
[proto_binary_fetched_other] => 0
)
```

See Also

[Stats description](#)

7.3.15.14 `mysqli_get_links_stats`

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- [mysqli_get_links_stats](#)

Return information about open and cached links

Description

```
array mysqli_get_links_stats();
```

`mysqli_get_links_stats` returns information about open and cached MySQL links.

Parameters

This function has no parameters.

Return Values

`mysqli_get_links_stats` returns an associative array with three elements, keyed as follows:

<code>total</code>	An integer indicating the total number of open links in any state.
<code>active_plinks</code>	An integer representing the number of active persistent connections.
<code>cached_plinks</code>	An integer representing the number of inactive persistent connections.

7.3.15.15 `mysqli_get_metadata`

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- `mysqli_get_metadata`

Alias for `mysqli_stmt_result_metadata`

Description

This function is an alias of: `mysqli_stmt_result_metadata`.

Warning

This function has been *DEPRECATED* as of PHP 5.3.0 and *REMOVED* as of PHP 5.4.0.

See Also

`mysqli_stmt_result_metadata`

7.3.15.16 `mysqli_master_query`

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- `mysqli_master_query`

Enforce execution of a query on the master in a master/slave setup

Description

```
bool mysqli_master_query(
    mysqli link,
    string query);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.15.17 [mysqli_param_count](#)

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- [mysqli_param_count](#)

Alias for [mysqli_stmt_param_count](#)

Description

This function is an alias of: [mysqli_stmt_param_count](#).

Warning

This function has been *DEPRECATED* as of PHP 5.3.0 and *REMOVED* as of PHP 5.4.0.

See Also

[mysqli_stmt_param_count](#)

7.3.15.18 [mysqli_report](#)

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- [mysqli_report](#)

Alias of [mysqli_driver->report_mode](#)

Description

This function is an alias of: [mysqli_driver->report_mode](#)

7.3.15.19 [mysqli_rpl_parse_enabled](#)

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- [mysqli_rpl_parse_enabled](#)

Check if RPL parse is enabled

Description

```
int mysqli_rpl_parse_enabled(  
    mysqli link);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.15.20 [mysqli_rpl_probe](#)

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- [mysqli_rpl_probe](#)

RPL probe

Description

```
bool mysqli_rpl_probe(  
    mysqli link);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.15.21 mysqli_send_long_data

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- [mysqli_send_long_data](#)

Alias for [mysqli_stmt_send_long_data](#)

Description

This function is an alias of: [mysqli_stmt_send_long_data](#).

Warning

This function has been *DEPRECATED* as of PHP 5.3.0 and *REMOVED* as of PHP 5.4.0.

See Also

[mysqli_stmt_send_long_data](#)

7.3.15.22 mysqli::set_opt, mysqli_set_opt

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- [mysqli::set_opt](#)

[mysqli_set_opt](#)

Alias of [mysqli_options](#)

Description

This function is an alias of: [mysqli_options](#).

7.3.15.23 mysqli_slave_query

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- [mysqli_slave_query](#)

Force execution of a query on a slave in a master/slave setup

Description

```
bool mysqli_slave_query(  
    mysqli link,
```

```
string query);
```

Warning

This function is currently not documented; only its argument list is available.

Warning

This function has been *DEPRECATED* and *REMOVED* as of PHP 5.3.0.

7.3.16 Changelog

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The following changes have been made to classes/functions/methods of this extension.

7.4 MySQL Functions (PDO_MYSQL)

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PDO_MYSQL is a driver that implements the [PHP Data Objects \(PDO\)](#) interface to enable access from PHP to MySQL databases.

As of PHP 5.2.1, PDO_MYSQL uses emulated prepares by default. Formerly, PDO_MYSQL defaulted to native prepared statement support present in MySQL 4.1 and higher, and emulated them for older versions of the mysql client libraries.

MySQL 8

When running a PHP version before 7.1.16, or PHP 7.2 before 7.2.4, set MySQL 8 Server's default password plugin to `mysql_native_password` or else you will see errors similar to *The server requested authentication method unknown to the client [caching_sha2_password]* even when `caching_sha2_password` is not used.

This is because MySQL 8 defaults to `caching_sha2_password`, a plugin that is not recognized by the older PHP (`mysqlnd`) releases. Instead, change it by setting `default_authentication_plugin=mysql_native_password` in `my.cnf`. The `caching_sha2_password` plugin will be supported in a future PHP release. In the meantime, the `mysql_xdevapi` extension does support it.

Warning

Beware: Some MySQL table types (storage engines) do not support transactions. When writing transactional database code using a table type that does not support transactions, MySQL will pretend that a transaction was initiated successfully. In addition, any DDL queries issued will implicitly commit any pending transactions.

The common Unix distributions include binary versions of PHP that can be installed. Although these binary versions are typically built with support for the MySQL extensions, the extension libraries themselves may need to be installed using an additional package. Check the package manager than comes with your chosen distribution for availability.

For example, on Ubuntu the `php5-mysql` package installs the `ext/mysql`, `ext/mysqli`, and `PDO_MYSQL` PHP extensions. On CentOS, the `php-mysql` package also installs these three PHP extensions.

Alternatively, you can compile this extension yourself. Building PHP from source allows you to specify the MySQL extensions you want to use, as well as your choice of client library for each extension.

When compiling, use `--with-pdo-mysql[=DIR]` to install the PDO MySQL extension, where the optional `[=DIR]` is the MySQL base library. As of PHP 5.4, `mysqld` is the default library. For details about choosing a library, see [Choosing a MySQL library](#).

Optionally, the `--with-mysql-sock[=DIR]` sets to location to the MySQL unix socket pointer for all MySQL extensions, including PDO_MYSQL. If unspecified, the default locations are searched.

Optionally, the `--with-zlib-dir[=DIR]` is used to set the path to the libz install prefix.

```
$ ./configure --with-pdo-mysql --with-mysql-sock=/var/mysql/mysql.sock
```

SSL support is enabled using the appropriate [PDO MySQL constants](#), which is equivalent to calling the [MySQL C API function mysql_ssl_set\(\)](#). Also, SSL cannot be enabled with `PDO::setAttribute` because the connection already exists. See also the MySQL documentation about [connecting to MySQL with SSL](#).

Table 7.21 Changelog

Version	Description
5.4.0	<code>mysqld</code> became the default MySQL library when compiling PDO_MYSQL. Previously, <code>libmysqlclient</code> was the default MySQL library.
5.4.0	MySQL client libraries 4.1 and below are no longer supported.
5.3.9	Added SSL support with <code>mysqld</code> and OpenSSL.
5.3.7	Added SSL support with <code>libmysqlclient</code> and OpenSSL.

The constants below are defined by this driver, and will only be available when the extension has been either compiled into PHP or dynamically loaded at runtime. In addition, these driver-specific constants should only be used if you are using this driver. Using driver-specific attributes with another driver may result in unexpected behaviour. `PDO::getAttribute` may be used to obtain the `PDO::ATTR_DRIVER_NAME` attribute to check the driver, if your code can run against multiple drivers.

PDO::MYSQL_ATTR_USE_BUFFERED_QUERY (integer) If this attribute is set to `TRUE` on a `PDOStatement`, the MySQL driver will use the buffered versions of the MySQL API. If you're writing portable code, you should use `PDOStatement::fetchAll` instead.

Example 7.145 Forcing queries to be buffered in mysql

```
<?php
if ($db->getAttribute(PDO::ATTR_DRIVER_NAME) == 'mysql') {
    $stmt = $db->prepare('select * from foo',
        array(PDO::MYSQL_ATTR_USE_BUFFERED_QUERY => true));
} else {
    die("my application only works with mysql; I should use \${$stmt->fetchA
}
?>
```

PDO::MYSQL_ATTR_LOCAL_INFILE (integer) Enable `LOAD LOCAL INFILE`.

Note, this constant can only be used in the `driver_options` array when constructing a new database handle.

PDO::MYSQL_ATTR_INIT_COMMAND (integer)	Command to execute when connecting to the MySQL server. Will automatically be re-executed when reconnecting.
	Note, this constant can only be used in the <i>driver_options</i> array when constructing a new database handle.
PDO::MYSQL_ATTR_READ_DEFAULT_FILE (integer)	Read options from the named option file instead of from <code>my.cnf</code> . This option is not available if mysqlnd is used, because mysqlnd does not read the mysql configuration files.
PDO::MYSQL_ATTR_READ_DEFAULT_GROUP (integer)	Read options from the named group from <code>my.cnf</code> or the file specified with <code>MYSQL_READ_DEFAULT_FILE</code> . This option is not available if mysqlnd is used, because mysqlnd does not read the mysql configuration files.
PDO::MYSQL_ATTR_MAX_BUFFER (integer)	Maximum buffer size. Defaults to 1 MiB. This constant is not supported when compiled against mysqlnd.
PDO::MYSQL_ATTR_DIRECT_QUERY (integer)	Perform direct queries, don't use prepared statements.
PDO::MYSQL_ATTR_FOUND_ROWS (integer)	Return the number of found (matched) rows, not the number of changed rows.
PDO::MYSQL_ATTR_IGNORE_SPACES (integer)	Permit spaces after function names. Makes all functions names reserved words.
PDO::MYSQL_ATTR_COMPRESS (integer)	Enable network communication compression. This is also supported when compiled against mysqlnd as of PHP 5.3.11.
PDO::MYSQL_ATTR_SSL_CA (integer)	The file path to the SSL certificate authority. This exists as of PHP 5.3.7.
PDO::MYSQL_ATTR_SSL_CAPATH (integer)	The file path to the directory that contains the trusted SSL CA certificates, which are stored in PEM format. This exists as of PHP 5.3.7.
PDO::MYSQL_ATTR_SSL_CERT (integer)	The file path to the SSL certificate. This exists as of PHP 5.3.7.
PDO::MYSQL_ATTR_SSL_CIPHER (integer)	A list of one or more permissible ciphers to use for SSL encryption, in a format understood by OpenSSL. For example: <code>DHE-RSA-AES256-SHA:AES128-SHA</code> This exists as of PHP 5.3.7.
PDO::MYSQL_ATTR_SSL_KEY (integer)	The file path to the SSL key. This exists as of PHP 5.3.7.
PDO::MYSQL_ATTR_SSL_VERIFY_SERVER_CERT (integer)	Provides a way to disable verification of the server SSL certificate. This exists as of PHP 7.0.18 and PHP 7.1.4.
PDO::MYSQL_ATTR_MULTI_STATEMENTS (integer)	Disables multi query execution in both <code>PDO::prepare</code> and <code>PDO::query</code> when set to <code>FALSE</code> . Note, this constant can only be used in the <i>driver_options</i> array when constructing a new database handle.

This exists as of PHP 5.5.21 and PHP 5.6.5.

The behaviour of these functions is affected by settings in [php.ini](#).

Table 7.22 PDO_MYSQL Configuration Options

Name	Default	Changeable
<code>pdo_mysql.default_socket</code>	"/tmp/mysql.sock"	PHP_INI_SYSTEM
<code>pdo_mysql.debug</code>	NULL	PHP_INI_SYSTEM

For further details and definitions of the PHP_INI_* modes, see the <http://www.php.net/manual/en/configuration.changes.modes>.

Here's a short explanation of the configuration directives.

<code>pdo_mysql.default_socket</code> string	Sets a Unix domain socket. This value can either be set at compile time if a domain socket is found at configure. This ini setting is Unix only.
<code>pdo_mysql.debug</code> boolean	Enables debugging for PDO_MYSQL. This setting is only available when PDO_MYSQL is compiled against mysqlnd and in PDO debug mode.

7.4.1 PDO_MYSQL DSN

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- [PDO_MYSQL DSN](#)

Connecting to MySQL databases

Description

The PDO_MYSQL Data Source Name (DSN) is composed of the following elements:

DSN prefix	The DSN prefix is <code>mysql:</code> .
<code>host</code>	The hostname on which the database server resides.
<code>port</code>	The port number where the database server is listening.
<code>dbname</code>	The name of the database.
<code>unix_socket</code>	The MySQL Unix socket (shouldn't be used with <code>host</code> or <code>port</code>).
<code>charset</code>	The character set. See the character set concepts documentation for more information. Prior to PHP 5.3.6, this element was silently ignored. The same behaviour can be partly replicated with the <code>PDO::MYSQL_ATTR_INIT_COMMAND</code> driver option, as the following example shows.

Warning

The method in the below example can only be used with character sets that share the same lower 7 bit representation as ASCII,

such as ISO-8859-1 and UTF-8. Users using character sets that have different representations (such as UTF-16 or Big5) *must* use the `charset` option provided in PHP 5.3.6 and later versions.

Example 7.146 Setting the connection character set to UTF-8 prior to PHP 5.3.6

```
<?php
$dsn = 'mysql:host=localhost;dbname=testdb';
$username = 'username';
$password = 'password';
$options = array(
    PDO::MYSQL_ATTR_INIT_COMMAND => 'SET NAMES utf8',
);
$dbh = new PDO($dsn, $username, $password, $options);
?>
```

Changelog

Version	Description
5.3.6	Prior to version 5.3.6, <code>charset</code> was ignored.

Examples

Example 7.147 PDO_MYSQL DSN examples

The following example shows a PDO_MYSQL DSN for connecting to MySQL databases:

```
mysql:host=localhost;dbname=testdb
```

More complete examples:

```
mysql:host=localhost;port=3307;dbname=testdb
mysql:unix_socket=/tmp/mysql.sock;dbname=testdb
```

Notes

Unix only:

When the host name is set to "`localhost`", then the connection to the server is made thru a domain socket. If PDO_MYSQL is compiled against libmysqlclient then the location of the socket file is at libmysqlclient's compiled in location. If PDO_MYSQL is compiled against mysqlnd a default socket can be set thru the `pdo_mysql.default_socket` setting.

7.5 Original MySQL API

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This extension is deprecated as of PHP 5.5.0, and has been removed as of PHP 7.0.0. Instead, either the `mysqli` or `PDO_MySQL` extension should be used. See also the [MySQL API Overview](#) for further help while choosing a MySQL API.

These functions allow you to access MySQL database servers. More information about MySQL can be found at <http://www.mysql.com/>.

Documentation for MySQL can be found at <http://dev.mysql.com/doc/>.

7.5.1 Installing/Configuring

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7.5.1.1 Requirements

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In order to have these functions available, you must compile PHP with MySQL support.

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information.
Alternatives to this function include:

7.5.1.2 Installation

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Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information.
Alternatives to this function include:

For compiling, simply use the `--with-mysql[=DIR]` configuration option where the optional `[DIR]` points to the MySQL installation directory.

Although this MySQL extension is compatible with MySQL 4.1.0 and greater, it doesn't support the extra functionality that these versions provide. For that, use the [MySQLi](#) extension.

If you would like to install the `mysql` extension along with the `mysqli` extension you have to use the same client library to avoid any conflicts.

Installation on Linux Systems

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Note: `[DIR]` is the path to the MySQL client library files (*headers and libraries*), which can be downloaded from [MySQL](#).

Table 7.23 ext/mysql compile time support matrix

PHP Version	Default	Configure Options: <code>mysqlnd</code>	Configure Options: <code>libmysqlclient</code>	Changelog
4.x.x	<code>libmysqlclient</code>	Not Available	<code>--without-mysql</code> to disable	MySQL enabled by default, MySQL client libraries are bundled
5.0.x, 5.1.x, 5.2.x	<code>libmysqlclient</code>	Not Available	<code>--with-mysql=[DIR]</code>	MySQL is no longer enabled

PHP Version	Default	Configure Options: <code>mysqlnd</code>	Configure Options: <code>libmysqlclient</code>	Changelog
				by default, and the MySQL client libraries are no longer bundled
5.3.x	<code>libmysqlclient</code>	<code>--with-mysql=mysqlnd</code>	<code>--with-mysql=[DIR]</code>	<code>mysqlnd</code> is now available
5.4.x	<code>mysqlnd</code>	<code>--with-mysql</code>	<code>--with-mysql=[DIR]</code>	<code>mysqlnd</code> is now the default

Installation on Windows Systems

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PHP 5.0.x, 5.1.x, 5.2.x

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MySQL is no longer enabled by default, so the `php_mysql.dll` DLL must be enabled inside of `php.ini`. Also, PHP needs access to the MySQL client library. A file named `libmysql.dll` is included in the Windows PHP distribution and in order for PHP to talk to MySQL this file needs to be available to the Windows systems `PATH`. See the FAQ titled "[How do I add my PHP directory to the PATH on Windows](#)" for information on how to do this. Although copying `libmysql.dll` to the Windows system directory also works (because the system directory is by default in the system's `PATH`), it's not recommended.

As with enabling any PHP extension (such as `php_mysql.dll`), the PHP directive `extension_dir` should be set to the directory where the PHP extensions are located. See also the [Manual Windows Installation Instructions](#). An example `extension_dir` value for PHP 5 is `c:\php\ext`

Note

If when starting the web server an error similar to the following occurs: "`Unable to load dynamic library './php_mysql.dll'`", this is because `php_mysql.dll` and/or `libmysql.dll` cannot be found by the system.

PHP 5.3.0+

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The [MySQL Native Driver](#) is enabled by default. Include `php_mysql.dll`, but `libmysql.dll` is no longer required or used.

MySQL Installation Notes

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Warning

Crashes and startup problems of PHP may be encountered when loading this extension in conjunction with the `recode` extension. See the `recode` extension for more information.

Note

If you need charsets other than `latin` (default), you have to install external (not bundled) `libmysqlclient` with compiled charset support.

7.5.1.3 Runtime Configuration

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The behaviour of these functions is affected by settings in `php.ini`.

Table 7.24 MySQL Configuration Options

Name	Default	Changeable	Changelog
<code>mysql.allow_local_infile</code>	"1"	PHP_INI_SYSTEM	
<code>mysql.allow_persistent</code>	"1"	PHP_INI_SYSTEM	
<code>mysql.max_persistent</code>	"-1"	PHP_INI_SYSTEM	
<code>mysql.max_links</code>	"-1"	PHP_INI_SYSTEM	
<code>mysql.trace_mode</code>	"0"	PHP_INI_ALL	
<code>mysql.default_port</code>	NULL	PHP_INI_ALL	
<code>mysql.default_socket</code>	NULL	PHP_INI_ALL	
<code>mysql.default_host</code>	NULL	PHP_INI_ALL	
<code>mysql.default_user</code>	NULL	PHP_INI_ALL	
<code>mysql.default_password</code>	NULL	PHP_INI_ALL	
<code>mysql.connect_timeout</code>	"60"	PHP_INI_ALL	

For further details and definitions of the PHP_INI_* modes, see the <http://www.php.net/manual/en/configuration.changes.modes>.

Here's a short explanation of the configuration directives.

<code>mysql.allow_local_infile</code> integer	Allow accessing, from PHP's perspective, local files with LOAD DATA statements
<code>mysql.allow_persistent</code> boolean	Whether to allow persistent connections to MySQL.
<code>mysql.max_persistent</code> integer	The maximum number of persistent MySQL connections per process.
<code>mysql.max_links</code> integer	The maximum number of MySQL connections per process, including persistent connections.
<code>mysql.trace_mode</code> boolean	Trace mode. When <code>mysql.trace_mode</code> is enabled, warnings for table/index scans, non free result sets, and SQL-Errors will be displayed. (Introduced in PHP 4.3.0)
<code>mysql.default_port</code> string	The default TCP port number to use when connecting to the database server if no other port is specified. If no default is specified, the port will be obtained from the <code>MYSQL_TCP_PORT</code> environment variable, the <code>mysql-tcp</code> entry in <code>/etc/services</code> or the compile-time <code>MYSQL_PORT</code> constant, in that order. Win32 will only use the <code>MYSQL_PORT</code> constant.
<code>mysql.default_socket</code> string	The default socket name to use when connecting to a local database server if no other socket name is specified.
<code>mysql.default_host</code> string	The default server host to use when connecting to the database server if no other host is specified. Doesn't apply in <code>SQL safe mode</code> .
<code>mysql.default_user</code> string	The default user name to use when connecting to the database server if no other name is specified. Doesn't apply in <code>SQL safe mode</code> .

<code>mysql.default_password</code> string	The default password to use when connecting to the database server if no other password is specified. Doesn't apply in SQL safe mode .
<code>mysql.connect_timeout</code> integer	Connect timeout in seconds. On Linux this timeout is also used for waiting for the first answer from the server.

7.5.1.4 Resource Types

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There are two resource types used in the MySQL module. The first one is the link identifier for a database connection, the second a resource which holds the result of a query.

7.5.2 Changelog

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The following changes have been made to classes/functions/methods of this extension.

General Changelog for the ext/mysql extension

This changelog references the ext/mysql extension.

Global ext/mysql changes

The following is a list of changes to the entire ext/mysql extension.

Version	Description
7.0.0	This extension was removed from PHP. For details, see Section 7.2.3, “Choosing an API” .
5.5.0	This extension has been deprecated. Connecting to a MySQL database via <code>mysql_connect</code> , <code>mysql_pconnect</code> or an implicit connection via any other <code>mysql_*</code> function will generate an <code>E_DEPRECATED</code> error.
5.5.0	All of the old deprecated functions and aliases now emit <code>E_DEPRECATED</code> errors. These functions are: <code>mysql()</code> , <code>mysql_fieldname()</code> , <code>mysql_fieldtable()</code> , <code>mysql_fieldlen()</code> , <code>mysql_fieldtype()</code> , <code>mysql_fieldflags()</code> , <code>mysql_selectdb()</code> , <code>mysql_createdb()</code> , <code>mysql_dropdb()</code> , <code>mysql_freeresult()</code> , <code>mysql_numfields()</code> , <code>mysql_numrows()</code> , <code>mysql_listdbs()</code> , <code>mysql_listtables()</code> , <code>mysql_listfields()</code> , <code>mysql_db_name()</code> , <code>mysql_dbname()</code> , <code>mysql_tablename()</code> , and <code>mysql_table_name()</code> .

Changes to existing functions

The following list is a compilation of changelog entries from the ext/mysql functions.

7.5.3 Predefined Constants

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The constants below are defined by this extension, and will only be available when the extension has either been compiled into PHP or dynamically loaded at runtime.

It is possible to specify additional client flags for the `mysql_connect` and `mysql_pconnect` functions. The following constants are defined:

Table 7.25 MySQL client constants

Constant	Description
<code>MYSQL_CLIENT_COMPRESS</code>	Use compression protocol
<code>MYSQL_CLIENT_IGNORE_SPACE</code>	Allow space after function names
<code>MYSQL_CLIENT_INTERACTIVE</code>	Allow <code>interactive_timeout</code> seconds (instead of <code>wait_timeout</code>) of inactivity before closing the connection.
<code>MYSQL_CLIENT_SSL</code>	Use SSL encryption. This flag is only available with version 4.x of the MySQL client library or newer. Version 3.23.x is bundled both with PHP 4 and Windows binaries of PHP 5.

The function `mysql_fetch_array` uses a constant for the different types of result arrays. The following constants are defined:

Table 7.26 MySQL fetch constants

Constant	Description
<code>MYSQL_ASSOC</code>	Columns are returned into the array having the fieldname as the array index.
<code>MYSQL_BOTH</code>	Columns are returned into the array having both a numerical index and the fieldname as the array index.
<code>MYSQL_NUM</code>	Columns are returned into the array having a numerical index to the fields. This index starts with 0, the first field in the result.

7.5.4 Examples

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7.5.4.1 MySQL extension overview example

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This simple example shows how to connect, execute a query, print resulting rows and disconnect from a MySQL database.

Example 7.148 MySQL extension overview example

```
<?php
// Connecting, selecting database
$link = mysql_connect('mysql_host', 'mysql_user', 'mysql_password')
    or die('Could not connect: ' . mysql_error());
echo 'Connected successfully';
mysql_select_db('my_database') or die('Could not select database');
// Performing SQL query
$query = 'SELECT * FROM my_table';
$result = mysql_query($query) or die('Query failed: ' . mysql_error());
```

```
// Printing results in HTML
echo "<table>\n";
while ($line = mysql_fetch_array($result, MYSQL_ASSOC)) {
    echo "\t<tr>\n";
    foreach ($line as $col_value) {
        echo "\t\t<td>$col_value</td>\n";
    }
    echo "\t</tr>\n";
}
echo "</table>\n";
// Free resultset
mysql_free_result($result);
// Closing connection
mysql_close($link);
?>
```

7.5.5 MySQL Functions

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Note

Most MySQL functions accept *link_identifier* as the last optional parameter. If it is not provided, last opened connection is used. If it doesn't exist, connection is tried to establish with default parameters defined in `php.ini`. If it is not successful, functions return `FALSE`.

7.5.5.1 `mysql_affected_rows`

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- `mysql_affected_rows`

Get number of affected rows in previous MySQL operation

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_affected_rows`
`PDOStatement::rowCount`

Description

```
int mysql_affected_rows(
    resource link_identifier
    = NULL);
```

Get the number of affected rows by the last INSERT, UPDATE, REPLACE or DELETE query associated with *link_identifier*.

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by `mysql_connect` is assumed. If no such link is found, it will try to create one as if `mysql_connect` had been called with no arguments. If no connection is found or established, an `E_WARNING` level error is generated.

Return Values

Returns the number of affected rows on success, and -1 if the last query failed.

If the last query was a DELETE query with no WHERE clause, all of the records will have been deleted from the table but this function will return zero with MySQL versions prior to 4.1.2.

When using UPDATE, MySQL will not update columns where the new value is the same as the old value. This creates the possibility that `mysql_affected_rows` may not actually equal the number of rows matched, only the number of rows that were literally affected by the query.

The REPLACE statement first deletes the record with the same primary key and then inserts the new record. This function returns the number of deleted records plus the number of inserted records.

In the case of "INSERT ... ON DUPLICATE KEY UPDATE" queries, the return value will be 1 if an insert was performed, or 2 for an update of an existing row.

Examples

Example 7.149 `mysql_affected_rows` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
mysql_select_db('mydb');
/* this should return the correct numbers of deleted records */
mysql_query('DELETE FROM mytable WHERE id < 10');
printf("Records deleted: %d\n", mysql_affected_rows());
/* with a where clause that is never true, it should return 0 */
mysql_query('DELETE FROM mytable WHERE 0');
printf("Records deleted: %d\n", mysql_affected_rows());
?>
```

The above example will output something similar to:

```
Records deleted: 10
Records deleted: 0
```

Example 7.150 `mysql_affected_rows` example using transactions

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
mysql_select_db('mydb');
/* Update records */
mysql_query("UPDATE mytable SET used=1 WHERE id < 10");
printf ("Updated records: %d\n", mysql_affected_rows());
mysql_query("COMMIT");
?>
```

The above example will output something similar to:

```
Updated Records: 10
```

Notes**Transactions**

If you are using transactions, you need to call `mysql_affected_rows` after your INSERT, UPDATE, or DELETE query, not after the COMMIT.

SELECT Statements

To retrieve the number of rows returned by a SELECT, it is possible to use `mysql_num_rows`.

Cascaded Foreign Keys

`mysql_affected_rows` does not count rows affected implicitly through the use of ON DELETE CASCADE and/or ON UPDATE CASCADE in foreign key constraints.

See Also

`mysql_num_rows`
`mysql_info`

7.5.5.2 mysql_client_encoding

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- `mysql_client_encoding`

Returns the name of the character set

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_character_set_name`

Description

```
string mysql_client_encoding(
    resource link_identifier
    = NULL);
```

Retrieves the `character_set` variable from MySQL.

Parameters

`link_identifier`

The MySQL connection. If the link identifier is not specified, the last link opened by `mysql_connect` is assumed. If no such link is found, it will try to create one as if `mysql_connect` had been called with no arguments. If no connection is found or established, an `E_WARNING` level error is generated.

Return Values

Returns the default character set name for the current connection.

Examples

Example 7.151 `mysql_client_encoding` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
$charset = mysql_client_encoding($link);
echo "The current character set is: $charset\n";
?>
```

The above example will output something similar to:

```
The current character set is: latin1
```

See Also

[mysql_set_charset](#)
[mysql_real_escape_string](#)

7.5.5.3 `mysql_close`

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- [mysql_close](#)

Close MySQL connection

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_close](#)

PDO: Assign the value of `NULL` to the PDO object

Description

```
bool mysql_close(
    resource link_identifier
    = NULL);
```

`mysql_close` closes the non-persistent connection to the MySQL server that's associated with the specified link identifier. If `link_identifier` isn't specified, the last opened link is used.

Open non-persistent MySQL connections and result sets are automatically destroyed when a PHP script finishes its execution. So, while explicitly closing open connections and freeing result sets is optional, doing so is recommended. This will immediately return resources to PHP and MySQL, which can improve performance. For related information, see [freeing resources](#)

Parameters

`link_identifier`

The MySQL connection. If the link identifier is not specified, the last link opened by `mysql_connect` is assumed. If no connection is found or established, an `E_WARNING` level error is generated.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.152 `mysql_close` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
echo 'Connected successfully';
mysql_close($link);
?>
```

The above example will output:

```
Connected successfully
```

Notes

Note

`mysql_close` will not close persistent links created by `mysql_pconnect`. For additional details, see the manual page on [persistent connections](#).

See Also

[mysql_connect](#)
[mysql_free_result](#)

7.5.5.4 `mysql_connect`

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- [mysql_connect](#)

Open a connection to a MySQL Server

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_connect](#)
[PDO::__construct](#)

Description

```
resource mysql_connect(
    string server
        = ini_get("mysql.default_host"),
    string username
        = ini_get("mysql.default_user"),
    string password
        = ini_get("mysql.default_password"),
    bool new_link
        = FALSE,
```

```
int client_flags
= = 0);
```

Opens or reuses a connection to a MySQL server.

Parameters

server

The MySQL server. It can also include a port number. e.g. "hostname:port" or a path to a local socket e.g. "./path/to/socket" for the localhost.

If the PHP directive [mysql.default_host](#) is undefined (default), then the default value is 'localhost:3306'. In [SQL safe mode](#), this parameter is ignored and value 'localhost:3306' is always used.

username

The username. Default value is defined by [mysql.default_user](#). In [SQL safe mode](#), this parameter is ignored and the name of the user that owns the server process is used.

password

The password. Default value is defined by [mysql.default_password](#). In [SQL safe mode](#), this parameter is ignored and empty password is used.

new_link

If a second call is made to [mysql_connect](#) with the same arguments, no new link will be established, but instead, the link identifier of the already opened link will be returned. The *new_link* parameter modifies this behavior and makes [mysql_connect](#) always open a new link, even if [mysql_connect](#) was called before with the same parameters. In [SQL safe mode](#), this parameter is ignored.

client_flags

The *client_flags* parameter can be a combination of the following constants: 128 (enable [LOAD DATA LOCAL](#) handling), [MYSQL_CLIENT_SSL](#), [MYSQL_CLIENT_COMPRESS](#), [MYSQL_CLIENT_IGNORE_SPACE](#) or [MYSQL_CLIENT_INTERACTIVE](#). Read the section about [Table 7.25, “MySQL client constants”](#) for further information. In [SQL safe mode](#), this parameter is ignored.

Return Values

Returns a MySQL link identifier on success or [FALSE](#) on failure.

Changelog

Version	Description
5.5.0	This function will generate an E_DEPRECATED error.

Examples

Example 7.153 [mysql_connect](#) example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
echo 'Connected successfully';
mysql_close($link);
?>
```

Example 7.154 `mysql_connect` example using `hostname:port` syntax

```
<?php
// we connect to example.com and port 3307
$link = mysql_connect('example.com:3307', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
echo 'Connected successfully';
mysql_close($link);
// we connect to localhost at port 3307
$link = mysql_connect('127.0.0.1:3307', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
echo 'Connected successfully';
mysql_close($link);
?>
```

Example 7.155 `mysql_connect` example using "`:/path/to/socket`" syntax

```
<?php
// we connect to localhost and socket e.g. /tmp/mysql.sock
// variant 1: omit localhost
$link = mysql_connect(':/tmp/mysql', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
echo 'Connected successfully';
mysql_close($link);
// variant 2: with localhost
$link = mysql_connect('localhost:/tmp/mysql.sock', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
echo 'Connected successfully';
mysql_close($link);
?>
```

Notes**Note**

Whenever you specify "localhost" or "localhost:port" as server, the MySQL client library will override this and try to connect to a local socket (named pipe on Windows). If you want to use TCP/IP, use "127.0.0.1" instead of "localhost". If the MySQL client library tries to connect to the wrong local socket, you should set the correct path as `mysql.default_host` string in your PHP configuration and leave the server field blank.

Note

The link to the server will be closed as soon as the execution of the script ends, unless it's closed earlier by explicitly calling `mysql_close`.

Note

Error "Can't create TCP/IP socket (10106)" usually means that the `variables_order` configure directive doesn't contain character `E`. On Windows, if

If the environment is not copied the `SYSTEMROOT` environment variable won't be available and PHP will have problems loading Winsock.

See Also

[mysql_pconnect](#)
[mysql_close](#)

7.5.5.5 `mysql_create_db`

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- [mysql_create_db](#)

Create a MySQL database

Warning

This function was deprecated in PHP 4.3.0, and it and the entire [original MySQL extension](#) was removed in PHP 7.0.0. Instead, use either the actively developed [MySQLi](#) or [PDO_MySQL](#) extensions. See also the [MySQL: choosing an API guide](#) and its [related FAQ entry](#) for additional information. Alternatives to this function include:

[mysqli_query](#)
[PDO::query](#)

Description

```
bool mysql_create_db(
    string database_name,
    resource link_identifier
    = NULL);
```

`mysql_create_db` attempts to create a new database on the server associated with the specified link identifier.

Parameters

<code>database_name</code>	The name of the database being created.
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been called with no arguments. If no connection is found or established, an <code>E_WARNING</code> level error is generated.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.156 `mysql_create_db` alternative example

The function `mysql_create_db` is deprecated. It is preferable to use `mysql_query` to issue an sql `CREATE DATABASE` statement instead.

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
```

```
$sql = 'CREATE DATABASE my_db';
if (mysql_query($sql, $link)) {
    echo "Database my_db created successfully\n";
} else {
    echo 'Error creating database: ' . mysql_error() . "\n";
}
?>
```

The above example will output something similar to:

```
Database my_db created successfully
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
[mysql_createdb](#)

Note

This function will not be available if the MySQL extension was built against a MySQL 4.x client library.

See Also

[mysql_query](#)
[mysql_select_db](#)

7.5.5.6 [mysql_data_seek](#)

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- [mysql_data_seek](#)

Move internal result pointer

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_data_seek](#)
[PDO::FETCH_ORI_ABS](#)

Description

```
bool mysql_data_seek(
    resource result,
    int row_number);
```

[mysql_data_seek](#) moves the internal row pointer of the MySQL result associated with the specified result identifier to point to the specified row number. The next call to a MySQL fetch function, such as [mysql_fetch_assoc](#), would return that row.

row_number starts at 0. The *row_number* should be a value in the range from 0 to [mysql_num_rows](#) - 1. However if the result set is empty ([mysql_num_rows == 0](#)), a seek to 0 will fail with an [E_WARNING](#) and [mysql_data_seek](#) will return [FALSE](#).

Parameters

`result`

The result resource that is being evaluated. This result comes from a call to `mysql_query`.

`row_number`

The desired row number of the new result pointer.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.157 `mysql_data_seek` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
$db_selected = mysql_select_db('sample_db');
if (!$db_selected) {
    die('Could not select database: ' . mysql_error());
}
$query = 'SELECT last_name, first_name FROM friends';
$result = mysql_query($query);
if (!$result) {
    die('Query failed: ' . mysql_error());
}
/* fetch rows in reverse order */
for ($i = mysql_num_rows($result) - 1; $i >= 0; $i--) {
    if (!mysql_data_seek($result, $i)) {
        echo "Cannot seek to row $i: " . mysql_error() . "\n";
        continue;
    }
    if (!$row = mysql_fetch_assoc($result)) {
        continue;
    }
    echo $row['last_name'] . ' ' . $row['first_name'] . "<br />\n";
}
mysql_free_result($result);
?>
```

Notes

Note

The function `mysql_data_seek` can be used in conjunction only with `mysql_query`, not with `mysql_unbuffered_query`.

See Also

`mysql_query`
`mysql_num_rows`
`mysql_fetch_row`
`mysql_fetch_assoc`
`mysql_fetch_array`
`mysql_fetch_object`

7.5.5.7 `mysql_db_name`

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- `mysql_db_name`

Retrieves database name from the call to `mysql_list_dbs`

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLI](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

Query: `SELECT DATABASE()`

Description

```
string mysql_db_name(
    resource result,
    int row,
    mixed field
    = =NULL);
```

Retrieve the database name from a call to `mysql_list_dbs`.

Parameters

<code>result</code>	The result pointer from a call to <code>mysql_list_dbs</code> .
<code>row</code>	The index into the result set.
<code>field</code>	The field name.

Return Values

Returns the database name on success, and `FALSE` on failure. If `FALSE` is returned, use `mysql_error` to determine the nature of the error.

Changelog

Version	Description
5.5.0	The <code>mysql_list_dbs</code> function is deprecated, and emits an <code>E_DEPRECATED</code> level error.

Examples

Example 7.158 `mysql_db_name` example

```
<?php
error_reporting(E_ALL);
$link = mysql_connect('dbhost', 'username', 'password');
$db_list = mysql_list_dbs($link);
$i = 0;
$cnt = mysql_num_rows($db_list);
while ($i < $cnt) {
    echo mysql_db_name($db_list, $i) . "\n";
    $i++;
}
?>
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_dbname`

See Also

[mysql_list_dbs](#)
[mysql_tablename](#)

7.5.5.8 mysql_db_query

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- [mysql_db_query](#)

Selects a database and executes a query on it

Warning

This function was deprecated in PHP 5.3.0, and it and the entire [original MySQL extension](#) was removed in PHP 7.0.0. Instead, use either the actively developed [MySQLi](#) or [PDO_MySQL](#) extensions. See also the [MySQL: choosing an API](#) guide and its [related FAQ entry](#) for additional information. Alternatives to this function include:

[mysqli_select_db](#) then the query
[PDO::__construct](#)

Description

```
resource mysql_db_query(
    string database,
    string query,
    resource link_identifier
    = NULL);
```

`mysql_db_query` selects a database, and executes a query on it.

Parameters

`database` The name of the database that will be selected.

`query` The MySQL query.

Data inside the query should be [properly escaped](#).

`link_identifier` The MySQL connection. If the link identifier is not specified, the last link opened by `mysql_connect` is assumed. If no such link is found, it will try to create one as if `mysql_connect` had been called with no arguments. If no connection is found or established, an `E_WARNING` level error is generated.

Return Values

Returns a positive MySQL result resource to the query result, or `FALSE` on error. The function also returns `TRUE/FALSE` for `INSERT/UPDATE/DELETE` queries to indicate success/failure.

Changelog

Version	Description
5.3.0	This function now throws an <code>E_DEPRECATED</code> notice.

Examples

Example 7.159 `mysql_db_query` alternative example

```
<?php
if (!$link = mysql_connect('mysql_host', 'mysql_user', 'mysql_password')) {
    echo 'Could not connect to mysql';
    exit;
}
if (!mysql_select_db('mysql_dbname', $link)) {
    echo 'Could not select database';
    exit;
}
$sql    = 'SELECT foo FROM bar WHERE id = 42';
$result = mysql_query($sql, $link);
if (!$result) {
    echo "DB Error, could not query the database\n";
    echo 'MySQL Error: ' . mysql_error();
    exit;
}
while ($row = mysql_fetch_assoc($result)) {
    echo $row['foo'];
}
mysql_free_result($result);
?>
```

Notes**Note**

Be aware that this function does *NOT* switch back to the database you were connected before. In other words, you can't use this function to *temporarily* run a sql query on another database, you would have to manually switch back. Users are strongly encouraged to use the `database.table` syntax in their sql queries or `mysql_select_db` instead of this function.

See Also

[mysql_query](#)
[mysql_select_db](#)

7.5.5.9 `mysql_drop_db`

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- [mysql_drop_db](#)

Drop (delete) a MySQL database

Warning

This function was deprecated in PHP 4.3.0, and it and the entire [original MySQL extension](#) was removed in PHP 7.0.0. Instead, use either the actively developed [MySQLi](#) or [PDO_MySQL](#) extensions. See also the [MySQL: choosing an API](#) guide and its [related FAQ entry](#) for additional information. Alternatives to this function include:

Execute a `DROP DATABASE` query

Description

```
bool mysql_drop_db(
    string database_name,
    resource link_identifier
```

```
= =NULL);
```

`mysql_drop_db` attempts to drop (remove) an entire database from the server associated with the specified link identifier. This function is deprecated, it is preferable to use `mysql_query` to issue an sql `DROP DATABASE` statement instead.

Parameters

<code>database_name</code>	The name of the database that will be deleted.
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been called with no arguments. If no connection is found or established, an <code>E_WARNING</code> level error is generated.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.160 `mysql_drop_db` alternative example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
$sql = 'DROP DATABASE my_db';
if (mysql_query($sql, $link)) {
    echo "Database my_db was successfully dropped\n";
} else {
    echo 'Error dropping database: ' . mysql_error() . "\n";
}
?>
```

Notes

Warning

This function will not be available if the MySQL extension was built against a MySQL 4.x client library.

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_dropdb`

See Also

`mysql_query`

7.5.5.10 `mysql_errno`

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- `mysql_errno`

Returns the numerical value of the error message from previous MySQL operation

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_errno`
`PDO::errorCode`

Description

```
int mysql_errno(
    resource link_identifier
    = NULL);
```

Returns the error number from the last MySQL function.

Errors coming back from the MySQL database backend no longer issue warnings. Instead, use `mysql_errno` to retrieve the error code. Note that this function only returns the error code from the most recently executed MySQL function (not including `mysql_error` and `mysql_errno`), so if you want to use it, make sure you check the value before calling another MySQL function.

Parameters

`link_identifier`

The MySQL connection. If the link identifier is not specified, the last link opened by `mysql_connect` is assumed. If no such link is found, it will try to create one as if `mysql_connect` had been called with no arguments. If no connection is found or established, an `E_WARNING` level error is generated.

Return Values

Returns the error number from the last MySQL function, or `0` (zero) if no error occurred.

Examples**Example 7.161 `mysql_errno` example**

```
<?php
$link = mysql_connect("localhost", "mysql_user", "mysql_password");
if (!mysql_select_db("nonexistentdb", $link)) {
    echo mysql_errno($link) . ":" . mysql_error($link). "\n";
}
mysql_select_db("kossu", $link);
if (!mysql_query("SELECT * FROM nonexistenttable", $link)) {
    echo mysql_errno($link) . ":" . mysql_error($link) . "\n";
}
?>
```

The above example will output something similar to:

```
1049: Unknown database 'nonexistentdb'
1146: Table 'kossu.nonexistenttable' doesn't exist
```

See Also

[mysql_error](#)

[MySQL error codes](#)**7.5.5.11 mysql_error**

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- [mysql_error](#)

Returns the text of the error message from previous MySQL operation

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_error](#)
[PDO::errorInfo](#)

Description

```
string mysql_error(
    resource link_identifier
    = NULL);
```

Returns the error text from the last MySQL function. Errors coming back from the MySQL database backend no longer issue warnings. Instead, use [mysql_error](#) to retrieve the error text. Note that this function only returns the error text from the most recently executed MySQL function (not including [mysql_error](#) and [mysql_errno](#)), so if you want to use it, make sure you check the value before calling another MySQL function.

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by [mysql_connect](#) is assumed. If no such link is found, it will try to create one as if [mysql_connect](#) had been called with no arguments. If no connection is found or established, an [E_WARNING](#) level error is generated.

Return Values

Returns the error text from the last MySQL function, or ' ' (empty string) if no error occurred.

Examples**Example 7.162 mysql_error example**

```
<?php
$link = mysql_connect("localhost", "mysql_user", "mysql_password");
mysql_select_db("nonexistentdb", $link);
echo mysql_errno($link) . ":" . mysql_error($link) . "\n";
mysql_select_db("kossu", $link);
mysql_query("SELECT * FROM nonexistenttable", $link);
echo mysql_errno($link) . ":" . mysql_error($link) . "\n";
?>
```

The above example will output something similar to:

```
1049: Unknown database 'nonexistentdb'
1146: Table 'kossu.nonexistenttable' doesn't exist
```

See Also

[mysql_errno](#)
[MySQL error codes](#)

7.5.5.12 mysql_escape_string

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- [mysql_escape_string](#)

Escapes a string for use in a `mysql_query`

Warning

This function was deprecated in PHP 4.3.0, and it and the entire [original MySQL extension](#) was removed in PHP 7.0.0. Instead, use either the actively developed [MySQLi](#) or [PDO_MySQL](#) extensions. See also the [MySQL: choosing an API](#) guide and its [related FAQ entry](#) for additional information. Alternatives to this function include:

[mysqli_escape_string](#)
[PDO::quote](#)

Description

```
string mysql_escape_string(
    string unescaped_string);
```

This function will escape the `unescaped_string`, so that it is safe to place it in a `mysql_query`. This function is deprecated.

This function is identical to `mysql_real_escape_string` except that `mysql_real_escape_string` takes a connection handler and escapes the string according to the current character set. `mysql_escape_string` does not take a connection argument and does not respect the current charset setting.

Parameters

`unescaped_string` The string that is to be escaped.

Return Values

Returns the escaped string.

Changelog

Version	Description
5.3.0	This function now throws an E_DEPRECATED notice.
4.3.0	This function became deprecated, do not use this function. Instead, use <code>mysql_real_escape_string</code> .

Examples

Example 7.163 `mysql_escape_string` example

```
<?php
$item = "Zak's Laptop";
$escaped_item = mysql_escape_string($item);
printf("Escaped string: %s\n", $escaped_item);
?>
```

The above example will output:

```
Escaped string: Zak\'s Laptop
```

Notes**Note**

`mysql_escape_string` does not escape `%` and `_`.

See Also

[mysql_real_escape_string](#)
[addslashes](#)
The [magic_quotes_gpc](#) directive.

7.5.5.13 `mysql_fetch_array`

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- [mysql_fetch_array](#)

Fetch a result row as an associative array, a numeric array, or both

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_fetch_array](#)
[PDOStatement::fetch](#)

Description

```
array mysql_fetch_array(
    resource result,
    int result_type
    = MYSQL_BOTH);
```

Returns an array that corresponds to the fetched row and moves the internal data pointer ahead.

Parameters

result

The result resource that is being evaluated. This result comes from a call to [mysql_query](#).

result_type

The type of array that is to be fetched. It's a constant and can take the following values: [MYSQL_ASSOC](#), [MYSQL_NUM](#), and [MYSQL_BOTH](#).

Return Values

Returns an array of strings that corresponds to the fetched row, or `FALSE` if there are no more rows. The type of returned array depends on how `result_type` is defined. By using `MYSQL_BOTH` (default), you'll get an array with both associative and number indices. Using `MYSQL_ASSOC`, you only get associative indices (as `mysql_fetch_assoc` works), using `MYSQL_NUM`, you only get number indices (as `mysql_fetch_row` works).

If two or more columns of the result have the same field names, the last column will take precedence. To access the other column(s) of the same name, you must use the numeric index of the column or make an alias for the column. For aliased columns, you cannot access the contents with the original column name.

Examples

Example 7.164 Query with aliased duplicate field names

```
SELECT table1.field AS foo, table2.field AS bar FROM table1, table2
```

Example 7.165 `mysql_fetch_array` with `MYSQL_NUM`

```
<?php
mysql_connect("localhost", "mysql_user", "mysql_password") or
    die("Could not connect: " . mysql_error());
mysql_select_db("mydb");
$result = mysql_query("SELECT id, name FROM mytable");
while ($row = mysql_fetch_array($result, MYSQL_NUM)) {
    printf("ID: %s Name: %s", $row[0], $row[1]);
}
mysql_free_result($result);
?>
```

Example 7.166 `mysql_fetch_array` with `MYSQL_ASSOC`

```
<?php
mysql_connect("localhost", "mysql_user", "mysql_password") or
    die("Could not connect: " . mysql_error());
mysql_select_db("mydb");
$result = mysql_query("SELECT id, name FROM mytable");
while ($row = mysql_fetch_array($result, MYSQL_ASSOC)) {
    printf("ID: %s Name: %s", $row["id"], $row["name"]);
}
mysql_free_result($result);
?>
```

Example 7.167 `mysql_fetch_array` with `MYSQL_BOTH`

```
<?php
mysql_connect("localhost", "mysql_user", "mysql_password") or
    die("Could not connect: " . mysql_error());
mysql_select_db("mydb");
$result = mysql_query("SELECT id, name FROM mytable");
while ($row = mysql_fetch_array($result, MYSQL_BOTH)) {
    printf ("ID: %s Name: %s", $row[0], $row["name"]);
}
mysql_free_result($result);
?>
```

Notes

Performance

An important thing to note is that using `mysql_fetch_array` is *not significantly* slower than using `mysql_fetch_row`, while it provides a significant added value.

Note

Field names returned by this function are *case-sensitive*.

Note

This function sets NULL fields to the PHP `NULL` value.

See Also

`mysql_fetch_row`
`mysql_fetch_assoc`
`mysql_data_seek`
`mysql_query`

7.5.5.14 `mysql_fetch_assoc`

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- `mysql_fetch_assoc`

Fetch a result row as an associative array

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information.
Alternatives to this function include:

`mysqli_fetch_assoc`
`PDOStatement::fetch(PDO::FETCH_ASSOC)`

Description

```
array mysql_fetch_assoc(  
    resource result);
```

Returns an associative array that corresponds to the fetched row and moves the internal data pointer ahead. `mysql_fetch_assoc` is equivalent to calling `mysql_fetch_array` with `MYSQL_ASSOC` for the optional second parameter. It only returns an associative array.

Parameters

`result`

The result resource that is being evaluated. This result comes from a call to `mysql_query`.

Return Values

Returns an associative array of strings that corresponds to the fetched row, or `FALSE` if there are no more rows.

If two or more columns of the result have the same field names, the last column will take precedence. To access the other column(s) of the same name, you either need to access the result with numeric indices by using [mysql_fetch_row](#) or add alias names. See the example at the [mysql_fetch_array](#) description about aliases.

Examples

Example 7.168 An expanded [mysql_fetch_assoc](#) example

```
<?php
$conn = mysql_connect("localhost", "mysql_user", "mysql_password");
if (!$conn) {
    echo "Unable to connect to DB: " . mysql_error();
    exit;
}
if (!mysql_select_db("mydbname")) {
    echo "Unable to select mydbname: " . mysql_error();
    exit;
}
$sql = "SELECT id as userid, fullname, userstatus
        FROM sometable
        WHERE userstatus = 1";
$result = mysql_query($sql);
if (!$result) {
    echo "Could not successfully run query ($sql) from DB: " . mysql_error();
    exit;
}
if (mysql_num_rows($result) == 0) {
    echo "No rows found, nothing to print so am exiting";
    exit;
}
// While a row of data exists, put that row in $row as an associative array
// Note: If you're expecting just one row, no need to use a loop
// Note: If you put extract($row); inside the following loop, you'll
//       then create $userid, $fullname, and $userstatus
while ($row = mysql_fetch_assoc($result)) {
    echo $row["userid"];
    echo $row["fullname"];
    echo $row["userstatus"];
}
mysql_free_result($result);
?>
```

Notes

Performance

An important thing to note is that using [mysql_fetch_assoc](#) is *not significantly* slower than using [mysql_fetch_row](#), while it provides a significant added value.

Note

Field names returned by this function are *case-sensitive*.

Note

This function sets NULL fields to the PHP [NULL](#) value.

See Also

[mysql_fetch_row](#)
[mysql_fetch_array](#)
[mysql_data_seek](#)

`mysql_query`
`mysql_error`

7.5.5.15 `mysql_fetch_field`

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- `mysql_fetch_field`

Get column information from a result and return as an object

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information.
Alternatives to this function include:

`mysqli_fetch_field`
`PDOStatement::getColumnMeta`

Description

```
object mysql_fetch_field(
    resource result,
    int field_offset
    = 0);
```

Returns an object containing field information. This function can be used to obtain information about fields in the provided query result.

Parameters

`result` The result resource that is being evaluated. This result comes from a call to `mysql_query`.

`field_offset` The numerical field offset. If the field offset is not specified, the next field that was not yet retrieved by this function is retrieved. The `field_offset` starts at 0.

Return Values

Returns an object containing field information. The properties of the object are:

- name - column name
- table - name of the table the column belongs to, which is the alias name if one is defined
- max_length - maximum length of the column
- not_null - 1 if the column cannot be `NULL`
- primary_key - 1 if the column is a primary key
- unique_key - 1 if the column is a unique key
- multiple_key - 1 if the column is a non-unique key
- numeric - 1 if the column is numeric
- blob - 1 if the column is a BLOB
- type - the type of the column

- `unsigned` - 1 if the column is unsigned
- `zerofill` - 1 if the column is zero-filled

Examples

Example 7.169 `mysql_fetch_field` example

```
<?php
$conn = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$conn) {
    die('Could not connect: ' . mysql_error());
}
mysql_select_db('database');
$result = mysql_query('select * from table');
if (!$result) {
    die('Query failed: ' . mysql_error());
}
/* get column metadata */
$i = 0;
while ($i < mysql_num_fields($result)) {
    echo "Information for column $i:<br />\n";
    $meta = mysql_fetch_field($result, $i);
    if (!$meta) {
        echo "No information available<br />\n";
    }
    echo "<pre>";
blob:           $meta->blob
max_length:    $meta->max_length
multiple_key:  $meta->multiple_key
name:          $meta->name
not_null:      $meta->not_null
numeric:       $meta->numeric
primary_key:   $meta->primary_key
table:         $meta->table
type:          $meta->type
unique_key:    $meta->unique_key
unsigned:      $meta->unsigned
zerofill:      $meta->zerofill
</pre>";
    $i++;
}
mysql_free_result($result);
?>
```

Notes

Note

Field names returned by this function are *case-sensitive*.

Note

If field or tablenames are aliased in the SQL query the aliased name will be returned. The original name can be retrieved for instance by using `mysqli_result::fetch_field`.

See Also

[mysql_field_seek](#)

7.5.5.16 `mysql_fetch_lengths`

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- [mysql_fetch_lengths](#)

Get the length of each output in a result

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

```
mysqli_fetch_lengths  
PDOStatement::getColumnMeta
```

Description

```
array mysql_fetch_lengths(  
    resource result);
```

Returns an array that corresponds to the lengths of each field in the last row fetched by MySQL.

`mysql_fetch_lengths` stores the lengths of each result column in the last row returned by `mysql_fetch_row`, `mysql_fetch_assoc`, `mysql_fetch_array`, and `mysql_fetch_object` in an array, starting at offset 0.

Parameters

`result` The result resource that is being evaluated. This result comes from a call to `mysql_query`.

Return Values

An array of lengths on success or `FALSE` on failure.

Examples

Example 7.170 A `mysql_fetch_lengths` example

```
<?php  
$result = mysql_query("SELECT id,email FROM people WHERE id = '42'");  
if (!$result) {  
    echo 'Could not run query: ' . mysql_error();  
    exit;  
}  
$row      = mysql_fetch_assoc($result);  
$lengths = mysql_fetch_lengths($result);  
print_r($row);  
print_r($lengths);  
?>
```

The above example will output something similar to:

```
Array  
(  
    [id] => 42  
    [email] => user@example.com  
)  
Array  
(  
    [0] => 2  
    [1] => 16  
)
```

See Also

[mysql_field_len](#)
[mysql_fetch_row](#)
[strlen](#)

7.5.5.17 mysql_fetch_object

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- [mysql_fetch_object](#)

Fetch a result row as an object

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_fetch_object](#)
[PDOStatement::fetch\(PDO::FETCH_OBJ\)](#)

Description

```
object mysql_fetch_object(
    resource result,
    string class_name,
    array params);
```

Returns an object with properties that correspond to the fetched row and moves the internal data pointer ahead.

Parameters

<i>result</i>	The result resource that is being evaluated. This result comes from a call to mysql_query .
<i>class_name</i>	The name of the class to instantiate, set the properties of and return. If not specified, a stdClass object is returned.
<i>params</i>	An optional array of parameters to pass to the constructor for <i>class_name</i> objects.

Return Values

Returns an object with string properties that correspond to the fetched row, or [FALSE](#) if there are no more rows.

Examples**Example 7.171 mysql_fetch_object example**

```
<?php
mysql_connect("hostname", "user", "password");
mysql_select_db("mydb");
$result = mysql_query("select * from mytable");
while ($row = mysql_fetch_object($result)) {
    echo $row->user_id;
    echo $row->fullname;
```

```

}
mysql_free_result($result);
?>

```

Example 7.172 `mysql_fetch_object` example

```

<?php
class foo {
    public $name;
}
mysql_connect("hostname", "user", "password");
mysql_select_db("mydb");
$result = mysql_query("select name from mytable limit 1");
$obj = mysql_fetch_object($result, 'foo');
var_dump($obj);
?>

```

Notes

Performance

Speed-wise, the function is identical to `mysql_fetch_array`, and almost as quick as `mysql_fetch_row` (the difference is insignificant).

Note

`mysql_fetch_object` is similar to `mysql_fetch_array`, with one difference - an object is returned, instead of an array. Indirectly, that means that you can only access the data by the field names, and not by their offsets (numbers are illegal property names).

Note

Field names returned by this function are *case-sensitive*.

Note

This function sets NULL fields to the PHP `NULL` value.

See Also

[mysql_fetch_array](#)
[mysql_fetch_assoc](#)
[mysql_fetch_row](#)
[mysql_data_seek](#)
[mysql_query](#)

7.5.5.18 `mysql_fetch_row`

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- [mysql_fetch_row](#)

Get a result row as an enumerated array

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See

also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information.
Alternatives to this function include:

```
mysqli_fetch_row
PDOStatement::fetch(PDO::FETCH_NUM)
```

Description

```
array mysql_fetch_row(
    resource result);
```

Returns a numerical array that corresponds to the fetched row and moves the internal data pointer ahead.

Parameters

<code>result</code>	The result resource that is being evaluated. This result comes from a call to mysql_query .
---------------------	---

Return Values

Returns an numerical array of strings that corresponds to the fetched row, or `FALSE` if there are no more rows.

`mysql_fetch_row` fetches one row of data from the result associated with the specified result identifier. The row is returned as an array. Each result column is stored in an array offset, starting at offset 0.

Examples

Example 7.173 Fetching one row with `mysql_fetch_row`

```
<?php
$result = mysql_query("SELECT id,email FROM people WHERE id = '42'");
if (!$result) {
    echo 'Could not run query: ' . mysql_error();
    exit;
}
$row = mysql_fetch_row($result);
echo $row[0]; // 42
echo $row[1]; // the email value
?>
```

Notes

Note

This function sets NULL fields to the PHP `NULL` value.

See Also

[mysql_fetch_array](#)
[mysql_fetch_assoc](#)
[mysql_fetch_object](#)
[mysql_data_seek](#)
[mysql_fetch_lengths](#)
[mysql_result](#)

7.5.5.19 `mysql_field_flags`

- `mysql_field_flags`

Get the flags associated with the specified field in a result

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

```
mysqli_fetch_field_direct [flags]
PDOStatement::getColumnMeta [flags]
```

Description

```
string mysql_field_flags(
    resource result,
    int field_offset);
```

`mysql_field_flags` returns the field flags of the specified field. The flags are reported as a single word per flag separated by a single space, so that you can split the returned value using [explode](#).

Parameters

<code>result</code>	The result resource that is being evaluated. This result comes from a call to mysql_query .
<code>field_offset</code>	The numerical field offset. The <code>field_offset</code> starts at 0. If <code>field_offset</code> does not exist, an error of level <code>E_WARNING</code> is also issued.

Return Values

Returns a string of flags associated with the result or `FALSE` on failure.

The following flags are reported, if your version of MySQL is current enough to support them:

`"not_null"`, `"primary_key"`, `"unique_key"`, `"multiple_key"`, `"blob"`, `"unsigned"`, `"zerofill"`, `"binary"`, `"enum"`, `"auto_increment"` and `"timestamp"`.

Examples

Example 7.174 A `mysql_field_flags` example

```
<?php
$result = mysql_query( "SELECT id,email FROM people WHERE id = '42'" );
if (!$result) {
    echo 'Could not run query: ' . mysql_error();
    exit;
}
$flags = mysql_field_flags($result, 0);
echo $flags;
print_r(explode(' ', $flags));
?>
```

The above example will output something similar to:

```
not_null primary_key auto_increment
Array
(
    [0] => not_null
```

```
[1] => primary_key
[2] => auto_increment
)
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_fieldflags`

See Also

`mysql_field_type`
`mysql_field_len`

7.5.5.20 `mysql_field_len`

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- `mysql_field_len`

Returns the length of the specified field

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_fetch_field_direct [length]`
`PDOStatement::getColumnMeta [len]`

Description

```
int mysql_field_len(
    resource result,
    int field_offset);
```

`mysql_field_len` returns the length of the specified field.

Parameters

<code>result</code>	The result resource that is being evaluated. This result comes from a call to mysql_query .
<code>field_offset</code>	The numerical field offset. The <code>field_offset</code> starts at 0. If <code>field_offset</code> does not exist, an error of level <code>E_WARNING</code> is also issued.

Return Values

The length of the specified field index on success or `FALSE` on failure.

Examples

Example 7.175 `mysql_field_len` example

```
<?php
```

```
$result = mysql_query("SELECT id,email FROM people WHERE id = '42'");
if (!$result) {
    echo 'Could not run query: ' . mysql_error();
    exit;
}
// Will get the length of the id field as specified in the database
// schema.
$length = mysql_field_len($result, 0);
echo $length;
?>
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_fieldlen`

See Also

[mysql_fetch_lengths](#)
[strlen](#)

7.5.5.21 `mysql_field_name`

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- [mysql_field_name](#)

Get the name of the specified field in a result

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information.
 Alternatives to this function include:

[mysqli_fetch_field_direct](#) [name] or [orgname]
[PDOStatement::getColumnMeta](#) [name]

Description

```
string mysql_field_name(
    resource result,
    int field_offset);
```

`mysql_field_name` returns the name of the specified field index.

Parameters

<code>result</code>	The result resource that is being evaluated. This result comes from a call to mysql_query .
<code>field_offset</code>	The numerical field offset. The <code>field_offset</code> starts at 0. If <code>field_offset</code> does not exist, an error of level <code>E_WARNING</code> is also issued.

Return Values

The name of the specified field index on success or `FALSE` on failure.

Examples

Example 7.176 `mysql_field_name` example

```
<?php
/* The users table consists of three fields:
 *   user_id
 *   username
 *   password.
 */
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect to MySQL server: ' . mysql_error());
}
$dbname = 'mydb';
$db_selected = mysql_select_db($dbname, $link);
if (!$db_selected) {
    die("Could not set $dbname: " . mysql_error());
}
$res = mysql_query('select * from users', $link);
echo mysql_field_name($res, 0) . "\n";
echo mysql_field_name($res, 2);
?>
```

The above example will output:

```
user_id
password
```

Notes

Note

Field names returned by this function are *case-sensitive*.

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_fieldname`

See Also

[mysql_field_type](#)
[mysql_field_len](#)

7.5.5.22 `mysql_field_seek`

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- [mysql_field_seek](#)

Set result pointer to a specified field offset

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_field_seek](#)

PDOStatement::fetch using the *cursor_orientation* and *offset* parameters

Description

```
bool mysql_field_seek(
    resource result,
    int field_offset);
```

Seeks to the specified field offset. If the next call to `mysql_fetch_field` doesn't include a field offset, the field offset specified in `mysql_field_seek` will be returned.

Parameters

<i>result</i>	The result resource that is being evaluated. This result comes from a call to <code>mysql_query</code> .
<i>field_offset</i>	The numerical field offset. The <i>field_offset</i> starts at 0. If <i>field_offset</i> does not exist, an error of level <code>E_WARNING</code> is also issued.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

See Also

[mysql_fetch_field](#)

7.5.5.23 mysql_field_table

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- [mysql_field_table](#)

Get name of the table the specified field is in

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_fetch_field_direct` [table] or [orgtable]
`PDOStatement::getColumnMeta` [table]

Description

```
string mysql_field_table(
    resource result,
    int field_offset);
```

Returns the name of the table that the specified field is in.

Parameters

<i>result</i>	The result resource that is being evaluated. This result comes from a call to <code>mysql_query</code> .
<i>field_offset</i>	The numerical field offset. The <i>field_offset</i> starts at 0. If <i>field_offset</i> does not exist, an error of level <code>E_WARNING</code> is also issued.

Return Values

The name of the table on success.

Examples

Example 7.177 A `mysql_field_table` example

```
<?php
$query = "SELECT account.*, country.* FROM account, country WHERE country.name = 'Portugal' AND account
// get the result from the DB
$result = mysql_query($query);
// Lists the table name and then the field name
for ($i = 0; $i < mysql_num_fields($result); ++$i) {
    $table = mysql_field_table($result, $i);
    $field = mysql_field_name($result, $i);
    echo "$table: $field\n";
}
?>
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_fieldtable`

See Also

[mysql_list_tables](#)

7.5.5.24 `mysql_field_type`

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- [mysql_field_type](#)

Get the type of the specified field in a result

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_fetch_field_direct [type]`
`PDOStatement::getColumnMeta [driver:decl_type] or [pdo_type]`

Description

```
string mysql_field_type(
    resource result,
    int field_offset);
```

`mysql_field_type` is similar to the `mysql_field_name` function. The arguments are identical, but the field type is returned instead.

Parameters

`result`

The result resource that is being evaluated. This result comes from a call to `mysql_query`.

<code>field_offset</code>	The numerical field offset. The <code>field_offset</code> starts at 0. If <code>field_offset</code> does not exist, an error of level <code>E_WARNING</code> is also issued.
---------------------------	--

Return Values

The returned field type will be one of "int", "real", "string", "blob", and others as detailed in the [MySQL documentation](#).

Examples

Example 7.178 `mysql_field_type` example

```
<?php
mysql_connect("localhost", "mysql_username", "mysql_password");
mysql_select_db("mysql");
$result = mysql_query("SELECT * FROM func");
$fields = mysql_num_fields($result);
$rows = mysql_num_rows($result);
$table = mysql_field_table($result, 0);
echo "Your '$table' table has $fields fields and $rows record(s)\n";
echo "The table has the following fields:\n";
for ($i=0; $i < $fields; $i++) {
    $type = mysql_field_type($result, $i);
    $name = mysql_field_name($result, $i);
    $len = mysql_field_len($result, $i);
    $flags = mysql_field_flags($result, $i);
    echo $type . " " . $name . " " . $len . " " . $flags . "\n";
}
mysql_free_result($result);
mysql_close();
?>
```

The above example will output something similar to:

```
Your 'func' table has 4 fields and 1 record(s)
The table has the following fields:
string name 64 not_null primary_key binary
int ret 1 not_null
string dl 128 not_null
string type 9 not_null enum
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_fieldtype`

See Also

[mysql_field_name](#)
[mysql_field_len](#)

7.5.5.25 `mysql_free_result`

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- [mysql_free_result](#)

Free result memory

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

```
mysqli_free_result
Assign the value of NULL to the PDO object, or
PDOStatement::closeCursor
```

Description

```
bool mysql_free_result(
    resource result);
```

`mysql_free_result` will free all memory associated with the result identifier `result`.

`mysql_free_result` only needs to be called if you are concerned about how much memory is being used for queries that return large result sets. All associated result memory is automatically freed at the end of the script's execution.

Parameters

<code>result</code>	The result resource that is being evaluated. This result comes from a call to <code>mysql_query</code> .
---------------------	--

Return Values

Returns `TRUE` on success or `FALSE` on failure.

If a non-resource is used for the `result`, an error of level `E_WARNING` will be emitted. It's worth noting that `mysql_query` only returns a resource for `SELECT`, `SHOW`, `EXPLAIN`, and `DESCRIBE` queries.

Examples**Example 7.179 A `mysql_free_result` example**

```
<?php
$result = mysql_query("SELECT id,email FROM people WHERE id = '42'");
if (!$result) {
    echo 'Could not run query: ' . mysql_error();
    exit;
}
/* Use the result, assuming we're done with it afterwards */
$row = mysql_fetch_assoc($result);
/* Now we free up the result and continue on with our script */
mysql_free_result($result);
echo $row['id'];
echo $row['email'];
?>
```

Notes**Note**

For backward compatibility, the following deprecated alias may be used:
`mysql_freeresult`

See Also

```
mysql_query  
is_resource
```

7.5.5.26 mysql_get_client_info

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- [mysql_get_client_info](#)

Get MySQL client info

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

```
mysqli_get_client_info  
PDO::getAttribute(PDO::ATTR_CLIENT_VERSION)
```

Description

```
string mysql_get_client_info();
```

`mysql_get_client_info` returns a string that represents the client library version.

Return Values

The MySQL client version.

Examples

Example 7.180 mysql_get_client_info example

```
<?php  
printf("MySQL client info: %s\n", mysql_get_client_info());  
?>
```

The above example will output something similar to:

```
MySQL client info: 3.23.39
```

See Also

```
mysql_get_host_info  
mysql_get_proto_info  
mysql_get_server_info
```

7.5.5.27 mysql_get_host_info

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- [mysql_get_host_info](#)

Get MySQL host info

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

```
mysqli_get_host_info
PDO::getAttribute(PDO::ATTR_CONNECTION_STATUS)
```

Description

```
string mysql_get_host_info(
    resource link_identifier
    = NULL);
```

Describes the type of connection in use for the connection, including the server host name.

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by [mysql_connect](#) is assumed. If no such link is found, it will try to create one as if [mysql_connect](#) had been called with no arguments. If no connection is found or established, an [E_WARNING](#) level error is generated.

Return Values

Returns a string describing the type of MySQL connection in use for the connection or [FALSE](#) on failure.

Examples**Example 7.181 `mysql_get_host_info` example**

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
printf("MySQL host info: %s\n", mysql_get_host_info());
?>
```

The above example will output something similar to:

```
MySQL host info: Localhost via UNIX socket
```

See Also

[mysql_get_client_info](#)
[mysql_get_proto_info](#)
[mysql_get_server_info](#)

7.5.5.28 `mysql_get_proto_info`

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- [mysql_get_proto_info](#)

Get MySQL protocol info

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_get_proto_info`

Description

```
int mysql_get_proto_info(  
    resource link_identifier  
    = NULL);
```

Retrieves the MySQL protocol.

Parameters

<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been called with no arguments. If no connection is found or established, an <code>E_WARNING</code> level error is generated.
------------------------------	---

Return Values

Returns the MySQL protocol on success or `FALSE` on failure.

Examples

Example 7.182 `mysql_get_proto_info` example

```
<?php  
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');  
if (!$link) {  
    die('Could not connect: ' . mysql_error());  
}  
printf("MySQL protocol version: %s\n", mysql_get_proto_info());  
?>
```

The above example will output something similar to:

```
MySQL protocol version: 10
```

See Also

[mysql_get_client_info](#)
[mysql_get_host_info](#)
[mysql_get_server_info](#)

7.5.5.29 `mysql_get_server_info`

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- [mysql_get_server_info](#)

Get MySQL server info

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

```
mysqli_get_server_info
PDO::getAttribute(PDO::ATTR_SERVER_VERSION)
```

Description

```
string mysql_get_server_info(
    resource link_identifier
    = NULL);
```

Retrieves the MySQL server version.

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by [mysql_connect](#) is assumed. If no such link is found, it will try to create one as if [mysql_connect](#) had been called with no arguments. If no connection is found or established, an [E_WARNING](#) level error is generated.

Return Values

Returns the MySQL server version on success or [FALSE](#) on failure.

Examples

Example 7.183 `mysql_get_server_info` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
printf("MySQL server version: %s\n", mysql_get_server_info());
?>
```

The above example will output something similar to:

```
MySQL server version: 4.0.1-alpha
```

See Also

[mysql_get_client_info](#)
[mysql_get_host_info](#)
[mysql_get_proto_info](#)
[phpversion](#)

7.5.5.30 `mysql_info`

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- [mysql_info](#)

Get information about the most recent query

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_info](#)

Description

```
string mysql_info(
    resource link_identifier
    = NULL);
```

Returns detailed information about the last query.

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by [mysql_connect](#) is assumed. If no such link is found, it will try to create one as if [mysql_connect](#) had been called with no arguments. If no connection is found or established, an [E_WARNING](#) level error is generated.

Return Values

Returns information about the statement on success, or [FALSE](#) on failure. See the example below for which statements provide information, and what the returned value may look like. Statements that are not listed will return [FALSE](#).

Examples

Example 7.184 Relevant MySQL Statements

Statements that return string values. The numbers are only for illustrating purpose; their values will correspond to the query.

```
INSERT INTO ... SELECT ...
String format: Records: 23 Duplicates: 0 Warnings: 0
INSERT INTO ... VALUES (...),(...),(...)
String format: Records: 37 Duplicates: 0 Warnings: 0
LOAD DATA INFILE ...
String format: Records: 42 Deleted: 0 Skipped: 0 Warnings: 0
ALTER TABLE
String format: Records: 60 Duplicates: 0 Warnings: 0
UPDATE
String format: Rows matched: 65 Changed: 65 Warnings: 0
```

Notes

Note

[mysql_info](#) returns a non-[FALSE](#) value for the `INSERT ... VALUES` statement only if multiple value lists are specified in the statement.

See Also

```
mysql_affected_rows
mysql_insert_id
mysql_stat
```

7.5.5.31 mysql_insert_id

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- [mysql_insert_id](#)

Get the ID generated in the last query

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

```
mysqli_insert_id
PDO::lastInsertId
```

Description

```
int mysql_insert_id(
    resource link_identifier
    = NULL);
```

Retrieves the ID generated for an AUTO_INCREMENT column by the previous query (usually INSERT).

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by [mysql_connect](#) is assumed. If no such link is found, it will try to create one as if [mysql_connect](#) had been called with no arguments. If no connection is found or established, an [E_WARNING](#) level error is generated.

Return Values

The ID generated for an AUTO_INCREMENT column by the previous query on success, 0 if the previous query does not generate an AUTO_INCREMENT value, or [FALSE](#) if no MySQL connection was established.

Examples

Example 7.185 mysql_insert_id example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
mysql_select_db('mydb');
mysql_query("INSERT INTO mytable (product) values ('kossu')");
printf("Last inserted record has id %d\n", mysql_insert_id());
?>
```

Notes

Caution

`mysql_insert_id` will convert the return type of the native MySQL C API function `mysql_insert_id()` to a type of `long` (named `int` in PHP). If your `AUTO_INCREMENT` column has a column type of `BIGINT` (64 bits) the conversion may result in an incorrect value. Instead, use the internal MySQL SQL function `LAST_INSERT_ID()` in an SQL query. For more information about PHP's maximum integer values, please see the [integer](#) documentation.

Note

Because `mysql_insert_id` acts on the last performed query, be sure to call `mysql_insert_id` immediately after the query that generates the value.

Note

The value of the MySQL SQL function `LAST_INSERT_ID()` always contains the most recently generated `AUTO_INCREMENT` value, and is not reset between queries.

See Also

[mysql_query](#)
[mysql_info](#)

7.5.5.32 `mysql_list_dbs`

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- [mysql_list_dbs](#)

List databases available on a MySQL server

Warning

This function was deprecated in PHP 5.4.0, and it and the entire [original MySQL extension](#) was removed in PHP 7.0.0. Instead, use either the actively developed `MySQLi` or `PDO_MySQL` extensions. See also the [MySQL: choosing an API](#) guide and its [related FAQ entry](#) for additional information. Alternatives to this function include:

SQL Query: `SHOW DATABASES`

Description

```
resource mysql_list_dbs(  
    resource link_identifier  
    = =NULL);
```

Returns a result pointer containing the databases available from the current mysql daemon.

Parameters

`link_identifier`

The MySQL connection. If the link identifier is not specified, the last link opened by `mysql_connect` is assumed. If no such link is found, it will try to create one as if `mysql_connect` had been called with no arguments. If no connection is found or established, an `E_WARNING` level error is generated.

Return Values

Returns a result pointer resource on success, or `FALSE` on failure. Use the `mysql_tablename` function to traverse this result pointer, or any function for result tables, such as `mysql_fetch_array`.

Examples

Example 7.186 `mysql_list_dbs` example

```
<?php
// Usage without mysql_list_dbs()
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
$res = mysql_query("SHOW DATABASES");
while ($row = mysql_fetch_assoc($res)) {
    echo $row['Database'] . "\n";
}
// Deprecated as of PHP 5.4.0
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
$db_list = mysql_list_dbs($link);
while ($row = mysql_fetch_object($db_list)) {
    echo $row->Database . "\n";
}
?>
```

The above example will output something similar to:

```
database1
database2
database3
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_listdbs`

See Also

[mysql_db_name](#)
[mysql_select_db](#)

7.5.5.33 `mysql_list_fields`

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- [mysql_list_fields](#)

List MySQL table fields

Warning

This function was deprecated in PHP 5.4.0, and it and the entire [original MySQL extension](#) was removed in PHP 7.0.0. Instead, use either the actively developed [MySQLi](#) or [PDO_MySQL](#) extensions. See also the [MySQL: choosing an API](#) guide and its [related FAQ entry](#) for additional information. Alternatives to this function include:

SQL Query: `SHOW COLUMNS FROM sometable`

Description

```
resource mysql_list_fields(
    string database_name,
```

```
    string table_name,
    resource link_identifier
    = =NULL);
```

Retrieves information about the given table name.

This function is deprecated. It is preferable to use `mysql_query` to issue an SQL `SHOW COLUMNS FROM table [LIKE 'name']` statement instead.

Parameters

<code>database_name</code>	The name of the database that's being queried.
<code>table_name</code>	The name of the table that's being queried.
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been called with no arguments. If no connection is found or established, an <code>E_WARNING</code> level error is generated.

Return Values

A result pointer resource on success, or `FALSE` on failure.

The returned result can be used with `mysql_field_flags`, `mysql_field_len`, `mysql_field_name` and `mysql_field_type`.

Examples

Example 7.187 Alternate to deprecated `mysql_list_fields`

```
<?php
$result = mysql_query( "SHOW COLUMNS FROM sometable");
if (!$result) {
    echo 'Could not run query: ' . mysql_error();
    exit;
}
if (mysql_num_rows($result) > 0) {
    while ($row = mysql_fetch_assoc($result)) {
        print_r($row);
    }
}
?>
```

The above example will output something similar to:

```
Array
(
    [Field] => id
    [Type] => int(7)
    [Null] =>
    [Key] => PRI
    [Default] =>
    [Extra] => auto_increment
)
Array
(
    [Field] => email
    [Type] => varchar(100)
    [Null] =>
    [Key] =>
    [Default] =>
```

```
[Extra] =>
)
```

Notes**Note**

For backward compatibility, the following deprecated alias may be used:
[mysql_listfields](#)

See Also

[mysql_field_flags](#)
[mysql_info](#)

7.5.5.34 mysql_list_processes

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- [mysql_list_processes](#)

List MySQL processes

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_thread_id](#)

Description

```
resource mysql_list_processes(
    resource link_identifier
    = =NULL) ;
```

Retrieves the current MySQL server threads.

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by [mysql_connect](#) is assumed. If no such link is found, it will try to create one as if [mysql_connect](#) had been called with no arguments. If no connection is found or established, an [E_WARNING](#) level error is generated.

Return Values

A result pointer resource on success or [FALSE](#) on failure.

Examples**Example 7.188 mysql_list_processes example**

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
$result = mysql_list_processes($link);
```

```

while ($row = mysql_fetch_assoc($result)){
    printf("%s %s %s %s\n", $row["Id"], $row["Host"], $row["db"],
           $row["Command"], $row["Time"]);
}
mysql_free_result($result);
?>

```

The above example will output something similar to:

```

1 localhost test Processlist 0
4 localhost mysql sleep 5

```

See Also

[mysql_thread_id](#)
[mysql_stat](#)

7.5.5.35 `mysql_list_tables`

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- [mysql_list_tables](#)

List tables in a MySQL database

Warning

This function was deprecated in PHP 4.3.0, and it and the entire [original MySQL extension](#) was removed in PHP 7.0.0. Instead, use either the actively developed [MySQLi](#) or [PDO_MySQL](#) extensions. See also the [MySQL: choosing an API](#) guide and its [related FAQ entry](#) for additional information. Alternatives to this function include:

SQL Query: `SHOW TABLES FROM dbname`

Description

```

resource mysql_list_tables(
    string database,
    resource link_identifier
    = =NULL);

```

Retrieves a list of table names from a MySQL database.

This function is deprecated. It is preferable to use [mysql_query](#) to issue an SQL `SHOW TABLES [FROM db_name] [LIKE 'pattern']` statement instead.

Parameters

<code>database</code>	The name of the database
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by mysql_connect is assumed. If no such link is found, it will try to create one as if mysql_connect had been called with no arguments. If no connection is found or established, an E_WARNING level error is generated.

Return Values

A result pointer resource on success or `FALSE` on failure.

Use the `mysql_tablename` function to traverse this result pointer, or any function for result tables, such as `mysql_fetch_array`.

Changelog

Version	Description
4.3.7	This function became deprecated.

Examples

Example 7.189 `mysql_list_tables` alternative example

```
<?php
$dbname = 'mysql_dbname';
if (!mysql_connect('mysql_host', 'mysql_user', 'mysql_password')) {
    echo 'Could not connect to mysql';
    exit;
}
$sql = "SHOW TABLES FROM $dbname";
$result = mysql_query($sql);
if (!$result) {
    echo "DB Error, could not list tables\n";
    echo 'MySQL Error: ' . mysql_error();
    exit;
}
while ($row = mysql_fetch_row($result)) {
    echo "Table: {$row[0]}\n";
}
mysql_free_result($result);
?>
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_listtables`

See Also

`mysql_list_dbs`
`mysql_tablename`

7.5.5.36 `mysql_num_fields`

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- `mysql_num_fields`

Get number of fields in result

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_num_fields`

PDOStatement::columnCount**Description**

```
int mysql_num_fields(
    resource result);
```

Retrieves the number of fields from a query.

Parameters

result

The result resource that is being evaluated. This result comes from a call to [mysql_query](#).

Return Values

Returns the number of fields in the result set resource on success or [FALSE](#) on failure.

Examples**Example 7.190 A `mysql_num_fields` example**

```
<?php
$result = mysql_query("SELECT id,email FROM people WHERE id = '42'");
if (!$result) {
    echo 'Could not run query: ' . mysql_error();
    exit;
}
/* returns 2 because id,email === two fields */
echo mysql_num_fields($result);
?>
```

Notes**Note**

For backward compatibility, the following deprecated alias may be used:
[mysql_numfields](#)

See Also

[mysql_select_db](#)
[mysql_query](#)
[mysql_fetch_field](#)
[mysql_num_rows](#)

7.5.5.37 `mysql_num_rows`

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- [mysql_num_rows](#)

Get number of rows in result

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API guide](#) and [related FAQ](#) for more information.
 Alternatives to this function include:

`mysqli_num_rows`
`mysqli_stmt_num_rows`
`PDOStatement::rowCount`

Description

```
int mysql_num_rows(
    resource result);
```

Retrieves the number of rows from a result set. This command is only valid for statements like SELECT or SHOW that return an actual result set. To retrieve the number of rows affected by a INSERT, UPDATE, REPLACE or DELETE query, use [mysql_affected_rows](#).

Parameters

`result` The result resource that is being evaluated. This result comes from a call to [mysql_query](#).

Return Values

The number of rows in a result set on success or `FALSE` on failure.

Examples

Example 7.191 `mysql_num_rows` example

```
<?php
$link = mysql_connect("localhost", "mysql_user", "mysql_password");
mysql_select_db("database", $link);
$result = mysql_query("SELECT * FROM table1", $link);
$num_rows = mysql_num_rows($result);
echo "$num_rows Rows\n";
?>
```

Notes

Note

If you use [mysql_unbuffered_query](#), [mysql_num_rows](#) will not return the correct value until all the rows in the result set have been retrieved.

Note

For backward compatibility, the following deprecated alias may be used:
[mysql_numrows](#)

See Also

[mysql_affected_rows](#)
[mysql_connect](#)
[mysql_data_seek](#)
[mysql_select_db](#)
[mysql_query](#)

7.5.5.38 `mysql_pconnect`

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- [mysql_pconnect](#)

Open a persistent connection to a MySQL server

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_connect` with `p`: host prefix
`PDO::__construct` with `PDO::ATTR_PERSISTENT` as a driver option

Description

```
resource mysql_pconnect()
  string server
    = ini_get("mysql.default_host"),
  string username
    = ini_get("mysql.default_user"),
  string password
    = ini_get("mysql.default_password"),
  int client_flags
    = 0;
```

Establishes a persistent connection to a MySQL server.

`mysql_pconnect` acts very much like `mysql_connect` with two major differences.

First, when connecting, the function would first try to find a (persistent) link that's already open with the same host, username and password. If one is found, an identifier for it will be returned instead of opening a new connection.

Second, the connection to the SQL server will not be closed when the execution of the script ends. Instead, the link will remain open for future use (`mysql_close` will not close links established by `mysql_pconnect`).

This type of link is therefore called 'persistent'.

Parameters

<code>server</code>	The MySQL server. It can also include a port number. e.g. "hostname:port" or a path to a local socket e.g. "./path/to/socket" for the localhost. If the PHP directive <code>mysql.default_host</code> is undefined (default), then the default value is 'localhost:3306'
<code>username</code>	The username. Default value is the name of the user that owns the server process.
<code>password</code>	The password. Default value is an empty password.
<code>client_flags</code>	The <code>client_flags</code> parameter can be a combination of the following constants: 128 (enable <code>LOAD DATA LOCAL</code> handling), <code>MYSQL_CLIENT_SSL</code> , <code>MYSQL_CLIENT_COMPRESS</code> , <code>MYSQL_CLIENT_IGNORE_SPACE</code> or <code>MYSQL_CLIENT_INTERACTIVE</code> .

Return Values

Returns a MySQL persistent link identifier on success, or `FALSE` on failure.

Changelog

Version	Description
5.5.0	This function will generate an E_DEPRECATED error.

Notes

Note

Note, that these kind of links only work if you are using a module version of PHP. See the [Persistent Database Connections](#) section for more information.

Warning

Using persistent connections can require a bit of tuning of your Apache and MySQL configurations to ensure that you do not exceed the number of connections allowed by MySQL.

See Also

[mysql_connect](#)
[Persistent Database Connections](#)

7.5.5.39 mysql_ping

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- [mysql_ping](#)

Ping a server connection or reconnect if there is no connection

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_ping](#)

Description

```
bool mysql_ping(
    resource link_identifier
    = =NULL);
```

Checks whether or not the connection to the server is working. If it has gone down, an automatic reconnection is attempted. This function can be used by scripts that remain idle for a long while, to check whether or not the server has closed the connection and reconnect if necessary.

Note

Automatic reconnection is disabled by default in versions of MySQL >= 5.0.3.

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by [mysql_connect](#) is assumed. If no such link is found, it will try to create one as if [mysql_connect](#) had been

called with no arguments. If no connection is found or established, an [E_WARNING](#) level error is generated.

Return Values

Returns [TRUE](#) if the connection to the server MySQL server is working, otherwise [FALSE](#).

Examples

Example 7.192 A [mysql_ping](#) example

```
<?php
set_time_limit(0);
$conn = mysql_connect('localhost', 'mysqluser', 'mypass');
$db   = mysql_select_db('mydb');
/* Assuming this query will take a long time */
$sql  = "SELECT SLEEP(100);";
$result = mysql_query($sql);
if (!$result) {
    echo 'Query #1 failed, exiting.';
    exit;
}
/* Make sure the connection is still alive, if not, try to reconnect */
if (!mysql_ping($conn)) {
    echo 'Lost connection, exiting after query #1';
    exit;
}
mysql_free_result($result);
/* So the connection is still alive, let's run another query */
$result2 = mysql_query($sql2);
?>
```

See Also

[mysql_thread_id](#)
[mysql_list_processes](#)

7.5.5.40 [mysql_query](#)

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- [mysql_query](#)

Send a MySQL query

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_query](#)
[PDO::query](#)

Description

```
mixed mysql_query(
    string query,
    resource link_identifier
    = =NULL);
```

[mysql_query](#) sends a unique query (multiple queries are not supported) to the currently active database on the server that's associated with the specified [link_identifier](#).

Parameters

<code>query</code>	An SQL query The query string should not end with a semicolon. Data inside the query should be properly escaped .
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been called with no arguments. If no connection is found or established, an E_WARNING level error is generated.

Return Values

For SELECT, SHOW, DESCRIBE, EXPLAIN and other statements returning resultset, `mysql_query` returns a resource on success, or `FALSE` on error.

For other type of SQL statements, INSERT, UPDATE, DELETE, DROP, etc, `mysql_query` returns `TRUE` on success or `FALSE` on error.

The returned result resource should be passed to `mysql_fetch_array`, and other functions for dealing with result tables, to access the returned data.

Use `mysql_num_rows` to find out how many rows were returned for a SELECT statement or `mysql_affected_rows` to find out how many rows were affected by a DELETE, INSERT, REPLACE, or UPDATE statement.

`mysql_query` will also fail and return `FALSE` if the user does not have permission to access the table(s) referenced by the query.

Examples

Example 7.193 Invalid Query

The following query is syntactically invalid, so `mysql_query` fails and returns `FALSE`.

```
<?php
$result = mysql_query('SELECT * WHERE 1=1');
if (!$result) {
    die('Invalid query: ' . mysql_error());
}
?>
```

Example 7.194 Valid Query

The following query is valid, so `mysql_query` returns a resource.

```
<?php
// This could be supplied by a user, for example
$firstname = 'fred';
$lastname = 'fox';
// Formulate Query
// This is the best way to perform an SQL query
// For more examples, see mysql_real_escape_string()
$query = sprintf("SELECT firstname, lastname, address, age FROM friends
    WHERE firstname='%s' AND lastname='%s'",
    mysql_real_escape_string($firstname),
    mysql_real_escape_string($lastname));
// Perform Query
```

```
$result = mysql_query($query);
// Check result
// This shows the actual query sent to MySQL, and the error. Useful for debugging.
if (!$result) {
    $message = 'Invalid query: ' . mysql_error() . "\n";
    $message .= 'Whole query: ' . $query;
    die($message);
}
// Use result
// Attempting to print $result won't allow access to information in the resource
// One of the mysql result functions must be used
// See also mysql_result(), mysql_fetch_array(), mysql_fetch_row(), etc.
while ($row = mysql_fetch_assoc($result)) {
    echo $row['firstname'];
    echo $row['lastname'];
    echo $row['address'];
    echo $row['age'];
}
// Free the resources associated with the result set
// This is done automatically at the end of the script
mysql_free_result($result);
?>
```

See Also

[mysql_connect](#)
[mysql_error](#)
[mysql_real_escape_string](#)
[mysql_result](#)
[mysql_fetch_assoc](#)
[mysql_unbuffered_query](#)

7.5.5.41 [mysql_real_escape_string](#)

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- [mysql_real_escape_string](#)

Escapes special characters in a string for use in an SQL statement

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_real_escape_string](#)
[PDO::quote](#)

Description

```
string mysql_real_escape_string(
    string unescaped_string,
    resource link_identifier
    = =NULL);
```

Escapes special characters in the [unescaped_string](#), taking into account the current character set of the connection so that it is safe to place it in a [mysql_query](#). If binary data is to be inserted, this function must be used.

[mysql_real_escape_string](#) calls MySQL's library function `mysql_real_escape_string`, which prepends backslashes to the following characters: `\x00`, `\n`, `\r`, `\``, `'`, `"` and `\x1a`.

This function must always (with few exceptions) be used to make data safe before sending a query to MySQL.

Security: the default character set

The character set must be set either at the server level, or with the API function `mysql_set_charset` for it to affect `mysql_real_escape_string`. See the concepts section on [character sets](#) for more information.

Parameters

<code>unesaped_string</code>	The string that is to be escaped.
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been called with no arguments. If no connection is found or established, an <code>E_WARNING</code> level error is generated.

Return Values

Returns the escaped string, or `FALSE` on error.

Errors/Exceptions

Executing this function without a MySQL connection present will also emit `E_WARNING` level PHP errors. Only execute this function with a valid MySQL connection present.

Examples

Example 7.195 Simple `mysql_real_escape_string` example

```
<?php
// Connect
$link = mysql_connect('mysql_host', 'mysql_user', 'mysql_password')
    OR die(mysql_error());
// Query
$query = sprintf("SELECT * FROM users WHERE user='%s' AND password='%s'",
    mysql_real_escape_string($user),
    mysql_real_escape_string($password));
?>
```

Example 7.196 `mysql_real_escape_string` requires a connection example

This example demonstrates what happens if a MySQL connection is not present when calling this function.

```
<?php
// We have not connected to MySQL
$lastname = "O'Reilly";
$_lastname = mysql_real_escape_string($lastname);
$query = "SELECT * FROM actors WHERE last_name = '$lastname'";
var_dump($_lastname);
var_dump($query);
?>
```

The above example will output something similar to:

```
Warning: mysql_real_escape_string(): No such file or directory in /this/test/script.php on line 5
Warning: mysql_real_escape_string(): A link to the server could not be established in /this/test/script.php
bool(false)
string(41) "SELECT * FROM actors WHERE last_name = ''"
```

Example 7.197 An example SQL Injection Attack

```
<?php
// We didn't check $_POST['password'], it could be anything the user wanted! For example:
$_POST['username'] = 'aidan';
$_POST['password'] = "' OR ''='";
// Query database to check if there are any matching users
$query = "SELECT * FROM users WHERE user='{$\_POST['username']}' AND password='{$\_POST['password']}'";
mysql_query($query);
// This means the query sent to MySQL would be:
echo $query;
?>
```

The query sent to MySQL:

```
SELECT * FROM users WHERE user='aidan' AND password=''' OR ''=''
```

This would allow anyone to log in without a valid password.

Notes

Note

A MySQL connection is required before using `mysql_real_escape_string` otherwise an error of level `E_WARNING` is generated, and `FALSE` is returned. If `link_identifier` isn't defined, the last MySQL connection is used.

Note

If `magic_quotes_gpc` is enabled, first apply `stripslashes` to the data. Using this function on data which has already been escaped will escape the data twice.

Note

If this function is not used to escape data, the query is vulnerable to [SQL Injection Attacks](#).

Note

`mysql_real_escape_string` does not escape `%` and `_`. These are wildcards in MySQL if combined with `LIKE`, `GRANT`, or `REVOKE`.

See Also

[mysql_set_charset](#)
[mysql_client_encoding](#)
[addslashes](#)
[stripslashes](#)
The [magic_quotes_gpc](#) directive
The [magic_quotes_runtime](#) directive

7.5.5.42 `mysql_result`

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- `mysql_result`

Get result data

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

`mysqli_data_seek` in conjunction with `mysqli_field_seek` and
`mysqli_fetch_field`
`PDOStatement::fetchColumn`

Description

```
string mysql_result(
    resource result,
    int row,
    mixed field
    = 0);
```

Retrieves the contents of one cell from a MySQL result set.

When working on large result sets, you should consider using one of the functions that fetch an entire row (specified below). As these functions return the contents of multiple cells in one function call, they're MUCH quicker than `mysql_result`. Also, note that specifying a numeric offset for the `field` argument is much quicker than specifying a `fieldname` or `tablename.fieldname` argument.

Parameters

<code>result</code>	The result resource that is being evaluated. This result comes from a call to <code>mysql_query</code> .
<code>row</code>	The row number from the result that's being retrieved. Row numbers start at 0.
<code>field</code>	The name or offset of the field being retrieved. It can be the field's offset, the field's name, or the field's table dot field name (<code>tablename.fieldname</code>). If the column name has been aliased ('select foo as bar from...'), use the alias instead of the column name. If undefined, the first field is retrieved.

Return Values

The contents of one cell from a MySQL result set on success, or `FALSE` on failure.

Examples

Example 7.198 `mysql_result` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Could not connect: ' . mysql_error());
}
```

```

if (!mysql_select_db('database_name')) {
    die('Could not select database: ' . mysql_error());
}
$result = mysql_query('SELECT name FROM work.employee');
if (!$result) {
    die('Could not query:' . mysql_error());
}
echo mysql_result($result, 2); // outputs third employee's name
mysql_close($link);
?>

```

Notes

Note

Calls to `mysql_result` should not be mixed with calls to other functions that deal with the result set.

See Also

`mysql_fetch_row`
`mysql_fetch_array`
`mysql_fetch_assoc`
`mysql_fetch_object`

7.5.5.43 `mysql_select_db`

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- `mysql_select_db`

Select a MySQL database

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information.
 Alternatives to this function include:

`mysqli_select_db`
`PDO::__construct` (part of dsn)

Description

```

bool mysql_select_db(
    string database_name,
    resource link_identifier
    = =NULL);

```

Sets the current active database on the server that's associated with the specified link identifier. Every subsequent call to `mysql_query` will be made on the active database.

Parameters

<code>database_name</code>	The name of the database that is to be selected.
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been called with no arguments. If no connection is found or established, an <code>E_WARNING</code> level error is generated.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.199 `mysql_select_db` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
if (!$link) {
    die('Not connected : ' . mysql_error());
}
// make foo the current db
$db_selected = mysql_select_db('foo', $link);
if (!$db_selected) {
    die ('Can\'t use foo : ' . mysql_error());
}
?>
```

Notes

Note

For backward compatibility, the following deprecated alias may be used:
`mysql_selectdb`

See Also

[mysql_connect](#)
[mysql_pconnect](#)
[mysql_query](#)

7.5.5.44 `mysql_set_charset`

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- [mysql_set_charset](#)

Sets the client character set

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_set_charset](#)

PDO: Add `charset` to the connection string, such as `charset=utf8`

Description

```
bool mysql_set_charset(
    string charset,
    resource link_identifier
    = NULL);
```

Sets the default character set for the current connection.

Parameters

<code>charset</code>	A valid character set name.
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been called with no arguments. If no connection is found or established, an <code>E_WARNING</code> level error is generated.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Notes

Note

This function requires MySQL 5.0.7 or later.

Note

This is the preferred way to change the charset. Using `mysql_query` to set it (such as `SET NAMES utf8`) is not recommended. See the [MySQL character set concepts](#) section for more information.

See Also

[Setting character sets in MySQL](#)

[List of character sets that MySQL supports](#)

`mysql_client_encoding`

7.5.5.45 `mysql_stat`

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- `mysql_stat`

Get current system status

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the `MySQLi` or `PDO_MySQL` extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

```
mysqli_stat  
PDO::getAttribute(PDO::ATTR_SERVER_INFO)
```

Description

```
string mysql_stat(  
    resource link_identifier  
    = =NULL);
```

`mysql_stat` returns the current server status.

Parameters

<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been
------------------------------	---

called with no arguments. If no connection is found or established, an `E_WARNING` level error is generated.

Return Values

Returns a string with the status for uptime, threads, queries, open tables, flush tables and queries per second. For a complete list of other status variables, you have to use the `SHOW STATUS` SQL command. If `link_identifier` is invalid, `NULL` is returned.

Examples

Example 7.200 `mysql_stat` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
$status = explode(' ', mysql_stat($link));
print_r($status);
?>
```

The above example will output something similar to:

```
Array
(
    [0] => Uptime: 5380
    [1] => Threads: 2
    [2] => Questions: 1321299
    [3] => Slow queries: 0
    [4] => Opens: 26
    [5] => Flush tables: 1
    [6] => Open tables: 17
    [7] => Queries per second avg: 245.595
)
```

Example 7.201 Alternative `mysql_stat` example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
$result = mysql_query('SHOW STATUS', $link);
while ($row = mysql_fetch_assoc($result)) {
    echo $row['Variable_name'] . ' = ' . $row['Value'] . "\n";
}
?>
```

The above example will output something similar to:

```
back_log = 50
basedir = /usr/local/
bdb_cache_size = 8388600
bdb_log_buffer_size = 32768
bdb_home = /var/db/mysql/
bdb_max_lock = 10000
bdb_logdir =
bdb_shared_data = OFF
bdb_tmpdir = /var/tmp/
...
```

See Also

```
mysql_get_server_info
mysql_list_processes
```

7.5.5.46 mysql_tablename

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- [mysql_tablename](#)

Get table name of field

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

SQL Query: `SHOW TABLES`

Description

```
string mysql_tablename(
    resource result,
    int i);
```

Retrieves the table name from a `result`.

This function is deprecated. It is preferable to use `mysql_query` to issue an SQL `SHOW TABLES [FROM db_name] [LIKE 'pattern']` statement instead.

Parameters

`result` A result pointer resource that's returned from `mysql_list_tables`.

`i` The integer index (row/table number)

Return Values

The name of the table on success or `FALSE` on failure.

Use the `mysql_tablename` function to traverse this result pointer, or any function for result tables, such as `mysql_fetch_array`.

Changelog

Version	Description
5.5.0	The <code>mysql_tablename</code> function is deprecated, and emits an <code>E_DEPRECATED</code> level error.

Examples

Example 7.202 `mysql_tablename` example

```
<?php
mysql_connect("localhost", "mysql_user", "mysql_password");
$result = mysql_list_tables("mydb");
$num_rows = mysql_num_rows($result);
for ($i = 0; $i < $num_rows; $i++) {
    echo "Table: ", mysql_tablename($result, $i), "\n";
```

```

    }
mysql_free_result($result);
?>

```

Notes

Note

The `mysql_num_rows` function may be used to determine the number of tables in the result pointer.

See Also

[mysql_list_tables](#)
[mysql_field_table](#)
[mysql_db_name](#)

7.5.5.47 mysql_thread_id

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- [mysql_thread_id](#)

Return the current thread ID

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

[mysqli_thread_id](#)

Description

```

int mysql_thread_id(
    resource link_identifier
    = NULL);

```

Retrieves the current thread ID. If the connection is lost, and a reconnect with `mysql_ping` is executed, the thread ID will change. This means only retrieve the thread ID when needed.

Parameters

link_identifier

The MySQL connection. If the link identifier is not specified, the last link opened by `mysql_connect` is assumed. If no such link is found, it will try to create one as if `mysql_connect` had been called with no arguments. If no connection is found or established, an `E_WARNING` level error is generated.

Return Values

The thread ID on success or `FALSE` on failure.

Examples

Example 7.203 mysql_thread_id example

```
<?php
$link = mysql_connect('localhost', 'mysql_user', 'mysql_password');
$thread_id = mysql_thread_id($link);
if ($thread_id){
    printf("current thread id is %d\n", $thread_id);
}
?>
```

The above example will output something similar to:

```
current thread id is 73
```

See Also

[mysql_ping](#)
[mysql_list_processes](#)

7.5.5.48 `mysql_unbuffered_query`

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- [mysql_unbuffered_query](#)

Send an SQL query to MySQL without fetching and buffering the result rows

Warning

This extension was deprecated in PHP 5.5.0, and it was removed in PHP 7.0.0. Instead, the [MySQLi](#) or [PDO_MySQL](#) extension should be used. See also [MySQL: choosing an API](#) guide and [related FAQ](#) for more information. Alternatives to this function include:

See: [Buffered and Unbuffered queries](#)

Description

```
resource mysql_unbuffered_query(
    string query,
    resource link_identifier
    = =NULL);
```

`mysql_unbuffered_query` sends the SQL query `query` to MySQL without automatically fetching and buffering the result rows as `mysql_query` does. This saves a considerable amount of memory with SQL queries that produce large result sets, and you can start working on the result set immediately after the first row has been retrieved as you don't have to wait until the complete SQL query has been performed. To use `mysql_unbuffered_query` while multiple database connections are open, you must specify the optional parameter `link_identifier` to identify which connection you want to use.

Parameters

<code>query</code>	The SQL query to execute. Data inside the query should be properly escaped .
<code>link_identifier</code>	The MySQL connection. If the link identifier is not specified, the last link opened by <code>mysql_connect</code> is assumed. If no such link is found, it will try to create one as if <code>mysql_connect</code> had been

called with no arguments. If no connection is found or established, an [E_WARNING](#) level error is generated.

Return Values

For SELECT, SHOW, DESCRIBE or EXPLAIN statements, [`mysql_unbuffered_query`](#) returns a resource on success, or [FALSE](#) on error.

For other type of SQL statements, UPDATE, DELETE, DROP, etc, [`mysql_unbuffered_query`](#) returns [TRUE](#) on success or [FALSE](#) on error.

Notes

Note

The benefits of [`mysql_unbuffered_query`](#) come at a cost: you cannot use [`mysql_num_rows`](#) and [`mysql_data_seek`](#) on a result set returned from [`mysql_unbuffered_query`](#), until all rows are fetched. You also have to fetch all result rows from an unbuffered SQL query before you can send a new SQL query to MySQL, using the same [`link_identifier`](#).

See Also

[`mysql_query`](#)

7.6 MySQL Native Driver

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MySQL Native Driver is a replacement for the MySQL Client Library (`libmysqlclient`). MySQL Native Driver is part of the official PHP sources as of PHP 5.3.0.

The MySQL database extensions MySQL extension, [`mysqli`](#) and PDO MYSQL all communicate with the MySQL server. In the past, this was done by the extension using the services provided by the MySQL Client Library. The extensions were compiled against the MySQL Client Library in order to use its client-server protocol.

With MySQL Native Driver there is now an alternative, as the MySQL database extensions can be compiled to use MySQL Native Driver instead of the MySQL Client Library.

MySQL Native Driver is written in C as a PHP extension.

7.6.1 Overview

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What it is not

Although MySQL Native Driver is written as a PHP extension, it is important to note that it does not provide a new API to the PHP programmer. The programmer APIs for MySQL database connectivity are provided by the MySQL extension, [`mysqli`](#) and PDO MYSQL. These extensions can now use the services of MySQL Native Driver to communicate with the MySQL Server. Therefore, you should not think of MySQL Native Driver as an API.

Why use it?

Using the MySQL Native Driver offers a number of advantages over using the MySQL Client Library.

The older MySQL Client Library was written by MySQL AB (now Oracle Corporation) and so was released under the MySQL license. This ultimately led to MySQL support being disabled by default in PHP. However, the MySQL Native Driver has been developed as part of the PHP project, and is

therefore released under the PHP license. This removes licensing issues that have been problematic in the past.

Also, in the past, you needed to build the MySQL database extensions against a copy of the MySQL Client Library. This typically meant you needed to have MySQL installed on a machine where you were building the PHP source code. Also, when your PHP application was running, the MySQL database extensions would call down to the MySQL Client library file at run time, so the file needed to be installed on your system. With MySQL Native Driver that is no longer the case as it is included as part of the standard distribution. So you do not need MySQL installed in order to build PHP or run PHP database applications.

Because MySQL Native Driver is written as a PHP extension, it is tightly coupled to the workings of PHP. This leads to gains in efficiency, especially when it comes to memory usage, as the driver uses the PHP memory management system. It also supports the PHP memory limit. Using MySQL Native Driver leads to comparable or better performance than using MySQL Client Library, it always ensures the most efficient use of memory. One example of the memory efficiency is the fact that when using the MySQL Client Library, each row is stored in memory twice, whereas with the MySQL Native Driver each row is only stored once in memory.

Reporting memory usage

Because MySQL Native Driver uses the PHP memory management system, its memory usage can be tracked with [memory_get_usage](#). This is not possible with libmysqlclient because it uses the C function malloc() instead.

Special features

MySQL Native Driver also provides some special features not available when the MySQL database extensions use MySQL Client Library. These special features are listed below:

- Improved persistent connections
- The special function [mysqli_fetch_all](#)
- Performance statistics calls: [mysqli_get_cache_stats](#), [mysqli_get_client_stats](#), [mysqli_get_connection_stats](#)

The performance statistics facility can prove to be very useful in identifying performance bottlenecks.

MySQL Native Driver also allows for persistent connections when used with the [mysqli](#) extension.

SSL Support

MySQL Native Driver has supported SSL since PHP version 5.3.3

Compressed Protocol Support

As of PHP 5.3.2 MySQL Native Driver supports the compressed client server protocol. MySQL Native Driver did not support this in 5.3.0 and 5.3.1. Extensions such as [ext/mysql](#), [ext/mysqli](#), that are configured to use MySQL Native Driver, can also take advantage of this feature. Note that [PDO_MYSQL](#) does *NOT* support compression when used together with mysqlnd.

Named Pipes Support

Named pipes support for Windows was added in PHP version 5.4.0.

7.6.2 Installation

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Changelog

Table 7.27 Changelog

Version	Description
5.3.0	The MySQL Native Driver was added, with support for all MySQL extensions (i.e., mysql, mysqli and PDO_MYSQL). Passing in <code>mysqlnd</code> to the appropriate configure switch enables this support.
5.4.0	The MySQL Native Driver is now the default for all MySQL extensions (i.e., mysql, mysqli and PDO_MYSQL). Passing in <code>mysqlnd</code> to configure is now optional.
5.5.0	SHA-256 Authentication Plugin support was added

Installation on Unix

The MySQL database extensions must be configured to use the MySQL Client Library. In order to use the MySQL Native Driver, PHP needs to be built specifying that the MySQL database extensions are compiled with MySQL Native Driver support. This is done through configuration options prior to building the PHP source code.

For example, to build the MySQL extension, `mysqli` and PDO MYSQL using the MySQL Native Driver, the following command would be given:

```
./configure --with-mysql=mysqlnd \
--with-mysqli=mysqlnd \
--with-pdo-mysql=mysqlnd \
[other options]
```

Installation on Windows

In the official PHP Windows distributions from 5.3 onwards, MySQL Native Driver is enabled by default, so no additional configuration is required to use it. All MySQL database extensions will use MySQL Native Driver in this case.

SHA-256 Authentication Plugin support

The MySQL Native Driver requires the OpenSSL functionality of PHP to be loaded and enabled to connect to MySQL through accounts that use the MySQL SHA-256 Authentication Plugin. For example, PHP could be configured using:

```
./configure --with-mysql=mysqlnd \
--with-mysqli=mysqlnd \
--with-pdo-mysql=mysqlnd \
--with-openssl \
[other options]
```

7.6.3 Runtime Configuration

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The behaviour of these functions is affected by settings in `php.ini`.

Table 7.28 MySQL Native Driver Configuration Options

Name	Default	Changeable	Changelog
mysqlnd.collect_statistics	"1"	PHP_INI_SYSTEM	Available since PHP 5.3.0.

Name	Default	Changeable	Changelog
<code>mysqlnd.collect_memory_statistics</code>	"0"	PHP_INI_SYSTEM	Available since PHP 5.3.0.
<code>mysqlnd.debug</code>	""	PHP_INI_SYSTEM	Available since PHP 5.3.0.
<code>mysqlnd.log_mask</code>	0	PHP_INI_ALL	Available since PHP 5.3.0
<code>mysqlnd.mempool_default</code>	16000	PHP_INI_ALL	Available since PHP 5.3.3
<code>mysqlnd.net_read_timeout</code>	"86400"	PHP_INI_ALL	Available since PHP 5.3.0. Before PHP 7.2.0 the default value was "31536000" and the changeability was PHP_INI_SYSTEM
<code>mysqlnd.net_cmd_buffer_size</code>	5120 - "2048", 5.3.1 - "4096"	PHP_INI_SYSTEM	Available since PHP 5.3.0.
<code>mysqlnd.net_read_buffer_size</code>	"32768"	PHP_INI_SYSTEM	Available since PHP 5.3.0.
<code>mysqlnd.sha256_server_public_key</code>	""	PHP_INI_PERDIR	Available since PHP 5.5.0.
<code>mysqlnd.trace_alloc</code>	""	PHP_INI_SYSTEM	Available since PHP 5.5.0.
<code>mysqlnd.fetch_data_copy</code>	0	PHP_INI_ALL	Available since PHP 5.6.0.

For further details and definitions of the PHP_INI_* modes, see the <http://www.php.net/manual/en/configuration.changes.modes>.

Here's a short explanation of the configuration directives.

<code>mysqlnd.collect_statistics</code>	boolean	Enables the collection of various client statistics which can be accessed through <code>mysqli_get_client_stats</code> , <code>mysqli_get_connection_stats</code> , <code>mysqli_get_cache_stats</code> and are shown in <code>mysqlnd</code> section of the output of the <code>phpinfo</code> function as well.
<code>mysqlnd.collect_memory_statistics</code>	boolean	This configuration setting enables all MySQL Native Driver statistics except those relating to memory management.
<code>mysqlnd.debug</code>	string	Enable the collection of various memory statistics which can be accessed through <code>mysqli_get_client_stats</code> , <code>mysqli_get_connection_stats</code> , <code>mysqli_get_cache_stats</code> and are shown in <code>mysqlnd</code> section of the output of the <code>phpinfo</code> function as well.
		This configuration setting enables the memory management statistics within the overall set of MySQL Native Driver statistics.
		Records communication from all extensions using <code>mysqlnd</code> to the specified log file.
		The format of the directive is <code>mysqlnd.debug = "option1[,parameter_option1][:option2[,parameter_option2]]"</code> .

The options for the format string are as follows:

- A[,file] - Appends trace output to specified file. Also ensures that data is written after each write. This is done by closing and reopening the trace file (this is slow). It helps ensure a complete log file should the application crash.
- a[,file] - Appends trace output to the specified file.
- d - Enables output from DBUG_<N> macros for the current state. May be followed by a list of keywords which selects output only for the DBUG macros with that keyword. An empty list of keywords implies output for all macros.
- f[,functions] - Limits debugger actions to the specified list of functions. An empty list of functions implies that all functions are selected.
- F - Marks each debugger output line with the name of the source file containing the macro causing the output.
- i - Marks each debugger output line with the PID of the current process.
- L - Marks each debugger output line with the name of the source file line number of the macro causing the output.
- n - Marks each debugger output line with the current function nesting depth
- o[,file] - Similar to a[,file] but overwrites old file, and does not append.
- O[,file] - Similar to A[,file] but overwrites old file, and does not append.
- t[N] - Enables function control flow tracing. The maximum nesting depth is specified by N, and defaults to 200.
- x - This option activates profiling.
- m - Trace memory allocation and deallocation related calls.

Example:

```
d:t:x:o,/tmp/mysqlnd.trace
```

Note

This feature is only available with a debug build of PHP. Works on Microsoft Windows if using a debug build of PHP and PHP was built using Microsoft Visual C version 9 and above.

`mysqlnd.log_mask` integer

Defines which queries will be logged. The default 0, which disables logging. Define using an integer, and not with PHP constants. For example, a value of 48 (16 + 32) will log slow queries which either use 'no good index' (SERVER_QUERY_NO_GOOD_INDEX_USED

= 16) or no index at all (SERVER_QUERY_NO_INDEX_USED = 32). A value of 2043 (1 + 2 + 8 + ... + 1024) will log all slow query types.

The types are as follows: SERVER_STATUS_IN_TRANS=1, SERVER_STATUS_AUTOCOMMIT=2, SERVER_MORE_RESULTS_EXISTS=8, SERVER_QUERY_NO_GOOD_INDEX_USED=16, SERVER_QUERY_NO_INDEX_USED=32, SERVER_STATUS_CURSOR_EXISTS=64, SERVER_STATUS_LAST_ROW_SENT=128, SERVER_STATUS_DB_DROPPED=256, SERVER_STATUS_NO_BACKSLASH_ESCAPES=512, and SERVER_QUERY_WAS_SLOW=1024.

`mysqlnd.mempool_default_size` Default size of the mysqlnd memory pool, which is used by result sets.
integer

`mysqlnd.net_read_timeout` mysqlnd and the MySQL Client Library, `libmysqlclient` use different networking APIs. `mysqlnd` uses PHP streams, whereas `libmysqlclient` uses its own wrapper around the operating level network calls. PHP, by default, sets a read timeout of 60s for streams. This is set via `php.ini`, `default_socket_timeout`. This default applies to all streams that set no other timeout value. `mysqlnd` does not set any other value and therefore connections of long running queries can be disconnected after `default_socket_timeout` seconds resulting in an error message "2006 - MySQL Server has gone away". The MySQL Client Library sets a default timeout of 24 * 3600 seconds (1 day) and waits for other timeouts to occur, such as TCP/IP timeouts. `mysqlnd` now uses the same very long timeout. The value is configurable through a new `php.ini` setting: `mysqlnd.net_read_timeout`. `mysqlnd.net_read_timeout` gets used by any extension (`ext/mysql`, `ext/mysqli`, `PDO_MySQL`) that uses `mysqlnd`. `mysqlnd` tells PHP Streams to use `mysqlnd.net_read_timeout`. Please note that there may be subtle differences between `MYSQL_OPT_READ_TIMEOUT` from the MySQL Client Library and PHP Streams, for example `MYSQL_OPT_READ_TIMEOUT` is documented to work only for TCP/IP connections and, prior to MySQL 5.1.2, only for Windows. PHP streams may not have this limitation. Please check the streams documentation, if in doubt.

`mysqlnd.net_cmd_buffer_size` mysqlnd allocates an internal command/network buffer of `mysqlnd.net_cmd_buffer_size` (in `php.ini`) bytes for every connection. If a MySQL Client Server protocol command, for example, `COM_QUERY` ("normal" query), does not fit into the buffer, `mysqlnd` will grow the buffer to the size required for sending the command. Whenever the buffer gets extended for one connection, `command_buffer_too_small` will be incremented by one.

If `mysqlnd` has to grow the buffer beyond its initial size of `mysqlnd.net_cmd_buffer_size` bytes for almost every

connection, you should consider increasing the default size to avoid re-allocations.

The default buffer size is 2048 bytes in PHP 5.3.0. In later versions the default is 4096 bytes.

It is recommended that the buffer size be set to no less than 4096 bytes because `mysqlnd` also uses it when reading certain communication packet from MySQL. In PHP 5.3.0, `mysqlnd` will not grow the buffer if MySQL sends a packet that is larger than the current size of the buffer. As a consequence, `mysqlnd` is unable to decode the packet and the client application will get an error. There are only two situations when the packet can be larger than the 2048 bytes default of `mysqlnd.net_cmd_buffer_size` in PHP 5.3.0: the packet transports a very long error message, or the packet holds column meta data from `COM_LIST_FIELD` (`mysql_list_fields()`) and the meta data come from a string column with a very long default value (>1900 bytes).

As of PHP 5.3.2 `mysqlnd` does not allow setting buffers smaller than 4096 bytes.

The value can also be set using `mysqli_options(link, MYSQLI_OPT_NET_CMD_BUFFER_SIZE, size)`.

`mysqlnd.net_read_buffer_size` Maximum read chunk size in bytes when reading the body of a MySQL command packet. The MySQL client server protocol encapsulates all its commands in packets. The packets consist of a small header and a body with the actual payload. The size of the body is encoded in the header. `mysqlnd` reads the body in chunks of `MIN(header.size, mysqlnd.net_read_buffer_size)` bytes. If a packet body is larger than `mysqlnd.net_read_buffer_size` bytes, `mysqlnd` has to call `read()` multiple times.

The value can also be set using `mysqli_options(link, MYSQLI_OPT_NET_READ_BUFFER_SIZE, size)`.

`mysqlnd.sha256_server_pubkey` SHA-256 Authentication Plugin related. File with the MySQL server public RSA key.

Clients can either omit setting a public RSA key, specify the key through this PHP configuration setting or set the key at runtime using `mysqli_options`. If not public RSA key file is given by the client, then the key will be exchanged as part of the standard SHA-256 Authentication Plugin authentication procedure.

`mysqlnd.trace_alloc` string

`mysqlnd.fetch_data_copy` integer

Enforce copying result sets from the internal result set buffers into PHP variables instead of using the default reference and copy-on-write logic. Please, see the [memory management implementation notes](#) for further details.

Copying result sets instead of having PHP variables reference them allows releasing the memory occupied for the PHP variables earlier. Depending on the user API code, the actual database queries and

the size of their result sets this may reduce the memory footprint of mysqlnd.

Do not set if using PDO_MySQL. PDO_MySQL has not yet been updated to support the new fetch mode.

7.6.4 Incompatibilities

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MySQL Native Driver is in most cases compatible with MySQL Client Library ([libmysql](#)). This section documents incompatibilities between these libraries.

- Values of `bit` data type are returned as binary strings (e.g. "\0" or "\x1F") with `libmysql` and as decimal strings (e.g. "0" or "31") with `mysqlnd`. If you want the code to be compatible with both libraries then always return bit fields as numbers from MySQL with a query like this: `SELECT bit + 0 FROM table`.

7.6.5 Persistent Connections

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Using Persistent Connections

If `mysqli` is used with `mysqlnd`, when a persistent connection is created it generates a `COM_CHANGE_USER` (`mysql_change_user()`) call on the server. This ensures that re-authentication of the connection takes place.

As there is some overhead associated with the `COM_CHANGE_USER` call, it is possible to switch this off at compile time. Reusing a persistent connection will then generate a `COM_PING` (`mysql_ping`) call to simply test the connection is reusable.

Generation of `COM_CHANGE_USER` can be switched off with the compile flag `MYSQLI_NO_CHANGE_USER_ON_PCONNECT`. For example:

```
shell# CFLAGS="-DMYSQLI_NO_CHANGE_USER_ON_PCONNECT" ./configure --with-mysql=/usr/local/mysql/ --with-mysq
```

Or alternatively:

```
shell# export CFLAGS="-DMYSQLI_NO_CHANGE_USER_ON_PCONNECT"
shell# configure --whatever-option
shell# make clean
shell# make
```

Note that only `mysqli` on `mysqlnd` uses `COM_CHANGE_USER`. Other extension-driver combinations use `COM_PING` on initial use of a persistent connection.

7.6.6 Statistics

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Using Statistical Data

MySQL Native Driver contains support for gathering statistics on the communication between the client and the server. The statistics gathered are of two main types:

- Client statistics

- Connection statistics

If you are using the `mysqli` extension, these statistics can be obtained through two API calls:

- `mysqli_get_client_stats`
- `mysqli_get_connection_stats`

Note

Statistics are aggregated among all extensions that use MySQL Native Driver. For example, when compiling both `ext/mysql` and `ext/mysqli` against MySQL Native Driver, both function calls of `ext/mysql` and `ext/mysqli` will change the statistics. There is no way to find out how much a certain API call of any extension that has been compiled against MySQL Native Driver has impacted a certain statistic. You can configure the PDO MySQL Driver, `ext/mysql` and `ext/mysqli` to optionally use the MySQL Native Driver. When doing so, all three extensions will change the statistics.

Accessing Client Statistics

To access client statistics, you need to call `mysqli_get_client_stats`. The function call does not require any parameters.

The function returns an associative array that contains the name of the statistic as the key and the statistical data as the value.

Client statistics can also be accessed by calling the `phpinfo` function.

Accessing Connection Statistics

To access connection statistics call `mysqli_get_connection_stats`. This takes the database connection handle as the parameter.

The function returns an associative array that contains the name of the statistic as the key and the statistical data as the value.

Buffered and Unbuffered Result Sets

Result sets can be buffered or unbuffered. Using default settings, `ext/mysql` and `ext/mysqli` work with buffered result sets for normal (non prepared statement) queries. Buffered result sets are cached on the client. After the query execution all results are fetched from the MySQL Server and stored in a cache on the client. The big advantage of buffered result sets is that they allow the server to free all resources allocated to a result set, once the results have been fetched by the client.

Unbuffered result sets on the other hand are kept much longer on the server. If you want to reduce memory consumption on the client, but increase load on the server, use unbuffered results. If you experience a high server load and the figures for unbuffered result sets are high, you should consider moving the load to the clients. Clients typically scale better than servers. “Load” does not only refer to memory buffers - the server also needs to keep other resources open, for example file handles and threads, before a result set can be freed.

Prepared Statements use unbuffered result sets by default. However, you can use `mysqli_stmt_store_result` to enable buffered result sets.

Statistics returned by MySQL Native Driver

The following tables show a list of statistics returned by the `mysqli_get_client_stats` and `mysqli_get_connection_stats` functions.

Table 7.29 Returned mysqlnd statistics: Network

Statistic	Scope	Description	Notes
<code>bytes_sent</code>	Connection	Number of bytes sent from PHP to the MySQL server	Can be used to check the efficiency of the compression protocol
<code>bytes_received</code>	Connection	Number of bytes received from MySQL server	Can be used to check the efficiency of the compression protocol
<code>packets_sent</code>	Connection	Number of MySQL Client Server protocol packets sent	Used for debugging Client Server protocol implementation
<code>packets_received</code>	Connection	Number of MySQL Client Server protocol packets received	Used for debugging Client Server protocol implementation
<code>protocol_overhead_in</code>	Connection	MySQL Client Server protocol overhead in bytes for incoming traffic. Currently only the Packet Header (4 bytes) is considered as overhead. $\text{protocol_overhead_in} = \text{packets_received} * 4$	Used for debugging Client Server protocol implementation
<code>protocol_overhead_out</code>	Connection	MySQL Client Server protocol overhead in bytes for outgoing traffic. Currently only the Packet Header (4 bytes) is considered as overhead. $\text{protocol_overhead_out} = \text{packets_sent} * 4$	Used for debugging Client Server protocol implementation
<code>bytes_received_size</code>	Connection	Total size in bytes of MySQL Client Server protocol OK packets received. OK packets can contain a status message. The length of the status message can vary and thus the size of an OK packet is not fixed.	Used for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>packets_received_size</code>	Connection	Number of MySQL Client Server protocol OK packets received.	Used for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>bytes_received_eof</code>	Connection	Total size in bytes of MySQL Client Server protocol EOF packets received. EOF can vary in size depending on the server version. Also, EOF can transport an error message.	Used for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>packets_received_eof</code>	Connection	Number of MySQL Client Server protocol EOF packets. Like with other packet statistics the number of packets will be increased even if PHP does not receive the expected packet but, for example, an error message.	Used for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>bytes_received_header</code>	Connection	Total size in bytes of MySQL Client Server protocol result set header packets. The size of the packets varies depending on the payload (<code>LOAD LOCAL INFILE</code> , <code>INSERT</code> , <code>UPDATE</code> , <code>SELECT</code> , error message).	Used for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>packets_received_header</code>	Connection	Number of MySQL Client Server protocol result set header packets.	Used for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).

Statistic	Scope	Description	Notes
			header packet (4 bytes, see protocol overhead).
<code>bytes_received_rset_meta_packet</code>	Connection	Total size in bytes of MySQL Client Server protocol result set meta data (field information) packets. Of course the size varies with the fields in the result set. The packet may also transport an error or an EOF packet in case of COM_LIST_FIELDS.	Only useful for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>packets_received_rset_meta_packet</code>	Connection	Number of MySQL Client Server protocol result set meta data (field information) packets.	Only useful for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>bytes_received_rset_row_packet</code>	Connection	Total size in bytes of MySQL Client Server protocol result set row data packets. The packet may also transport an error or an EOF packet. You can reverse engineer the number of error and EOF packets by subtracting <code>rows_fetched_from_server_normal</code> and <code>rows_fetched_from_server_ps</code> from <code>bytes_received_rset_row_packet</code> .	Only useful for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>packets_received_rset_row_packet</code>	Connection	Number of MySQL Client Server protocol result set row data packets and their total size in bytes.	Only useful for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>bytes_received_prepare_response_packet</code>	Connection	Total size in bytes of MySQL Client Server protocol OK for Prepared Statement Initialization packets (prepared statement init packets). The packet may also transport an error. The packet size depends on the MySQL version: 9 bytes with MySQL 4.1 and 12 bytes from MySQL 5.0 on. There is no safe way to know how many errors happened. You may be able to guess that an error has occurred if, for example, you always connect to MySQL 5.0 or newer and, <code>bytes_received_prepare_response_packet != packets_received_prepare_response * 12.</code> See also <code>ps_prepared_never_executed</code> , <code>ps_prepared_once_executed</code> .	Only useful for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>packets_received_prepare_response_packet</code>	Connection	Number of MySQL Client Server protocol OK for Prepared Statement Initialization packets (prepared statement init packets).	Only useful for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).

Statistic	Scope	Description	Notes
<code>bytes_recd</code>	Connection	Total size in bytes of MySQL Client Server protocol COM_CHANGE_USER packets. The packet may also transport an error or EOF.	Only useful for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>packets_recvd</code>	Connection	Number of MySQL Client Server protocol COM_CHANGE_USER packets	Only useful for debugging CS protocol implementation. Note that the total size in bytes includes the size of the header packet (4 bytes, see protocol overhead).
<code>packets_sent</code>	Connection	Number of MySQL Client Server protocol commands sent from PHP to MySQL. There is no way to know which specific commands and how many of them have been sent. At its best you can use it to check if PHP has sent any commands to MySQL to know if you can consider to disable MySQL support in your PHP binary. There is also no way to reverse engineer the number of errors that may have occurred while sending data to MySQL. The only error that is recorded is command_buffer_too_small (see below).	Only useful for debugging CS protocol implementation.
<code>bytes_recd</code>	Connection	Number of bytes of payload fetched by the PHP client from <code>mysqlnd</code> using the text protocol.	<p>This is the size of the actual data contained in result sets that do not originate from prepared statements and which have been fetched by the PHP client. Note that although a full result set may have been pulled from MySQL by <code>mysqlnd</code>, this statistic only counts actual data pulled from <code>mysqlnd</code> by the PHP client. An example of a code sequence that will increase the value is as follows:</p> <pre>\$mysqli = new mysqli(); \$res = \$mysqli->query("SELECT 'abc'"); \$res->fetch_assoc(); \$res->close();</pre> <p>Every fetch operation will increase the value.</p> <p>The statistic will not be increased if the result set is only buffered on the client, but not fetched, such as in the following example:</p> <pre>\$mysqli = new mysqli(); \$res = \$mysqli->query("SELECT 'abc'"); \$res->close();</pre>

Statistic	Scope	Description	Notes
			This statistic is available as of PHP version 5.3.4.
<code>bytes_received_real_data_normal</code>	Connection	Number of bytes of the payload fetched by the PHP client from <code>mysqlnd</code> using the prepared statement protocol.	This is the size of the actual data contained in result sets that originate from prepared statements and which has been fetched by the PHP client. The value will not be increased if the result set is not subsequently read by the PHP client. Note that although a full result set may have been pulled from MySQL by <code>mysqlnd</code> , this statistic only counts actual data pulled from <code>mysqlnd</code> by the PHP client. See also <code>bytes_received_real_data_normal</code> . This statistic is available as of PHP version 5.3.4.

*Result Set***Table 7.30 Returned mysqlnd statistics: Result Set**

Statistic	Scope	Description	Notes
<code>result_set_queries</code>	Connection	Number of queries that have generated a result set. Examples of queries that generate a result set: <code>SELECT</code> , <code>SHOW</code> . The statistic will not be incremented if there is an error reading the result set header packet from the line.	You may use it as an indirect measure for the number of queries PHP has sent to MySQL, for example, to identify a client that causes a high database load.
<code>non_result_queries</code>	Connection	Number of queries that did not generate a result set. Examples of queries that do not generate a result set: <code>INSERT</code> , <code>UPDATE</code> , <code>LOAD DATA</code> . The statistic will not be incremented if there is an error reading the result set header packet from the line.	You may use it as an indirect measure for the number of queries PHP has sent to MySQL, for example, to identify a client that causes a high database load.
<code>no_index_queries</code>	Connection	Number of queries that have generated a result set but did not use an index (see also mysqld start option <code>-log-queries-not-using-indexes</code>). If you want these queries to be reported you can use <code>mysqli_report(MYSQLI_REPORT_INDEX)</code> to make ext/mysql throw an exception. If you prefer a warning instead of an exception use <code>mysqli_report(MYSQLI_REPORT_INDEX ^ MYSQLI_REPORT_STRICT)</code> .	
<code>bad_index_queries</code>	Connection	Number of queries that have generated a result set and did not use a good index (see also mysqld start option <code>-log-slow-queries</code>).	If you want these queries to be reported you can use <code>mysqli_report(MYSQLI_REPORT_INDEX)</code> to make ext/mysql throw an exception. If you prefer a warning instead of an exception use <code>mysqli_report(MYSQLI_REPORT_INDEX ^ MYSQLI_REPORT_STRICT)</code>

Statistic	Scope	Description	Notes
<code>slow_queries</code>	Connection	SQL statements that took more than <code>long_query_time</code> seconds to execute and required at least <code>min_examined_row_limit</code> rows to be examined.	Not reported through <code>mysqli_report</code>
<code>buffered_queries</code>	Connection	Number of buffered result sets returned by “normal” queries. “Normal” means “not prepared statement” in the following notes.	Examples of API calls that will buffer result sets on the client: <code>mysql_query</code> , <code>mysqli_query</code> , <code>mysqli_store_result</code> , <code>mysqli_stmt_get_result</code> . Buffering result sets on the client ensures that server resources are freed as soon as possible and it makes result set scrolling easier. The downside is the additional memory consumption on the client for buffering data. Note that mysqlnd (unlike the MySQL Client Library) respects the PHP memory limit because it uses PHP internal memory management functions to allocate memory. This is also the reason why <code>memory_get_usage</code> reports a higher memory consumption when using mysqlnd instead of the MySQL Client Library. <code>memory_get_usage</code> does not measure the memory consumption of the MySQL Client Library at all because the MySQL Client Library does not use PHP internal memory management functions monitored by the function!
<code>unbuffered_queries</code>	Connection	Number of unbuffered result sets returned by normal (non prepared statement) queries.	Examples of API calls that will not buffer result sets on the client: <code>mysqli_use_result</code>
<code>ps_buffered_queries</code>	Connection	Number of buffered result sets returned by prepared statements. By default prepared statements are unbuffered.	Examples of API calls that will buffer result sets on the client: <code>mysqli_stmt_store_result</code>
<code>ps_unbuffered_queries</code>	Connection	Number of unbuffered result sets returned by prepared statements.	By default prepared statements are unbuffered.
<code>flushed_queries</code>	Connection	Number of result sets from normal (non prepared statement) queries with unread data which have been flushed silently for you. Flushing happens only with unbuffered result sets.	<p>Unbuffered result sets must be fetched completely before a new query can be run on the connection otherwise MySQL will throw an error. If the application does not fetch all rows from an unbuffered result set, mysqlnd does implicitly fetch the result set to clear the line. See also <code>rows_skipped_normal</code>, <code>rows_skipped_ps</code>. Some possible causes for an implicit flush:</p> <ul style="list-style-type: none"> • Faulty client application • Client stopped reading after it found what it was looking for but has made

Statistic	Scope	Description	Notes
			<p>MySQL calculate more records than needed</p> <ul style="list-style-type: none"> • Client application has stopped unexpectedly
<code>flushed_Connection</code>	Connection	Number of result sets from prepared statements with unread data which have been flushed silently for you. Flushing happens only with unbuffered result sets.	<p>Unbuffered result sets must be fetched completely before a new query can be run on the connection otherwise MySQL will throw an error. If the application does not fetch all rows from an unbuffered result set, mysqlnd does implicitly fetch the result set to clear the line. See also <code>rows_skipped_normal</code>, <code>rows_skipped_ps</code>. Some possible causes for an implicit flush:</p> <ul style="list-style-type: none"> • Faulty client application • Client stopped reading after it found what it was looking for but has made MySQL calculate more records than needed • Client application has stopped unexpectedly
<code>ps_prepared_Connection</code>	Connection	Number of statements prepared but never executed.	Prepared statements occupy server resources. You should not prepare a statement if you do not plan to execute it.
<code>ps_executed_Connection</code>	Connection	Number of prepared statements executed only one.	One of the ideas behind prepared statements is that the same query gets executed over and over again (with different parameters) and some parsing and other preparation work can be saved, if statement execution is split up in separate prepare and execute stages. The idea is to prepare once and “cache” results, for example, the parse tree to be reused during multiple statement executions. If you execute a prepared statement only once the two stage processing can be inefficient compared to “normal” queries because all the caching means extra work and it takes (limited) server resources to hold the cached information. Consequently, prepared statements that are executed only once may cause performance hurts.
<code>rows_fetched_Connection</code> <code>rows_fetched_free_Connection</code>	Connection	Total number of result set rows successfully fetched from MySQL regardless if the client application has consumed them or not. Some of the rows may not have been fetched by the	See also <code>packets_received_rset_row</code>

Statistic	Scope	Description	Notes
		client application but have been flushed implicitly.	
<code>rows_buffered</code>	Connection	Total number of successfully buffered rows originating from a "normal" query or a prepared statement . This is the number of rows that have been fetched from MySQL and buffered on client. Note that there are two distinct statistics on rows that have been buffered (MySQL to mysqlnd internal buffer) and buffered rows that have been fetched by the client application (mysqlnd internal buffer to client application). If the number of buffered rows is higher than the number of fetched buffered rows it can mean that the client application runs queries that cause larger result sets than needed resulting in rows not read by the client.	Examples of queries that will buffer results: mysqli_query , mysqli_store_result
<code>rows_fetched</code>	Connection	Total number of rows fetched by the client from a buffered resultset created by a normal query or a prepared statement .	
<code>rows_fetched_from_ps</code>	Connection	Total number of rows fetched by the client from a unbuffered resultset created by a "normal" query or a prepared statement .	
<code>rows_fetched_ps</code>	Connection	Total number of rows fetch by the client from a cursor created by a prepared statement .	
<code>rows_skipped_ps</code>	Connection	Reserved for future use (currently not supported)	
<code>copy_on_write_ps</code>	Process state	With mysqlnd, variables returned by the extensions point into mysqlnd internal network result buffers. If you do not change the variables, fetched data will be kept only once in memory. If you change the variables, mysqlnd has to perform a copy-on-write to protect the internal network result buffers from being changed. With the MySQL Client Library you always hold fetched data twice in memory. Once in the internal MySQL Client Library buffers and once in the variables returned by the extensions. In theory mysqlnd can save up to 40% memory. However, note that the memory saving cannot be measured using memory_get_usage .	
<code>explicit_result_sets</code> <code>implicit_result_sets</code> (only during prepared)	Process result	Total number of freed result sets .	The free is always considered explicit but for result sets created by an init command, for example, mysqli_options(MYSQLI_INIT_COMMAND , ...)

Statistic	Scope	Description	Notes	
	statement cleanup)	proto_text_fetched_type	<p>Connection Total number of columns of a certain type fetched from a normal query (MySQL text protocol).</p> <p>proto_text_fetched_short, proto_text_fetched_int24, proto_text_fetched_int proto_text_fetched_bigint, proto_text_fetched_decimal, proto_text_fetched_float proto_text_fetched_double, proto_text_fetched_date, proto_text_fetched_year proto_text_fetched_time, proto_text_fetched_datetime, proto_text_fetched_timestamp proto_text_fetched_string, proto_text_fetched_blob, proto_text_fetched_enum proto_text_fetched_set, proto_text_fetched_geometry, proto_text_fetched_other</p>	<p>Mapping from C API / MySQL meta data type to statistics name:</p> <ul style="list-style-type: none"> • <code>MYSQL_TYPE_NULL</code> - <code>proto_text_fetched_null</code> • <code>MYSQL_TYPE_BIT</code> - <code>proto_text_fetched_bit</code> • <code>MYSQL_TYPE_TINY</code> - <code>proto_text_fetched_tinyint</code> • <code>MYSQL_TYPE_SHORT</code> - <code>proto_text_fetched_short</code> • <code>MYSQL_TYPE_INT24</code> - <code>proto_text_fetched_int24</code> • <code>MYSQL_TYPE_LONG</code> - <code>proto_text_fetched_int</code> • <code>MYSQL_TYPE_LONGLONG</code> - <code>proto_text_fetched_bigint</code> • <code>MYSQL_TYPE_DECIMAL</code>, <code>MYSQL_TYPE_NEWDECIMAL</code> - <code>proto_text_fetched_decimal</code> • <code>MYSQL_TYPE_FLOAT</code> - <code>proto_text_fetched_float</code> • <code>MYSQL_TYPE_DOUBLE</code> - <code>proto_text_fetched_double</code> • <code>MYSQL_TYPE_DATE</code>, <code>MYSQL_TYPE_NEWDATE</code> - <code>proto_text_fetched_date</code> • <code>MYSQL_TYPE_YEAR</code> - <code>proto_text_fetched_year</code> • <code>MYSQL_TYPE_TIME</code> - <code>proto_text_fetched_time</code> • <code>MYSQL_TYPE_DATETIME</code> - <code>proto_text_fetched_datetime</code> • <code>MYSQL_TYPE_TIMESTAMP</code> - <code>proto_text_fetched_timestamp</code> • <code>MYSQL_TYPE_STRING</code>, <code>MYSQL_TYPE_VARSTRING</code>, <code>MYSQL_TYPE_VARCHAR</code> - <code>proto_text_fetched_string</code> • <code>MYSQL_TYPE_TINY_BLOB</code>, <code>MYSQL_TYPE_MEDIUM_BLOB</code>,

Statistic	Scope	Description	Notes
			<p>MYSQL_TYPE_LONG_BLOB, MYSQL_TYPE_BLOB - proto_text_fetched_blob</p> <ul style="list-style-type: none"> MYSQL_TYPE_ENUM - proto_text_fetched_enum MYSQL_TYPE_SET - proto_text_fetched_set MYSQL_TYPE_GEOMETRY - proto_text_fetched_geometry Any MYSQL_TYPE_* not listed before (there should be none) - proto_text_fetched_other <p>Note that the MYSQL_*-type constants may not be associated with the very same SQL column types in every version of MySQL.</p>
proto_binary_fetched_number	Connection	Total number of columns of a certain type fetched from a prepared statement (MySQL binary protocol). proto_binary_fetched_short, proto_binary_fetched_int24, proto_binary_fetched_int, proto_binary_fetched_bigint, proto_binary_fetched_decimal, proto_binary_fetched_float, proto_binary_fetched_double, proto_binary_fetched_date, proto_binary_fetched_year, proto_binary_fetched_time, proto_binary_fetched_datetime, proto_binary_fetched_timestamp, proto_binary_fetched_string, proto_binary_fetched_blob, proto_binary_fetched_enum, proto_binary_fetched_set, proto_binary_fetched_geometry, proto_binary_fetched_other	For type mapping see proto_text_* described in the preceding text.

Table 7.31 Returned mysqlnd statistics: Connection

Statistic	Scope	Description	Notes
connect_connection	Connection	Total number of successful / failed connection attempt.	Reused connections and all other kinds of connections are included.
reconnect	Process	Total number of (real_)connect attempts made on an already opened connection handle.	The code sequence <code>\$link = new mysqli(...); \$link->real_connect(...)</code> will cause a reconnect. But <code>\$link = new mysqli(...); \$link->connect(...)</code> will not because <code>\$link->connect(...)</code> will explicitly close the existing connection before a new connection is established.

Statistic	Scope	Description	Notes
pconnect	Connection	Total number of successful persistent connection attempts.	Note that <code>connect_success</code> holds the sum of successful persistent and non-persistent connection attempts. The number of successful non-persistent connection attempts is <code>connect_success - pconnect_success</code> .
active_connections	Connection	Total number of active persistent and non-persistent connections.	
active_non_persistent_connections	Connection	Total number of active non-persistent connections.	The total number of active non-persistent connections is <code>active_connections - active_persistent_connections</code> .
explicit_connections	Connection	Total number of explicitly closed connections (ext/mysql only).	Examples of code snippets that cause an explicit close : <pre>\$link = new mysqli(...); \$link->close(...)</pre> <pre>\$link = new mysqli(...); \$link->connect(...)</pre>
implicit_connections	Connection	Total number of implicitly closed connections (ext/mysql only).	Examples of code snippets that cause an implicit close : <ul style="list-style-type: none"> <code>\$link = new mysqli(...); \$link->real_connect(...)</code> <code>unset(\$link)</code> Persistent connection: pooled connection has been created with <code>real_connect</code> and there may be unknown options set - close implicitly to avoid returning a connection with unknown options Persistent connection: ping/<code>change_user</code> fails and ext/mysql closes the connection end of script execution: close connections that have not been closed by the user
disconnected_connections	Connection	Connection failures indicated by the C API call <code>mysql_real_connect</code> during an attempt to establish a connection.	It is called <code>disconnect_close</code> because the connection handle passed to the C API call will be closed.
in_middle_of_a_command	Process or connection	An <code>connection</code> has been closed in the middle of a command execution (outstanding result sets not fetched, after sending a query and before retrieving an answer, while fetching data, while transferring data with LOAD DATA).	Unless you use asynchronous queries this should only happen if your script stops unexpectedly and PHP shuts down the connections for you.
init_commands	Connection	Total number of init command executions, for example, <code>mysqli_options(MYSQLI_INIT_COMMAND,...)</code> .	The number of successful executions is <code>init_command_executed_count - init_command_failed_count</code> .
init_command_failed_count	Connection	Total number of failed init commands.	

Table 7.32 Returned mysqlnd statistics: COM_* Command

Statistic	Scope	Description	Notes
<code>com_query,</code> <code>com_init_db,</code> <code>com_create_db,</code> <code>com_drop_db,</code> <code>com_refresh,</code> <code>com_shutdown,</code> <code>com_statistics,</code> <code>com_process_info,</code> <code>com_connect,</code> <code>com_process_kill,</code> <code>com_debug,</code> <code>com_ping,</code> <code>com_time,</code> <code>com_delayed_insert,</code> <code>com_change_user,</code> <code>com_binlog_dump,</code> <code>com_table_dump,</code> <code>com_connect_out,</code> <code>com_register_slave,</code> <code>com_stmt_prepare,</code> <code>com_stmt_execute,</code> <code>com_stmt_send_long_data,</code> <code>com_stmt_close,</code> <code>com_stmt_reset,</code> <code>com_stmt_set_option,</code> <code>com_stmt_fetch,</code> <code>com_daemon</code>	Connection	Total number of attempts to send a certain COM_* command from PHP to MySQL.	<p>The statistics are incremented after checking the line and immediately before sending the corresponding MySQL client server protocol packet. If mysqlnd fails to send the packet over the wire the statistics will not be decremented. In case of a failure mysqlnd emits a PHP warning "Error while sending %s packet. PID=%d."</p> <p>Usage examples:</p> <ul style="list-style-type: none"> Check if PHP sends certain commands to MySQL, for example, check if a client sends <code>COM_PROCESS_KILL</code> Calculate the average number of prepared statement executions by comparing <code>COM_EXECUTE</code> with <code>COM_PREPARE</code> Check if PHP has run any non-prepared SQL statements by checking if <code>COM_QUERY</code> is zero Identify PHP scripts that run an excessive number of SQL statements by checking <code>COM_QUERY</code> and <code>COM_EXECUTE</code>

*Miscellaneous***Table 7.33 Returned mysqlnd statistics: Miscellaneous**

Statistic	Scope	Description	Notes
<code>explicit_stmt_close</code> , <code>implicit_stmt_close</code>	Process control	Total number of close prepared statements.	A close is always considered explicit but for a failed prepare.
<code>mem_early_free_count</code> , <code>mem_early_free_amount</code> , <code>mem_early_malloc_count</code> , <code>mem_early_malloc_amount</code> , <code>mem_erealloc_count</code> , <code>mem_erealloc_amount</code> , <code>mem_efree_count</code> , <code>mem_malloc_count</code> , <code>mem_malloc_amount</code> , <code>mem_realloc_count</code> , <code>mem_realloc_amount</code> , <code>mem_free_count</code>	Memory management	Memory management calls.	Development only.
<code>command_extensions</code>	Connection	Number of network command buffer extensions while sending commands from PHP to MySQL.	mysqlnd allocates an internal command/network buffer of <code>mysqlnd.net_cmd_buffer_size</code> (<code>php.ini</code>) bytes for every connection.

Statistic	Scope	Description	Notes
			<p>If a MySQL Client Server protocol command, for example, COM_QUERY (normal query), does not fit into the buffer, mysqlnd will grow the buffer to what is needed for sending the command. Whenever the buffer gets extended for one connection command_buffer_too_small will be incremented by one.</p> <p>If mysqlnd has to grow the buffer beyond its initial size of mysqlnd.net_cmd_buffer_size (php.ini) bytes for almost every connection, you should consider to increase the default size to avoid re-allocations.</p> <p>The default buffer size is 2048 bytes in PHP 5.3.0. In future versions the default will be 4kB or larger. The default can be changed either through the php.ini setting mysqlnd.net_cmd_buffer_size or using mysqli_options(MYSQLI_OPT_NET_CMD_BUFFER_SIZE, size).</p> <p>It is recommended to set the buffer size to no less than 4096 bytes because mysqlnd also uses it when reading certain communication packet from MySQL. In PHP 5.3.0, mysqlnd will not grow the buffer if MySQL sends a packet that is larger than the current size of the buffer. As a consequence mysqlnd is unable to decode the packet and the client application will get an error. There are only two situations when the packet can be larger than the 2048 bytes default of mysqlnd.net_cmd_buffer_size in PHP 5.3.0: the packet transports a very long error message or the packet holds column meta data from COM_LIST_FIELD (mysql_list_fields) and the meta data comes from a string column with a very long default value (>1900 bytes). No bug report on this exists - it should happen rarely.</p> <p>As of PHP 5.3.2 mysqlnd does not allow setting buffers smaller than 4096 bytes.</p>
connection_reused			

7.6.7 Notes

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This section provides a collection of miscellaneous notes on MySQL Native Driver usage.

- Using `mysqlnd` means using PHP streams for underlying connectivity. For `mysqlnd`, the PHP streams documentation (<http://www.php.net/manual/en/book.stream>) should be consulted on such details as timeout settings, not the documentation for the MySQL Client Library.

7.6.8 Memory management

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Introduction

The MySQL Native Driver manages memory different than the MySQL Client Library. The libraries differ in the way memory is allocated and released, how memory is allocated in chunks while reading results from MySQL, which debug and development options exist, and how results read from MySQL are linked to PHP user variables.

The following notes are intended as an introduction and summary to users interested at understanding the MySQL Native Driver at the C code level.

Memory management functions used

All memory allocation and deallocation is done using the PHP memory management functions. Therefore, the memory consumption of mysqlnd can be tracked using PHP API calls, such as `memory_get_usage`. Because memory is allocated and released using the PHP memory management, the changes may not immediately become visible at the operating system level. The PHP memory management acts as a proxy which may delay releasing memory towards the system. Due to this, comparing the memory usage of the MySQL Native Driver and the MySQL Client Library is difficult. The MySQL Client Library is using the operating system memory management calls directly, hence the effects can be observed immediately at the operating system level.

Any memory limit enforced by PHP also affects the MySQL Native Driver. This may cause out of memory errors when fetching large result sets that exceed the size of the remaining memory made available by PHP. Because the MySQL Client Library is not using PHP memory management functions, it does not comply to any PHP memory limit set. If using the MySQL Client Library, depending on the deployment model, the memory footprint of the PHP process may grow beyond the PHP memory limit. But also PHP scripts may be able to process larger result sets as parts of the memory allocated to hold the result sets are beyond the control of the PHP engine.

PHP memory management functions are invoked by the MySQL Native Driver through a lightweight wrapper. Among others, the wrapper makes debugging easier.

Handling of result sets

The various MySQL Server and the various client APIs differentiate between [buffered](#) and [unbuffered](#) result sets. Unbuffered result sets are transferred row-by-row from MySQL to the client as the client iterates over the results. Buffered results are fetched in their entirety by the client library before passing them on to the client.

The MySQL Native Driver is using PHP Streams for the network communication with the MySQL Server. Results sent by MySQL are fetched from the PHP Streams network buffers into the result buffer of mysqlnd. The result buffer is made of zvals. In a second step the results are made available to the PHP script. This final transfer from the result buffer into PHP variables impacts the memory consumption and is mostly noticeable when using buffered result sets.

By default the MySQL Native Driver tries to avoid holding buffered results twice in memory. Results are kept only once in the internal result buffers and their zvals. When results are fetched into PHP variables

by the PHP script, the variables will reference the internal result buffers. Database query results are not copied and kept in memory only once. Should the user modify the contents of a variable holding the database results a copy-on-write must be performed to avoid changing the referenced internal result buffer. The contents of the buffer must not be modified because the user may decide to read the result set a second time. The copy-on-write mechanism is implemented using an additional reference management list and the use of standard zval reference counters. Copy-on-write must also be done if the user reads a result set into PHP variables and frees a result set before the variables are unset.

Generally speaking, this pattern works well for scripts that read a result set once and do not modify variables holding results. Its major drawback is the memory overhead caused by the additional reference management which comes primarily from the fact that user variables holding results cannot be entirely released until the mysqlnd reference management stops referencing them. The MySQL Native driver removes the reference to the user variables when the result set is freed or a copy-on-write is performed. An observer will see the total memory consumption grow until the result set is released. Use the [statistics](#) to check whether a script does release result sets explicitly or the driver is doing implicit releases and thus memory is used for a time longer than necessary. Statistics also help to see how many copy-on-write operations happened.

A PHP script reading many small rows of a buffered result set using a code snippet equal or equivalent to `while ($row = $res->fetch_assoc()) { ... }` may optimize memory consumption by requesting copies instead of references. Albeit requesting copies means keeping results twice in memory, it allows PHP to free the copy contained in `$row` as the result set is being iterated and prior to releasing the result set itself. On a loaded server optimizing peak memory usage may help improving the overall system performance although for an individual script the copy approach may be slower due to additional allocations and memory copy operations.

The copy mode can be enforced by setting `mysqlnd.fetch_data_copy=1`.

Monitoring and debugging

There are multiple ways of tracking the memory usage of the MySQL Native Driver. If the goal is to get a quick high level overview or to verify the memory efficiency of PHP scripts, then check the [statistics](#) collected by the library. The statistics allow you, for example, to catch SQL statements which generate more results than are processed by a PHP script.

The [debug](#) trace log can be configured to record memory management calls. This helps to see when memory is allocated or free'd. However, the size of the requested memory chunks may not be listed.

Some, recent versions of the MySQL Native Driver feature the emulation of random out of memory situations. This feature is meant to be used by the C developers of the library or mysqlnd [plugin](#) authors only. Please, search the source code for corresponding PHP configuration settings and further details. The feature is considered private and may be modified at any time without prior notice.

7.6.9 MySQL Native Driver Plugin API

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The MySQL Native Driver Plugin API is a feature of MySQL Native Driver, or `mysqlnd`. `mysqlnd` plugins operate in the layer between PHP applications and the MySQL server. This is comparable to MySQL Proxy. MySQL Proxy operates on a layer between any MySQL client application, for example, a PHP application and, the MySQL server. `mysqlnd` plugins can undertake typical MySQL Proxy tasks such as load balancing, monitoring and performance optimizations. Due to the different architecture and location, `mysqlnd` plugins do not have some of MySQL Proxy's disadvantages. For example, with plugins, there is no single point of failure, no dedicated proxy server to deploy, and no new programming language to learn (Lua).

A `mysqlnd` plugin can be thought of as an extension to `mysqlnd`. Plugins can intercept the majority of `mysqlnd` functions. The `mysqlnd` functions are called by the PHP MySQL extensions such as `ext/mysql`, `ext/mysqli`, and `PDO_MYSQL`. As a result, it is possible for a `mysqlnd` plugin to intercept all calls made to these extensions from the client application.

Internal `mysqlnd` function calls can also be intercepted, or replaced. There are no restrictions on manipulating `mysqlnd` internal function tables. It is possible to set things up so that when certain `mysqlnd` functions are called by the extensions that use `mysqlnd`, the call is directed to the appropriate function in the `mysqlnd` plugin. The ability to manipulate `mysqlnd` internal function tables in this way allows maximum flexibility for plugins.

`Mysqlnd` plugins are in fact PHP Extensions, written in C, that use the `mysqlnd` plugin API (which is built into MySQL Native Driver, `mysqlnd`). Plugins can be made 100% transparent to PHP applications. No application changes are needed because plugins operate on a different layer. The `mysqlnd` plugin can be thought of as operating in a layer below `mysqlnd`.

The following list represents some possible applications of `mysqlnd` plugins.

- Load Balancing
 - Read/Write Splitting. An example of this is the PECL/`mysqlnd_ms` (Master Slave) extension. This extension splits read/write queries for a replication setup.
 - Failover
 - Round-Robin, least loaded
- Monitoring
 - Query Logging
 - Query Analysis
- Query Auditing. An example of this is the PECL/`mysqlnd_sip` (SQL Injection Protection) extension. This extension inspects queries and executes only those that are allowed according to a ruleset.
- Performance
 - Caching. An example of this is the PECL/`mysqlnd qc` (Query Cache) extension.
 - Throttling
 - Sharding. An example of this is the PECL/`mysqlnd_mc` (Multi Connect) extension. This extension will attempt to split a SELECT statement into n-parts, using SELECT ... LIMIT part_1, SELECT ... LIMIT part_n. It sends the queries to distinct MySQL servers and merges the result at the client.

MySQL Native Driver Plugins Available

There are a number of `mysqlnd` plugins already available. These include:

- *PECL/mysqlnd_mc* - Multi Connect plugin.
- *PECL/mysqlnd_ms* - Master Slave plugin.
- *PECL/mysqlnd qc* - Query Cache plugin.
- *PECL/mysqlnd_pscache* - Prepared Statement Handle Cache plugin.
- *PECL/mysqlnd_sip* - SQL Injection Protection plugin.
- *PECL/mysqlnd_uh* - User Handler plugin.

7.6.9.1 A comparison of `mysqlnd` plugins with MySQL Proxy

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`Mysqlnd` plugins and MySQL Proxy are different technologies using different approaches. Both are valid tools for solving a variety of common tasks such as load balancing, monitoring, and performance

enhancements. An important difference is that MySQL Proxy works with all MySQL clients, whereas [mysqlnd](#) plugins are specific to PHP applications.

As a PHP Extension, a [mysqlnd](#) plugin gets installed on the PHP application server, along with the rest of PHP. MySQL Proxy can either be run on the PHP application server or can be installed on a dedicated machine to handle multiple PHP application servers.

Deploying MySQL Proxy on the application server has two advantages:

1. No single point of failure
2. Easy to scale out (horizontal scale out, scale by client)

MySQL Proxy (and [mysqlnd](#) plugins) can solve problems easily which otherwise would have required changes to existing applications.

However, MySQL Proxy does have some disadvantages:

- MySQL Proxy is a new component and technology to master and deploy.
- MySQL Proxy requires knowledge of the Lua scripting language.

MySQL Proxy can be customized with C and Lua programming. Lua is the preferred scripting language of MySQL Proxy. For most PHP experts Lua is a new language to learn. A [mysqlnd](#) plugin can be written in C. It is also possible to write plugins in PHP using [PECL/mysqlnd_uh](#).

MySQL Proxy runs as a daemon - a background process. MySQL Proxy can recall earlier decisions, as all state can be retained. However, a [mysqlnd](#) plugin is bound to the request-based lifecycle of PHP. MySQL Proxy can also share one-time computed results among multiple application servers. A [mysqlnd](#) plugin would need to store data in a persistent medium to be able to do this. Another daemon would need to be used for this purpose, such as Memcache. This gives MySQL Proxy an advantage in this case.

MySQL Proxy works on top of the wire protocol. With MySQL Proxy you have to parse and reverse engineer the MySQL Client Server Protocol. Actions are limited to those that can be achieved by manipulating the communication protocol. If the wire protocol changes (which happens very rarely) MySQL Proxy scripts would need to be changed as well.

[Mysqlnd](#) plugins work on top of the C API, which mirrors the [libmysqlclient](#) client. This C API is basically a wrapper around the MySQL Client Server protocol, or wire protocol, as it is sometimes called. You can intercept all C API calls. PHP makes use of the C API, therefore you can hook all PHP calls, without the need to program at the level of the wire protocol.

[Mysqlnd](#) implements the wire protocol. Plugins can therefore parse, reverse engineer, manipulate and even replace the communication protocol. However, this is usually not required.

As plugins allow you to create implementations that use two levels (C API and wire protocol), they have greater flexibility than MySQL Proxy. If a [mysqlnd](#) plugin is implemented using the C API, any subsequent changes to the wire protocol do not require changes to the plugin itself.

7.6.9.2 Obtaining the mysqlnd plugin API

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The [mysqlnd](#) plugin API is simply part of the MySQL Native Driver PHP extension, [ext/mysqlnd](#). Development started on the [mysqlnd](#) plugin API in December 2009. It is developed as part of the PHP source repository, and as such is available to the public either via Git, or through source snapshot downloads.

The following table shows PHP versions and the corresponding [mysqlnd](#) version contained within.

Table 7.34 The bundled mysqlnd version per PHP release

PHP Version	MySQL Native Driver version
5.3.0	5.0.5
5.3.1	5.0.5
5.3.2	5.0.7
5.3.3	5.0.7
5.3.4	5.0.7

Plugin developers can determine the `mysqlnd` version through accessing `MYSQLND_VERSION`, which is a string of the format "mysqlnd 5.0.7-dev - 091210 - \$Revision: 300535", or through `MYSQLND_VERSION_ID`, which is an integer such as 50007. Developers can calculate the version number as follows:

Table 7.35 MYSQLND_VERSION_ID calculation table

Version (part)	Example
Major*10000	$5 * 10000 = 50000$
Minor*100	$0 * 100 = 0$
Patch	$7 = 7$
MYSQLND_VERSION_ID	50007

During development, developers should refer to the `mysqlnd` version number for compatibility and version tests, as several iterations of `mysqlnd` could occur during the lifetime of a PHP development branch with a single PHP version number.

7.6.9.3 MySQL Native Driver Plugin Architecture

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This section provides an overview of the `mysqlnd` plugin architecture.

MySQL Native Driver Overview

Before developing `mysqlnd` plugins, it is useful to know a little of how `mysqlnd` itself is organized. `Mysqlnd` consists of the following modules:

Table 7.36 The mysqlnd organization chart, per module

Modules Statistics	<code>mysqlnd_statistics.c</code>
Connection	<code>mysqlnd.c</code>
Resultset	<code>mysqlnd_result.c</code>
Resultset Metadata	<code>mysqlnd_result_meta.c</code>
Statement	<code>mysqlnd_ps.c</code>
Network	<code>mysqlnd_net.c</code>
Wire protocol	<code>mysqlnd_wireprotocol.c</code>

C Object Oriented Paradigm

At the code level, `mysqlnd` uses a C pattern for implementing object orientation.

In C you use a `struct` to represent an object. Members of the struct represent object properties. Struct members pointing to functions represent methods.

Unlike with other languages such as C++ or Java, there are no fixed rules on inheritance in the C object oriented paradigm. However, there are some conventions that need to be followed that will be discussed later.

The PHP Life Cycle

When considering the PHP life cycle there are two basic cycles:

- PHP engine startup and shutdown cycle
- Request cycle

When the PHP engine starts up it will call the module initialization (MINIT) function of each registered extension. This allows each module to setup variables and allocate resources that will exist for the lifetime of the PHP engine process. When the PHP engine shuts down it will call the module shutdown (MSHUTDOWN) function of each extension.

During the lifetime of the PHP engine it will receive a number of requests. Each request constitutes another life cycle. On each request the PHP engine will call the request initialization function of each extension. The extension can perform any variable setup and resource allocation required for request processing. As the request cycle ends the engine calls the request shutdown (RSHUTDOWN) function of each extension so the extension can perform any cleanup required.

How a plugin works

A `mysqlnd` plugin works by intercepting calls made to `mysqlnd` by extensions that use `mysqlnd`. This is achieved by obtaining the `mysqlnd` function table, backing it up, and replacing it by a custom function table, which calls the functions of the plugin as required.

The following code shows how the `mysqlnd` function table is replaced:

```
/* a place to store original function table */
struct st_mysqlnd_conn_methods org_methods;
void minit_register_hooks(TSRMLS_D) {
    /* active function table */
    struct st_mysqlnd_conn_methods * current_methods
        = mysqlnd_conn_get_methods();
    /* backup original function table */
    memcpy(&org_methods, current_methods,
           sizeof(struct st_mysqlnd_conn_methods));
    /* install new methods */
    current_methods->query = MYSQLND_METHOD(my_conn_class, query);
}
```

Connection function table manipulations must be done during Module Initialization (MINIT). The function table is a global shared resource. In a multi-threaded environment, with a TSRM build, the manipulation of a global shared resource during the request processing will almost certainly result in conflicts.

Note

Do not use any fixed-size logic when manipulating the `mysqlnd` function table: new methods may be added at the end of the function table. The function table may change at any time in the future.

Calling parent methods

If the original function table entries are backed up, it is still possible to call the original function table entries - the parent methods.

In some cases, such as for `Connection::stmt_init()`, it is vital to call the parent method prior to any other activity in the derived method.

```
MYSQLND_METHOD(my_conn_class, query)(MYSQLND *conn,
    const char *query, unsigned int query_len TSRMLS_DC) {
    php_printf("my_conn_class::query(query = %s)\n", query);
    query = "SELECT 'query rewritten' FROM DUAL";
    query_len = strlen(query);
```

```

    return org_methods.query(conn, query, query_len); /* return with call to parent */
}

```

Extending properties

A `mysqlnd` object is represented by a C struct. It is not possible to add a member to a C struct at run time. Users of `mysqlnd` objects cannot simply add properties to the objects.

Arbitrary data (properties) can be added to a `mysqlnd` objects using an appropriate function of the `mysqlnd_plugin_get_plugin_<object>_data()` family. When allocating an object `mysqlnd` reserves space at the end of the object to hold a `void *` pointer to arbitrary data. `mysqlnd` reserves space for one `void *` pointer per plugin.

The following table shows how to calculate the position of the pointer for a specific plugin:

Table 7.37 Pointer calculations for mysqlnd

Memory address	Contents
0	Beginning of the <code>mysqlnd</code> object C struct
n	End of the <code>mysqlnd</code> object C struct
<code>n + (m x sizeof(void*))</code>	<code>void*</code> to object data of the m-th plugin

If you plan to subclass any of the `mysqlnd` object constructors, which is allowed, you must keep this in mind!

The following code shows extending properties:

```

/* any data we want to associate */
typedef struct my_conn_properties {
    unsigned long query_counter;
} MY_CONN_PROPERTIES;
/* plugin id */
unsigned int my_plugin_id;
void minit_register_hooks(TSRMLS_D) {
    /* obtain unique plugin ID */
    my_plugin_id = mysqlnd_plugin_register();
    /* snip - see Extending Connection: methods */
}
static MY_CONN_PROPERTIES** get_conn_properties(const MYSQLND *conn TSRMLS_DC) {
    MY_CONN_PROPERTIES** props;
    props = (MY_CONN_PROPERTIES**)mysqlnd_plugin_get_plugin_connection_data(
        conn, my_plugin_id);
    if (!props || !(*props)) {
        *props = mnd_palloc(1, sizeof(MY_CONN_PROPERTIES), conn->persistent);
        (*props)->query_counter = 0;
    }
    return props;
}

```

The plugin developer is responsible for the management of plugin data memory.

Use of the `mysqlnd` memory allocator is recommended for plugin data. These functions are named using the convention: `mnd_*loc()`. The `mysqlnd` allocator has some useful features, such as the ability to use a debug allocator in a non-debug build.

Table 7.38 When and how to subclass

	When to subclass?	Each instance has its own private function table?	How to subclass?
Connection (MYSQLND)	MINIT	No	<code>mysqlnd_conn_get_methods()</code>
Resultset (MYSQLND_RES)	MINIT or later	Yes	<code>mysqlnd_result_get_methods()</code> or object method

	When to subclass?	Each instance has its own private function table?	How to subclass?
			function table manipulation
Resultset Meta (MYSQLND_RES_METADATA)	MINIT	No	mysqlnd_result_metadata_get_m
Statement (MYSQLND_STMT)	MINIT	No	mysqlnd_stmt_get_methods()
Network (MYSQLND_NET)	MINIT or later	Yes	mysqlnd_net_get_methods() or object method function table manipulation
Wire protocol (MYSQLND_PROTOCOL)	MINIT or later	Yes	mysqlnd_protocol_get_methods() or object method function table manipulation

You must not manipulate function tables at any time later than MINIT if it is not allowed according to the above table.

Some classes contain a pointer to the method function table. All instances of such a class will share the same function table. To avoid chaos, in particular in threaded environments, such function tables must only be manipulated during MINIT.

Other classes use copies of a globally shared function table. The class function table copy is created together with the object. Each object uses its own function table. This gives you two options: you can manipulate the default function table of an object at MINIT, and you can additionally refine methods of an object without impacting other instances of the same class.

The advantage of the shared function table approach is performance. There is no need to copy a function table for each and every object.

Table 7.39 Constructor status

Type	Allocation, construction, reset	Can be modified?	Caller
Connection (MYSQLND)	mysqlnd_init()	No	mysqlnd_connect()
Resultset(MYSQLND_RES)	Allocation: • Connection::result_init() Reset and re-initialized during: • Result::use_result() • Result::store_result	Yes, but call parent!	<ul style="list-style-type: none"> • Connection::list_fields() • Statement::get_result() • Statement::prepare() (Metadata only) • Statement::resultMetaData()
Resultset Meta (MYSQLND_RES_METADATA)	Connection::result_meta_	Yes, but call parent!	Result::read_result_metadata()
Statement (MYSQLND_STMT)	Connection::stmt_init()	Yes, but call parent!	Connection::stmt_init()
Network (MYSQLND_NET)	mysqlnd_net_init()	No	Connection::init()
Wire protocol (MYSQLND_PROTOCOL)	mysqlnd_protocol_init()	No	Connection::init()

It is strongly recommended that you do not entirely replace a constructor. The constructors perform memory allocations. The memory allocations are vital for the `mysqlnd` plugin API and the object logic of `mysqlnd`. If you do not care about warnings and insist on hooking the constructors, you should at least call the parent constructor before doing anything in your constructor.

Regardless of all warnings, it can be useful to subclass constructors. Constructors are the perfect place for modifying the function tables of objects with non-shared object tables, such as Resultset, Network, Wire Protocol.

Table 7.40 Destruction status

Type	Derived method must call parent?	Destructor
Connection	yes, after method execution	<code>free_contents()</code> , <code>end_psessions()</code>
Resultset	yes, after method execution	<code>free_result()</code>
Resultset Meta	yes, after method execution	<code>free()</code>
Statement	yes, after method execution	<code>dtor()</code> , <code>free_stmt_content()</code>
Network	yes, after method execution	<code>free()</code>
Wire protocol	yes, after method execution	<code>free()</code>

The destructors are the appropriate place to free properties, `mysqlnd_plugin_get_plugin_<object>_data()`.

The listed destructors may not be equivalent to the actual `mysqlnd` method freeing the object itself. However, they are the best possible place for you to hook in and free your plugin data. As with constructors you may replace the methods entirely but this is not recommended. If multiple methods are listed in the above table you will need to hook all of the listed methods and free your plugin data in whichever method is called first by `mysqlnd`.

The recommended method for plugins is to simply hook the methods, free your memory and call the parent implementation immediately following this.

Caution

Due to a bug in PHP versions 5.3.0 to 5.3.3, plugins do not associate plugin data with a persistent connection. This is because `ext/mysql` and `ext/mysqli` do not trigger all the necessary `mysqlnd end_psessions()` method calls and the plugin may therefore leak memory. This has been fixed in PHP 5.3.4.

7.6.9.4 The `mysqlnd` plugin API

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The following is a list of functions provided in the `mysqlnd` plugin API:

- `mysqlnd_plugin_register()`
- `mysqlnd_plugin_count()`
- `mysqlnd_plugin_get_plugin_connection_data()`
- `mysqlnd_plugin_get_plugin_result_data()`
- `mysqlnd_plugin_get_plugin_stmt_data()`
- `mysqlnd_plugin_get_plugin_net_data()`
- `mysqlnd_plugin_get_plugin_protocol_data()`
- `mysqlnd_conn_get_methods()`

- `mysqlnd_result_get_methods()`
- `mysqlnd_result_meta_get_methods()`
- `mysqlnd_stmt_get_methods()`
- `mysqlnd_net_get_methods()`
- `mysqlnd_protocol_get_methods()`

There is no formal definition of what a plugin is and how a plugin mechanism works.

Components often found in plugins mechanisms are:

- A plugin manager
- A plugin API
- Application services (or modules)
- Application service APIs (or module APIs)

The `mysqlnd` plugin concept employs these features, and additionally enjoys an open architecture.

No Restrictions

A plugin has full access to the inner workings of `mysqlnd`. There are no security limits or restrictions. Everything can be overwritten to implement friendly or hostile algorithms. It is recommended you only deploy plugins from a trusted source.

As discussed previously, plugins can use pointers freely. These pointers are not restricted in any way, and can point into another plugin's data. Simple offset arithmetic can be used to read another plugin's data.

It is recommended that you write cooperative plugins, and that you always call the parent method. The plugins should always cooperate with `mysqlnd` itself.

Table 7.41 Issues: an example of chaining and cooperation

Extension	<code>mysqlnd.query()</code> pointer	call stack if calling parent
<code>ext/mysqlnd</code>	<code>mysqlnd.query()</code>	<code>mysqlnd.query</code>
<code>ext/mysqlnd_cache</code>	<code>mysqlnd_cache.query()</code>	<ol style="list-style-type: none">1. <code>mysqlnd_cache.query()</code>2. <code>mysqlnd.query</code>
<code>ext/mysqlnd_monitor</code>	<code>mysqlnd_monitor.query()</code>	<ol style="list-style-type: none">1. <code>mysqlnd_monitor.query()</code>2. <code>mysqlnd_cache.query()</code>3. <code>mysqlnd.query</code>

In this scenario, a cache (`ext/mysqlnd_cache`) and a monitor (`ext/mysqlnd_monitor`) plugin are loaded. Both subclass `Connection::query()`. Plugin registration happens at `MINIT` using the logic shown previously. PHP calls extensions in alphabetical order by default. Plugins are not aware of each other and do not set extension dependencies.

By default the plugins call the parent implementation of the query method in their derived version of the method.

PHP Extension Recap

This is a recap of what happens when using an example plugin, `ext/mysqlnd_plugin`, which exposes the `mysqlnd` C plugin API to PHP:

- Any PHP MySQL application tries to establish a connection to 192.168.2.29
- The PHP application will either use `ext/mysql`, `ext/mysqli` or `PDO_MYSQL`. All three PHP MySQL extensions use `mysqlnd` to establish the connection to 192.168.2.29.
- `Mysqlnd` calls its connect method, which has been subclassed by `ext/mysqlnd_plugin`.
- `ext/mysqlnd_plugin` calls the userspace hook `proxy::connect()` registered by the user.
- The userspace hook changes the connection host IP from 192.168.2.29 to 127.0.0.1 and returns the connection established by `parent::connect()`.
- `ext/mysqlnd_plugin` performs the equivalent of `parent::connect(127.0.0.1)` by calling the original `mysqlnd` method for establishing a connection.
- `ext/mysqlnd` establishes a connection and returns to `ext/mysqlnd_plugin`. `ext/mysqlnd_plugin` returns as well.
- Whatever PHP MySQL extension had been used by the application, it receives a connection to 127.0.0.1. The PHP MySQL extension itself returns to the PHP application. The circle is closed.

7.6.9.5 Getting started building a mysqlnd plugin

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It is important to remember that a `mysqlnd` plugin is itself a PHP extension.

The following code shows the basic structure of the MINIT function that will be used in the typical `mysqlnd` plugin:

```
/* my_php_mysqlnd_plugin.c */
static PHP_MINIT_FUNCTION(mysqlnd_plugin) {
    /* globals, ini entries, resources, classes */
    /* register mysqlnd plugin */
    mysqlnd_plugin_id = mysqlnd_plugin_register();
    conn_m = mysqlnd_get_conn_methods();
    memcpy(org_conn_m, conn_m,
           sizeof(struct st_mysqlnd_conn_methods));
    conn_m->query = MYSQLND_METHOD(mysqlnd_plugin_conn, query);
    conn_m->connect = MYSQLND_METHOD(mysqlnd_plugin_conn, connect);
}
```

```
/* my_mysqlnd_plugin.c */
enum_func_status MYSQLND_METHOD(mysqlnd_plugin_conn, query)(/* ... */) {
    /* ... */
}
enum_func_status MYSQLND_METHOD(mysqlnd_plugin_conn, connect)(/* ... */) {
    /* ... */
}
```

Task analysis: from C to userspace

```
class proxy extends mysqlnd_plugin_connection {
    public function connect($host, ...) { .. }
}
mysqlnd_plugin_set_conn_proxy(new proxy());
```

Process:

1. PHP: user registers plugin callback
2. PHP: user calls any PHP MySQL API to connect to MySQL
3. C: `ext/*mysql*` calls `mysqlnd` method

4. C: mysqlnd ends up in ext/mysqlnd_plugin
5. C: ext/mysqlnd_plugin
 - a. Calls userspace callback
 - b. Or original `mysqlnd` method, if userspace callback not set

You need to carry out the following:

1. Write a class "mysqlnd_plugin_connection" in C
2. Accept and register proxy object through "mysqlnd_plugin_set_conn_proxy()"
3. Call userspace proxy methods from C (optimization - zend_interfaces.h)

Userspace object methods can either be called using `call_user_function()` or you can operate at a level closer to the Zend Engine and use `zend_call_method()`.

Optimization: calling methods from C using zend_call_method

The following code snippet shows the prototype for the `zend_call_method` function, taken from `zend_interfaces.h`.

```
ZEND_API zval* zend_call_method(
    zval **object_pp, zend_class_entry *obj_ce,
    zend_function **fn_proxy, char *function_name,
    int function_name_len, zval **retval_ptr_ptr,
    int param_count, zval* arg1, zval* arg2 TSRMLS_DC
);
```

Zend API supports only two arguments. You may need more, for example:

```
enum_func_status (*func_mysqlnd_conn_connect)(
    MYSQLND *conn, const char *host,
    const char * user, const char * passwd,
    unsigned int passwd_len, const char * db,
    unsigned int db_len, unsigned int port,
    const char * socket, unsigned int mysql_flags TSRMLS_DC
);
```

To get around this problem you will need to make a copy of `zend_call_method()` and add a facility for additional parameters. You can do this by creating a set of `MY_ZEND_CALL_METHOD_WRAPPER` macros.

Calling PHP userspace

This code snippet shows the optimized method for calling a userspace function from C:

```
/* my_mysqlnd_plugin.c */
MYSQLND_METHOD(my_conn_class,connect){
    MYSQLND *conn, const char *host /* ... */ TSRMLS_DC) {
    enum_func_status ret = FAIL;
    zval * global_user_conn_proxy = fetch_userspace_proxy();
    if (global_user_conn_proxy) {
        /* call userspace proxy */
        ret = MY_ZEND_CALL_METHOD_WRAPPER(global_user_conn_proxy, host, /*...*/);
    } else {
        /* or original mysqlnd method = do nothing, be transparent */
        ret = org_methods.connect(conn, host, user, passwd,
            passwd_len, db, db_len, port,
            socket, mysql_flags TSRMLS_CC);
    }
    return ret;
}
```

```
}
```

Calling userspace: simple arguments

```
/* my_mysqlnd_plugin.c */
MYSQLND_METHOD(my_conn_class,connect)(
    /* ... */, const char *host, /* ... */ {
    /* ... */
    if (global_user_conn_proxy) {
        /* ... */
        zval* zv_host;
        MAKE_STD_ZVAL(zv_host);
        ZVAL_STRING(zv_host, host, 1);
        MY ZEND_CALL_METHOD_WRAPPER(global_user_conn_proxy, zv_retval, zv_host /*, ...*/);
        zval_ptr_dtor(&zv_host);
        /* ... */
    }
    /* ... */
}
```

Calling userspace: structs as arguments

```
/* my_mysqlnd_plugin.c */
MYSQLND_METHOD(my_conn_class, connect)(
    MYSQLND *conn, /* ... */ {
    /* ... */
    if (global_user_conn_proxy) {
        /* ... */
        zval* zv_conn;
        ZEND_REGISTER_RESOURCE(zv_conn, (void *)conn, le_mysqlnd_plugin_conn);
        MY ZEND_CALL_METHOD_WRAPPER(global_user_conn_proxy, zv_retval, zv_conn, zv_host /*, ...*/);
        zval_ptr_dtor(&zv_conn);
        /* ... */
    }
    /* ... */
}
```

The first argument of many `mysqlnd` methods is a C "object". For example, the first argument of the `connect()` method is a pointer to `MYSQLND`. The struct `MYSQLND` represents a `mysqlnd` connection object.

The `mysqlnd` connection object pointer can be compared to a standard I/O file handle. Like a standard I/O file handle a `mysqlnd` connection object shall be linked to the userspace using the PHP resource variable type.

From C to userspace and back

```
class proxy extends mysqlnd_plugin_connection {
    public function connect($conn, $host, ...) {
        /* "pre" hook */
        printf("Connecting to host = '%s'\n", $host);
        debug_print_backtrace();
        return parent::connect($conn);
    }
    public function query($conn, $query) {
        /* "post" hook */
        $ret = parent::query($conn, $query);
        printf("Query = '%s'\n", $query);
        return $ret;
    }
}
mysqlnd_plugin_set_conn_proxy(new proxy());
```

PHP users must be able to call the parent implementation of an overwritten method.

As a result of subclassing it is possible to refine only selected methods and you can choose to have "pre" or "post" hooks.

Buildin class: mysqlnd_plugin_connection::connect()

```
/* my_mysqlnd_plugin_classes.c */
PHP_METHOD("mysqlnd_plugin_connection", connect) {
    /* ... simplified! ... */
    zval* mysqlnd_rsrc;
    MYSQLND* conn;
    char* host; int host_len;
    if (zend_parse_parameters(ZEND_NUM_ARGS() TSRMLS_CC, "rs",
        &mysqlnd_rsrc, &host, &host_len) == FAILURE) {
        RETURN_NULL();
    }
    ZEND_FETCH_RESOURCE(conn, MYSQLND* conn, &mysqlnd_rsrc, -1,
        "Mysqld Connection", le_mysqlnd_plugin_conn);
    if (PASS == org_methods.connect(conn, host, /* simplified! */ TSRMLS_CC))
        RETVAL_TRUE;
    else
        RETVAL_FALSE;
}
```

7.7 Mysqld replication and load balancing plugin

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The mysqld replication and load balancing plugin ([mysqlnd_ms](#)) adds easy to use MySQL replication support to all PHP MySQL extensions that use [mysqld](#).

As of version PHP 5.3.3 the MySQL native driver for PHP ([mysqlnd](#)) features an internal plugin C API. C plugins, such as the replication and load balancing plugin, can extend the functionality of [mysqld](#).

The MySQL native driver for PHP is a C library that ships together with PHP as of PHP 5.3.0. It serves as a drop-in replacement for the MySQL Client Library (libmysqlclient). Using mysqld has several advantages: no extra downloads are required because it's bundled with PHP, it's under the PHP license, there is lower memory consumption in certain cases, and it contains new functionality such as asynchronous queries.

Mysqld plugins like [mysqlnd_ms](#) operate, for the most part, transparently from a user perspective. The replication and load balancing plugin supports all PHP applications, and all MySQL PHP extensions. It does not change existing APIs. Therefore, it can easily be used with existing PHP applications.

7.7.1 Key Features

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The key features of PECL/mysqlnd_ms are as follows.

- Transparent and therefore easy to use.
 - Supports all of the PHP MySQL extensions.
 - SSL support.
 - A consistent API.
 - Little to no application changes required, dependent on the required usage scenario.
 - Lazy connections: connections to master and slave servers are not opened before a SQL statement is executed.
 - Optional: automatic use of master after the first write in a web request, to lower the possible impact of replication lag.

- Can be used with any MySQL clustering solution.
 - MySQL Replication: Read-write splitting is done by the plugin. Primary focus of the plugin.
 - MySQL Cluster: Read-write splitting can be disabled. Configuration of multiple masters possible
 - Third-party solutions: the plugin is optimized for MySQL Replication but can be used with any other kind of MySQL clustering solution.
- Featured read-write split strategies
 - Automatic detection of SELECT.
 - Supports SQL hints to overrule automatism.
 - User-defined.
 - Can be disabled for, for example, when using synchronous clusters such as MySQL Cluster.
- Featured load balancing strategies
 - Round Robin: choose a different slave in round-robin fashion for every slave request.
 - Random: choose a random slave for every slave request.
 - Random once (sticky): choose a random slave once to run all slave requests for the duration of a web request.
 - User-defined. The application can register callbacks with mysqlnd_ms.
- PHP 5.4.0 or newer: transaction aware when using API calls only to control transactions.
- Weighted load balancing: servers can be assigned different priorities, for example, to direct more requests to a powerful machine than to another less powerful machine. Or, to prefer nearby machines to reduce latency.
- Global transaction ID
 - Client-side emulation. Makes manual master server failover and slave promotion easier with asynchronous clusters, such as MySQL Replication.
 - Support for built-in global transaction identifier feature of MySQL 5.6.5 or newer.
 - Supports using transaction ids to identify up-to-date asynchronous slaves for reading when session consistency is required. Please, note the restrictions mentioned in the manual.
 - Throttling: optionally, the plugin can wait for a slave to become "synchronous" before continuing.
- Service and consistency levels
 - Applications can request eventual, session and strong consistency service levels for connections. Appropriate cluster nodes will be searched automatically.
 - Eventual consistent MySQL Replication slave accesses can be replaced with fast local cache accesses transparently to reduce server load.
- Partitioning and sharding
 - Servers of a replication cluster can be organized into groups. SQL hints can be used to manually direct queries to a specific group. Grouping can be used to partition (shard) the data, or to cure the issue of hotspots with updates.
 - MySQL Replication filters are supported through the table filter.

- MySQL Fabric
 - Experimental support for MySQL Fabric is included.

7.7.2 Limitations

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The built-in read-write-split mechanism is very basic. Every query which starts with `SELECT` is considered a read request to be sent to a MySQL slave server. All other queries (such as `SHOW` statements) are considered as write requests that are sent to the MySQL master server. The build-in behavior can be overruled using `SQL hints`, or a user-defined `callback function`.

The read-write splitter is not aware of multi-statements. Multi-statements are considered as one statement. The decision of where to run the statement will be based on the beginning of the statement string. For example, if using `mysqli_multi_query` to execute the multi-statement `SELECT id FROM test ; INSERT INTO test(id) VALUES (1)`, the statement will be redirected to a slave server because it begins with `SELECT`. The `INSERT` statement, which is also part of the multi-statement, will not be redirected to a master server.

Note

Applications must be aware of the consequences of connection switches that are performed for load balancing purposes. Please check the documentation on `connection pooling and switching`, `transaction handling`, `failover load balancing` and `read-write splitting`.

7.7.3 On the name

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The shortcut `mysqlnd_ms` stands for `mysqlnd master slave plugin`. The name was chosen for a quick-and-dirty proof-of-concept. In the beginning the developers did not expect to continue using the code base.

7.7.4 Quickstart and Examples

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The mysqlnd replication load balancing plugin is easy to use. This quickstart will demo typical use-cases, and provide practical advice on getting started.

It is strongly recommended to read the reference sections in addition to the quickstart. The quickstart tries to avoid discussing theoretical concepts and limitations. Instead, it will link to the reference sections. It is safe to begin with the quickstart. However, before using the plugin in mission critical environments we urge you to read additionally the background information from the reference sections.

The focus is on using PECL `mysqlnd_ms` for work with an asynchronous MySQL cluster, namely MySQL replication. Generally speaking an asynchronous cluster is more difficult to use than a synchronous one. Thus, users of, for example, MySQL Cluster will find more information than needed.

7.7.4.1 Setup

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The plugin is implemented as a PHP extension. See also the [installation instructions](#) to install the `PECL/mysqlnd_ms` extension.

Compile or configure the PHP MySQL extension (API) (`mysqli`, `PDO_MYSQL`, `mysql`) that you plan to use with support for the `mysqlnd` library. PECL/`mysqlnd_ms` is a plugin for the `mysqlnd` library. To use the plugin with any of the PHP MySQL extensions, the extension has to use the `mysqlnd` library.

Then, load the extension into PHP and activate the plugin in the PHP configuration file using the PHP configuration directive named [mysqlnd_ms.enable](#).

Example 7.204 Enabling the plugin (php.ini)

```
mysqlnd_ms.enable=1
mysqlnd_ms.config_file=/path/to/mysqlnd_ms_plugin.ini
```

The plugin uses its own configuration file. Use the PHP configuration directive [mysqlnd_ms.config_file](#) to set the full file path to the plugin-specific configuration file. This file must be readable by PHP (e.g., the web server user). Please note, the configuration directive [mysqlnd_ms.config_file](#) superseeds [mysqlnd_ms.ini_file](#) since 1.4.0. It is a common pitfall to use the old, no longer available configuration directive.

Create a plugin-specific configuration file. Save the file to the path set by the PHP configuration directive [mysqlnd_ms.config_file](#).

The plugins [configuration file](#) is JSON based. It is divided into one or more sections. Each section has a name, for example, [myapp](#). Every section makes its own set of configuration settings.

A section must, at a minimum, list the MySQL replication master server, and set a list of slaves. The plugin supports using only one master server per section. Multi-master MySQL replication setups are not yet fully supported. Use the configuration setting [master](#) to set the hostname, and the port or socket of the MySQL master server. MySQL slave servers are configured using the [slave](#) keyword.

Example 7.205 Minimal plugin-specific configuration file (mysqlnd_ms_plugin.ini)

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": [
        ]
    }
}
```

Configuring a MySQL slave server list is required, although it may contain an empty list. It is recommended to always configure at least one slave server.

Server lists can use [anonymous or non-anonymous syntax](#). Non-anonymous lists include alias names for the servers, such as [master_0](#) for the master in the above example. The quickstart uses the more verbose non-anonymous syntax.

Example 7.206 Recommended minimal plugin-specific config (mysqlnd_ms_plugin.ini)

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.2.27",
                "port": 3306
            }
        }
    }
}
```

```
        "port": "3306"
    }
}
}
```

If there are at least two servers in total, the plugin can start to load balance and switch connections. Switching connections is not always transparent and can cause issues in certain cases. The reference sections about [connection pooling and switching](#), [transaction handling](#), [fail over load balancing](#) and [read-write splitting](#) all provide more details. And potential pitfalls are described later in this guide.

It is the responsibility of the application to handle potential issues caused by connection switches, by configuring a master with at least one slave server, which allows switching to work therefore related problems can be found.

The MySQL master and MySQL slave servers, which you configure, do not need to be part of MySQL replication setup. For testing purpose you can use single MySQL server and make it known to the plugin as a master and slave server as shown below. This could help you to detect many potential issues with connection switches. However, such a setup will not be prone to the issues caused by replication lag.

Example 7.207 Using one server as a master and as a slave (testing only!)

```
{  
    "myapp": {  
        "master": {  
            "master_0": {  
                "host": "localhost",  
                "socket": "\tmp\mysql.sock"  
            }  
        },  
        "slave": {  
            "slave_0": {  
                "host": "127.0.0.1",  
                "port": "3306"  
            }  
        }  
    }  
}
```

The plugin attempts to notify you of invalid configurations. Since 1.5.0 it will throw a warning during PHP startup if the configuration file cannot be read, is empty or parsing the JSON failed. Depending on your PHP settings those errors may appear in some log files only. Further validation is done when a connection is to be established and the configuration file is searched for valid sections. Setting [mysqlnd_ms.force_config_usage](#) may help debugging a faulty setup. Please, see also [configuration file debugging notes](#).

7.7.4.2 Running statements

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The plugin can be used with any PHP MySQL extension ([mysqli](#), [mysql](#), and [PDO_MYSQL](#)) that is compiled to use the [mysqlnd](#) library. [PECL/mysqlnd_ms](#) plugs into the [mysqlnd](#) library. It does not change the API or behavior of those extensions.

Whenever a connection to MySQL is being opened, the plugin compares the host parameter value of the connect call, with the section names from the plugin specific configuration file. If, for example, the plugin specific configuration file has a section `myapp` then the section should be referenced by opening a MySQL connection to the host `myapp`

Example 7.208 Plugin specific configuration file (mysqlnd_ms_plugin.ini)

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.2.27",
                "port": "3306"
            }
        }
    }
}
```

Example 7.209 Opening a load balanced connection

```
<?php
/* Load balanced following "myapp" section rules from the plugins config file */
$mysqli = new mysqli("myapp", "username", "password", "database");
$pdo = new PDO('mysql:host=myapp;dbname=database', 'username', 'password');
$mysql = mysql_connect("myapp", "username", "password");
?>
```

The connection examples above will be load balanced. The plugin will send read-only statements to the MySQL slave server with the IP `192.168.2.27` and will listen on port `3306` for the MySQL client connection. All other statements will be directed to the MySQL master server running on the host `localhost`. If on Unix like operating systems, the master on `localhost` will be accepting MySQL client connections on the Unix domain socket `/tmp/mysql.sock`, while TCP/IP is the default port on Windows. The plugin will use the user name `username` and the password `password` to connect to any of the MySQL servers listed in the section `myapp` of the plugins configuration file. Upon connect, the plugin will select `database` as the current schemata.

The `username`, `password` and schema name are taken from the connect API calls and used for all servers. In other words: you must use the same `username` and `password` for every MySQL server listed in a plugin configuration file section. This is not a general limitation. As of PECL/mysqlnd_ms 1.1.0, it is possible to set the `username` and `password` for any server in the plugins configuration file, to be used instead of the credentials passed to the API call.

The plugin does not change the API for running statements. [Read-write splitting](#) works out of the box. The following example assumes that there is no significant replication lag between the master and the slave.

Example 7.210 Executing statements

```
<?php
/* Load balanced following "myapp" section rules from the plugins config file */
$mysqli = new mysqli("myapp", "username", "password", "database");
if ($mysqli_connect_errno()) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", $mysqli_connect_errno(), $mysqli_connect_error()));
}
/* Statements will be run on the master */
if (!$mysqli->query("DROP TABLE IF EXISTS test")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
if (!$mysqli->query("CREATE TABLE test(id INT)")) {
```

```

    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
if (!$mysqli->query("INSERT INTO test(id) VALUES (1)")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
/* read-only: statement will be run on a slave */
if (!($res = $mysqli->query("SELECT id FROM test")) ) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
} else {
    $row = $res->fetch_assoc();
    $res->close();
    printf("Slave returns id = '%s'\n", $row['id']);
}
$mysqli->close();
?>

```

The above example will output something similar to:

```
Slave returns id = '1'
```

7.7.4.3 Connection state

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The plugin changes the semantics of a PHP MySQL connection handle. A new connection handle represents a connection pool, instead of a single MySQL client-server network connection. The connection pool consists of a master connection, and optionally any number of slave connections.

Every connection from the connection pool has its own state. For example, SQL user variables, temporary tables and transactions are part of the state. For a complete list of items that belong to the state of a connection, see the [connection pooling and switching](#) concepts documentation. If the plugin decides to switch connections for load balancing, the application could be given a connection which has a different state. Applications must be made aware of this.

Example 7.211 Plugin config with one slave and one master

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.2.27",
                "port": "3306"
            }
        }
    }
}
```

Example 7.212 Pitfall: connection state and SQL user variables

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
```

```

}
/* Connection 1, connection bound SQL user variable, no SELECT thus run on master */
if (!$mysqli->query("SET @myrole='master'")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
/* Connection 2, run on slave because SELECT */
if (!$res = $mysqli->query("SELECT @myrole AS _role")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
} else {
    $row = $res->fetch_assoc();
    $res->close();
    printf("@myrole = '%s'\n", $row['_role']);
}
$mysqli->close();
?>

```

The above example will output:

```
@myrole = ''
```

The example opens a load balanced connection and executes two statements. The first statement `SET @myrole='master'` does not begin with the string `SELECT`. Therefore the plugin does not recognize it as a read-only query which shall be run on a slave. The plugin runs the statement on the connection to the master. The statement sets a SQL user variable which is bound to the master connection. The state of the master connection has been changed.

The next statement is `SELECT @myrole AS _role`. The plugin does recognize it as a read-only query and sends it to the slave. The statement is run on a connection to the slave. This second connection does not have any SQL user variables bound to it. It has a different state than the first connection to the master. The requested SQL user variable is not set. The example script prints `@myrole = ''`.

It is the responsibility of the application developer to take care of the connection state. The plugin does not monitor all connection state changing activities. Monitoring all possible cases would be a very CPU intensive task, if it could be done at all.

The pitfalls can easily be worked around using SQL hints.

7.7.4.4 SQL Hints

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SQL hints can force a query to choose a specific server from the connection pool. It gives the plugin a hint to use a designated server, which can solve issues caused by connection switches and connection state.

SQL hints are standard compliant SQL comments. Because SQL comments are supposed to be ignored by SQL processing systems, they do not interfere with other programs such as the MySQL Server, the MySQL Proxy, or a firewall.

Three SQL hints are supported by the plugin: The `MYSQLND_MS_MASTER_SWITCH` hint makes the plugin run a statement on the master, `MYSQLND_MS_SLAVE_SWITCH` enforces the use of the slave, and `MYSQLND_MS_LAST_USED_SWITCH` will run a statement on the same server that was used for the previous statement.

The plugin scans the beginning of a statement for the existence of an SQL hint. SQL hints are only recognized if they appear at the beginning of the statement.

Example 7.213 Plugin config with one slave and one master

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.2.27",
                "port": "3306"
            }
        }
    }
}
```

Example 7.214 SQL hints to prevent connection switches

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if ($mysqli_connect_errno()) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", $mysqli_connect_errno(), $mysqli_connect_error()));
}
/* Connection 1, connection bound SQL user variable, no SELECT thus run on master */
if (!$mysqli->query("SET @myrole='master'")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
/* Connection 1, run on master because of SQL hint */
if (!$res = $mysqli->query(sprintf("/*%s*/SELECT @_role", MYSQLND_MS_LAST_USED_SWITCH))) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
} else {
    $row = $res->fetch_assoc();
    $res->close();
    printf("@myrole = '%s'\n", $row['_role']);
}
$mysqli->close();
?>
```

The above example will output:

```
@myrole = 'master'
```

In the above example, using `MYSQLND_MS_LAST_USED_SWITCH` prevents session switching from the master to a slave when running the `SELECT` statement.

SQL hints can also be used to run `SELECT` statements on the MySQL master server. This may be desired if the MySQL slave servers are typically behind the master, but you need current data from the cluster.

In version 1.2.0 the concept of a service level has been introduced to address cases when current data is required. Using a service level requires less attention and removes the need of using SQL hints for this use case. Please, find more information below in the service level and consistency section.

Example 7.215 Fighting replication lag

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
```

```

    die(sprintf("%d %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* Force use of master, master has always fresh and current data */
if (!$mysqli->query(sprintf("/%s*/SELECT critical_data FROM important_table", MYSQLND_MS_MASTER_SWITCH)))
    printf("%d %s\n", $mysqli->errno, $mysqli->error);
}
?>

```

A use case may include the creation of tables on a slave. If an SQL hint is not given, then the plugin will send `CREATE` and `INSERT` statements to the master. Use the SQL hint `MYSQLND_MS_SLAVE_SWITCH` if you want to run any such statement on a slave, for example, to build temporary reporting tables.

Example 7.216 Table creation on a slave

```

<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("%d %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* Force use of slave */
if (!$mysqli->query(sprintf("/%s*/CREATE TABLE slave_reporting(id INT)", MYSQLND_MS_SLAVE_SWITCH))) {
    printf("%d %s\n", $mysqli->errno, $mysqli->error);
}
/* Continue using this particular slave connection */
if (!$mysqli->query(sprintf("/%s*/INSERT INTO slave_reporting(id) VALUES (1), (2), (3)", MYSQLND_MS_LAST_USED)))
    printf("%d %s\n", $mysqli->errno, $mysqli->error);
}
/* Don't use MYSQLND_MS_SLAVE_SWITCH which would allow switching to another slave! */
if ($res = $mysqli->query(sprintf("/%s*/SELECT COUNT(*) AS _num FROM slave_reporting", MYSQLND_MS_LAST_USED)))
    $row = $res->fetch_assoc();
    $res->close();
    printf("There are %d rows in the table 'slave_reporting'", $row['_num']);
} else {
    printf("%d %s\n", $mysqli->errno, $mysqli->error);
}
$mysqli->close();
?>

```

The SQL hint `MYSQLND_MS_LAST_USED` forbids switching a connection, and forces use of the previously used connection.

7.7.4.5 Local transactions

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The current version of the plugin is not transaction safe by default, because it is not aware of running transactions in all cases. SQL transactions are units of work to be run on a single server. The plugin does not always know when the unit of work starts and when it ends. Therefore, the plugin may decide to switch connections in the middle of a transaction.

No kind of MySQL load balancer can detect transaction boundaries without any kind of hint from the application.

You can either use SQL hints to work around this limitation. Alternatively, you can activate transaction API call monitoring. In the latter case you must use API calls only to control transactions, see below.

Example 7.217 Plugin config with one slave and one master

```
[myapp]
{
```

```

"myapp": {
    "master": {
        "master_0": {
            "host": "localhost",
            "socket": "\tmp\mysql.sock"
        }
    },
    "slave": {
        "slave_0": {
            "host": "192.168.2.27",
            "port": "3306"
        }
    }
}

```

Example 7.218 Using SQL hints for transactions

```

<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* Not a SELECT, will use master */
if (!$mysqli->query("START TRANSACTION")) {
    /* Please use better error handling in your code */
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Prevent connection switch! */
if (!$mysqli->query(sprintf("/%s*/INSERT INTO test(id) VALUES (1)", MYSQLND_MS_LAST_USED_SWITCH))) {
    /* Please do proper ROLLBACK in your code, don't just die */
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
if ($res = $mysqli->query(sprintf("/%s*/SELECT COUNT(*) AS _num FROM test", MYSQLND_MS_LAST_USED_SWITCH))) {
    $row = $res->fetch_assoc();
    $res->close();
    if ($row['_num'] > 1000) {
        if (!$mysqli->query(sprintf("/%s*/INSERT INTO events(task) VALUES ('cleanup')", MYSQLND_MS_LAST_USED_SWITCH)))
            die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
    }
} else {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
if (!$mysqli->query(sprintf("/%s*/UPDATE log SET last_update = NOW()", MYSQLND_MS_LAST_USED_SWITCH))) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
if (!$mysqli->query(sprintf("/%s*/COMMIT", MYSQLND_MS_LAST_USED_SWITCH))) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
$mysqli->close();
?>

```

Starting with PHP 5.4.0, the `mysqlnd` library allows the plugin to monitor the status of the `autocommit` mode, if the mode is set by API calls instead of using SQL statements such as `SET AUTOCOMMIT=0`. This makes it possible for the plugin to become transaction aware. In this case, you do not need to use SQL hints.

If using PHP 5.4.0 or newer, API calls that enable `autocommit` mode, and when setting the plugin configuration option `trx_stickiness=master`, the plugin can automatically disable load balancing and connection switches for SQL transactions. In this configuration, the plugin stops load balancing if `autocommit` is disabled and directs all statements to the master. This prevents connection switches in the middle of a transaction. Once `autocommit` is re-enabled, the plugin starts to load balance statements again.

API based transaction boundary detection has been improved with PHP 5.5.0 and PECL/mysqlnd_ms 1.5.0 to cover not only calls to `mysqli_autocommit` but also `mysqli_begin`, `mysqli_commit` and `mysqli_rollback`.

Example 7.219 Transaction aware load balancing: `trx_stickiness` setting

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "127.0.0.1",
                "port": "3306"
            }
        },
        "trx_stickiness": "master"
    }
}
```

Example 7.220 Transaction aware

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* Disable autocommit, plugin will run all statements on the master */
$mysqli->autocommit(false);
if (!$mysqli->query("INSERT INTO test(id) VALUES (1)")) {
    /* Please do proper ROLLBACK in your code, don't just die */
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
if ($res = $mysqli->query("SELECT COUNT(*) AS _num FROM test")) {
    $row = $res->fetch_assoc();
    $res->close();
    if ($row['_num'] > 1000) {
        if (!$mysqli->query("INSERT INTO events(task) VALUES ('cleanup')")) {
            die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
        }
    }
} else {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
if (!$mysqli->query("UPDATE log SET last_update = NOW()")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
if (!$mysqli->commit()) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Plugin assumes that the transaction has ended and starts load balancing again */
$mysqli->autocommit(true);
$mysqli->close();
?>
```

Version requirement

The plugin configuration option `trx_stickiness=master` requires PHP 5.4.0 or newer.

Please note the restrictions outlined in the [transaction handling](#) concepts section.

7.7.4.6 XA/Distributed Transactions

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Version requirement

XA related functions have been introduced in PECL mysqlnd_ms version 1.6.0-alpha.

Early adaptors wanted

The feature is currently under development. There may be issues and/or feature limitations. Do not use in production environments, although early lab tests indicate reasonable quality.

Please, contact the development team if you are interested in this feature. We are looking for real life feedback to complement the feature.

XA transactions are a standardized method for executing transactions across multiple resources. Those resources can be databases or other transactional systems. The MySQL server supports XA SQL statements which allows users to carry out a distributed SQL transaction that spawns multiple database servers or any kind as long as they support the SQL statements too. In such a scenario it is in the responsibility of the user to coordinate the participating servers.

PECL/mysqlnd_ms can act as a transaction coordinator for a global (distributed, XA) transaction carried out on MySQL servers only. As a transaction coordinator, the plugin tracks all servers involved in a global transaction and transparently issues appropriate SQL statements on the participants. The global transactions are controlled with `mysqlnd_ms_xa_begin`, `mysqlnd_ms_xa_commit` and `mysqlnd_ms_xa_rollback`. SQL details are mostly hidden from the application as is the need to track and coordinate participants.

Example 7.221 General pattern for XA transactions

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* start a global transaction */
$gtrid_id = "12345";
if (!mysqlnd_ms_xa_begin($mysqli, $gtrid_id)) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* run queries as usual: XA BEGIN will be injected upon running a query */
if (!$mysqli->query("INSERT INTO orders(order_id, item) VALUES (1, 'christmas tree, 1.8m')")) {
    /* Either INSERT failed or the injected XA BEGIN failed */
    if ('XA' == substr($mysqli->sqlstate, 0, 2)) {
        printf("Global transaction/XA related failure, [%d] %s\n", $mysqli->errno, $mysqli->error);
    } else {
        printf("INSERT failed, [%d] %s\n", $mysqli->errno, $mysqli->error);
    }
    /* rollback global transaction */
    mysqlnd_ms_xa_rollback($mysqli, $xid);
    die("Stopping.");
}
/* continue carrying out queries on other servers, e.g. other shards */
/* commit the global transaction */
if (!mysqlnd_ms_xa_commit($mysqli, $xa_id)) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
?>
```

Unlike with local transactions, which are carried out on a single server, XA transactions have an identifier (xid) associated with them. The XA transaction identifier is composed of a global transaction identifier (gtrid), a branch qualifier (bqual) a format identifier (formatID). Only the global transaction identifier can and must be given when calling any of the plugins XA functions.

Once a global transaction has been started, the plugin begins tracking servers until the global transaction ends. When a server is picked for query execution, the plugin injects the SQL statement `XA BEGIN` prior to executing the actual SQL statement on the server. `XA BEGIN` makes the server participate in the global transaction. If the injected SQL statement fails, the plugin will report the issue in reply to the query execution function that was used. In the above example, `$mysqli->query("INSERT INTO orders(order_id, item) VALUES (1, 'christmas tree, 1.8m')")` would indicate such an error. You may want to check the errors SQL state code to determine whether the actual query (here: `INSERT`) has failed or the error is related to the global transaction. It is up to you to ignore the failure to start the global transaction on a server and continue execution without having the server participate in the global transaction.

Example 7.222 Local and global transactions are mutually exclusive

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* start a local transaction */
if (!$mysqli->begin_transaction()) {
    die(sprintf("[%d/%s] %s\n", $mysqli->errno, $mysqli->sqlstate, $mysqli->error));
}
/* cannot start global transaction now - must end local transaction first */
$gtrid_id = "12345";
if (!mysqlnd_ms_xa_begin($mysqli, $gtrid_id)) {
    die(sprintf("[%d/%s] %s\n", $mysqli->errno, $mysqli->sqlstate, $mysqli->error));
}
?>
```

The above example will output:

```
Warning: mysqlnd_ms_xa_begin(): (mysqlnd_ms) Some work is done outside global transaction. You must end the active local transaction [1400/XAE09] (mysqlnd_ms) Some work is done outside global transaction. You must end the active local transaction [1400/XAE09]
```

A global transaction cannot be started when a local transaction is active. The plugin tries to detect this situation as early as possible, that is when `mysqlnd_ms_xa_begin` is called. If using API calls only to control transactions, the plugin will know that a local transaction is open and return an error for `mysqlnd_ms_xa_begin`. However, note the plugins [limitations on detecting transaction boundaries..](#) In the worst case, if using direct SQL for local transactions (`BEGIN`, `COMMIT`, ...), it may happen that an error is delayed until some SQL is executed on a server.

To end a global transaction invoke `mysqlnd_ms_xa_commit` or `mysqlnd_ms_xa_rollback`. When a global transaction is ended all participants must be informed of the end. Therefore, PECL/`mysqlnd_ms` transparently issues appropriate XA related SQL statements on some or all of them. Any failure during this phase will cause an implicit rollback. The XA related API is intentionally kept simple here. A more complex API that gave more control would bare few, if any, advantages over a user implementation that issues all lower level XA SQL statements itself.

XA transactions use the two-phase commit protocol. The two-phase commit protocol is a blocking protocol. There are cases when no progress can be made, not even when using timeouts. Transaction

coordinators should survive their own failure, be able to detect blockades and break ties. [PECL/mysqlnd_ms](#) takes the role of a transaction coordinator and can be configured to survive its own crash to avoid issues with blocked MySQL servers. Therefore, the plugin can and should be configured to use a persistent and crash-safe state to allow garbage collection of unfinished, aborted global transactions. A global transaction can be aborted in an open state if either the plugin fails (crashes) or a connection from the plugin to a global transaction participant fails.

Example 7.223 Transaction coordinator state store

```
{
    "myapp": {
        "xa": {
            "state_store": {
                "participant_localhost_ip": "192.168.2.12",
                "mysql": {
                    "host": "192.168.2.13",
                    "user": "root",
                    "password": "",
                    "db": "test",
                    "port": "3312",
                    "socket": null
                }
            }
        },
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.2.14",
                "port": "3306"
            }
        }
    }
}
```

Currently, [PECL/mysqlnd_ms](#) supports only using MySQL database tables as a state store. The SQL definitions of the tables are given in the [plugin configuration section](#). Please, make sure to use a transactional and crash-safe storage engine for the tables, such as InnoDB. InnoDB is the default table engine in recent versions of the MySQL server. Make also sure the database server itself is highly available.

If a state store has been configured, the plugin can perform a garbage collection. During garbage collection it may be necessary to connect to a participant of a failed global transaction. Thus, the state store holds a list of participants and, among others, their host names. If the garbage collection is run on another host but the one that has written a participant entry with the host name `localhost`, then `localhost` resolves to different machines. There are two solutions to the problem. Either you do not configure any servers with the host name `localhost` but configure an IP address (and port) or, you hint the garbage collection. In the above example, `localhost` is used for `master_0`, hence it may not resolve to the correct host during garbage collection. However, `participant_localhost_ip` is also set to hint the garbage collection that `localhost` stands for the IP `192.168.2.12`.

7.7.4.7 Service level and consistency

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Version requirement

Service levels have been introduced in PECL mysqlnd_ms version 1.2.0-alpha. `mysqlnd_ms_set_qos` is available with PHP 5.4.0 or newer.

Different types of MySQL cluster solutions offer different service and data consistency levels to their users. An asynchronous MySQL replication cluster offers eventual consistency by default. A read executed on an asynchronous slave may return current, stale or no data at all, depending on whether the slave has replayed all changesets from the master or not.

Applications using an MySQL replication cluster need to be designed to work correctly with eventual consistent data. In some cases, however, stale data is not acceptable. In those cases only certain slaves or even only master accesses are allowed to achieve the required quality of service from the cluster.

As of PECL mysqlnd_ms 1.2.0 the plugin is capable of selecting MySQL replication nodes automatically that deliver session consistency or strong consistency. Session consistency means that one client can read its writes. Other clients may or may not see the clients' write. Strong consistency means that all clients will see all writes from the client.

Example 7.224 Session consistency: read your writes

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "127.0.0.1",
                "port": "3306"
            }
        }
    }
}
```

Example 7.225 Requesting session consistency

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("%d %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* read-write splitting: master used */
if (!$mysqli->query("INSERT INTO orders(order_id, item) VALUES (1, 'christmas tree, 1.8m')")) {
    /* Please use better error handling in your code */
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
/* Request session consistency: read your writes */
if (!mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_SESSION)) {
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
/* Plugin picks a node which has the changes, here: master */
if (!$res = $mysqli->query("SELECT item FROM orders WHERE order_id = 1")) {
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
var_dump($res->fetch_assoc());
/* Back to eventual consistency: stale data allowed */
if (!mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL)) {
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
/* Plugin picks any slave, stale data is allowed */
if (!$res = $mysqli->query("SELECT item, price FROM specials")) {
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
?>
```

Service levels can be set in the plugins configuration file and at runtime using `mysqlnd_ms_set_qos`. In the example the function is used to enforce session consistency (read your writes) for all future statements until further notice. The `SELECT` statement on the `orders` table is run on the master to ensure the previous write can be seen by the client. Read-write splitting logic has been adapted to fulfill the service level.

After the application has read its changes from the `orders` table it returns to the default service level, which is eventual consistency. Eventual consistency puts no restrictions on choosing a node for statement execution. Thus, the `SELECT` statement on the `specials` table is executed on a slave.

The new functionality supersedes the use of SQL hints and the `master_on_write` configuration option. In many cases `mysqlnd_ms_set_qos` is easier to use, more powerful improves portability.

Example 7.226 Maximum age/slave lag

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "127.0.0.1",
                "port": "3306"
            }
        },
        "failover" : "master"
    }
}
```

Example 7.227 Limiting slave lag

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* Read from slaves lagging no more than four seconds */
$ret = mysqlnd_ms_set_qos(
    $mysqli,
    MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL,
    MYSQLND_MS_QOS_OPTION_AGE,
    4
);
if (!$ret) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Plugin picks any slave, which may or may not have the changes */
if (!$res = $mysqli->query("SELECT item, price FROM daytrade")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Back to default: use of all slaves and masters permitted */
if (!mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL)) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
?>
```

The eventual consistency service level can be used with an optional parameter to set a maximum slave lag for choosing slaves. If set, the plugin checks `SHOW SLAVE STATUS` for all configured slaves. In case of the example, only slaves for which `Slave_IO_Running=Yes`, `Slave_SQL_Running=Yes` and `Seconds_Behind_Master <= 4` is true are considered for executing the statement `SELECT item, price FROM daytrade`.

Checking `SHOW SLAVE STATUS` is done transparently from an applications perspective. Errors, if any, are reported as warnings. No error will be set on the connection handle. Even if all `SHOW SLAVE STATUS` SQL statements executed by the plugin fail, the execution of the users statement is not stopped, given that master fail over is enabled. Thus, no application changes are required.

Expensive and slow operation

Checking `SHOW SLAVE STATUS` for all slaves adds overhead to the application. It is an expensive and slow background operation. Try to minimize the use of it. Unfortunately, a MySQL replication cluster does not give clients the possibility to request a list of candidates from a central instance. Thus, a more efficient way of checking the slaves lag is not available.

Please, note the limitations and properties of `SHOW SLAVE STATUS` as explained in the MySQL reference manual.

To prevent `mysqlnd_ms` from emitting a warning if no slaves can be found that lag no more than the defined number of seconds behind the master, it is necessary to enable master fail over in the plugins configuration file. If no slaves can be found and fail over is turned on, the plugin picks a master for executing the statement.

If no slave can be found and fail over is turned off, the plugin emits a warning, it does not execute the statement and it sets an error on the connection.

Example 7.228 Fail over not set

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\/tmp\/mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "127.0.0.1",
                "port": "3306"
            }
        }
    }
}
```

Example 7.229 No slave within time limit

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* Read from slaves lagging no more than four seconds */
$ret = mysqlnd_ms_set_qos(
    $mysqli,
    MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL,
    MYSQLND_MS_QOS_OPTION_AGE,
```

```

    4
);
if (!$ret) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Plugin picks any slave, which may or may not have the changes */
if (!$res = $mysqli->query("SELECT item, price FROM daytrade")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Back to default: use of all slaves and masters permitted */
if (!mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL)) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
?>

```

The above example will output:

```

PHP Warning: mysqli::query(): (mysqlnd_ms) Couldn't find the appropriate slave connection. 0 slaves to
PHP Warning: mysqli::query(): (mysqlnd_ms) No connection selected by the last filter in %s on line %d
[2000] (mysqlnd_ms) No connection selected by the last filter

```

7.7.4.8 Global transaction IDs

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Version requirement

A client-side global transaction ID injection has been introduced in `mysqlnd_ms` version 1.2.0-alpha. The feature is not required for synchronous clusters, such as MySQL Cluster. Use it with asynchronous clusters such as classical MySQL replication.

As of MySQL 5.6.5-m8 release candidate the MySQL server features built-in global transaction identifiers. The MySQL built-in global transaction ID feature is supported by [PECL/mysqlnd_ms](#) 1.3.0-alpha or later. However, the final feature set found in MySQL 5.6 production releases to date is not sufficient to support the ideas discussed below in all cases. Please, see also the [concepts section](#).

[PECL/mysqlnd_ms](#) can either use its own global transaction ID emulation or the global transaction ID feature built-in to MySQL 5.6.5-m8 or later. From a developer perspective the client-side and server-side approach offer the same features with regards to service levels provided by PECL/mysqlnd_ms. Their differences are discussed in the [concepts section](#).

The quickstart first demonstrates the use of the client-side global transaction ID emulation built-in to [PECL/mysqlnd_ms](#) before its show how to use the server-side counterpart. The order ensures that the underlying idea is discussed first.

Idea and client-side emulation

In its most basic form a global transaction ID (GTID) is a counter in a table on the master. The counter is incremented whenever a transaction is committed on the master. Slaves replicate the table. The counter serves two purposes. In case of a master failure, it helps the database administrator to identify the most recent slave for promoting it to the new master. The most recent slave is the one with the highest counter value. Applications can use the global transaction ID to search for slaves which have replicated a certain write (identified by a global transaction ID) already.

[PECL/mysqlnd_ms](#) can inject SQL for every committed transaction to increment a GTID counter. The so created GTID is accessible by the application to identify an applications write operation. This

enables the plugin to deliver session consistency (read your writes) service level by not only querying masters but also slaves which have replicated the change already. Read load is taken away from the master.

Client-side global transaction ID emulation has some limitations. Please, read the [concepts section](#) carefully to fully understand the principles and ideas behind it, before using in production environments. The background knowledge is not required to continue with the quickstart.

First, create a counter table on your master server and insert a record into it. The plugin does not assist creating the table. Database administrators must make sure it exists. Depending on the error reporting mode, the plugin will silently ignore the lack of the table or bail out.

Example 7.230 Create counter table on master

```
CREATE TABLE `trx` (
  `trx_id` int(11) DEFAULT NULL,
  `last_update` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP
) ENGINE=InnoDB DEFAULT CHARSET=latin1
INSERT INTO `trx`(`trx_id`) VALUES (1);
```

In the plugins configuration file set the SQL to update the global transaction ID table using [on_commit](#) from the [global_transaction_id_injection](#) section. Make sure the table name used for the [UPDATE](#) statement is fully qualified. In the example, `test trx` is used to refer to table `trx` in the schema (database) `test`. Use the table that was created in the previous step. It is important to set the fully qualified table name because the connection on which the injection is done may use a different default database. Make sure the user that opens the connection is allowed to execute the [UPDATE](#).

Enable reporting of errors that may occur when mysqlnd_ms does global transaction ID injection.

Example 7.231 Plugin config: SQL for client-side GTID injection

```
{
  "myapp": {
    "master": {
      "master_0": {
        "host": "localhost",
        "socket": "\/tmp\/mysql.sock"
      }
    },
    "slave": {
      "slave_0": {
        "host": "127.0.0.1",
        "port": "3306"
      }
    },
    "global_transaction_id_injection": {
      "on_commit": "UPDATE test trx SET trx_id = trx_id + 1",
      "report_error": true
    }
  }
}
```

Example 7.232 Transparent global transaction ID injection

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
  /* Of course, your error handling is nicer... */
  die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* auto commit mode, transaction on master, GTID must be incremented */
```

```

if (!$mysqli->query("DROP TABLE IF EXISTS test")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* auto commit mode, transaction on master, GTID must be incremented */
if (!$mysqli->query("CREATE TABLE test(id INT)")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* auto commit mode, transaction on master, GTID must be incremented */
if (!$mysqli->query("INSERT INTO test(id) VALUES (1)")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* auto commit mode, read on slave, no increment */
if (!$res = $mysqli->query("SELECT id FROM test")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
var_dump($res->fetch_assoc());
?>

```

The above example will output:

```

array(1) {
    ["id"]=>
    string(1) "1"
}

```

The example runs three statements in auto commit mode on the master, causing three transactions on the master. For every such statement, the plugin will inject the configured [UPDATE](#) transparently before executing the users SQL statement. When the script ends the global transaction ID counter on the master has been incremented by three.

The fourth SQL statement executed in the example, a [SELECT](#), does not trigger an increment. Only transactions (writes) executed on a master shall increment the GTID counter.

SQL for global transaction ID: efficient solution wanted!

The SQL used for the client-side global transaction ID emulation is inefficient. It is optimized for clarity not for performance. Do not use it for production environments. Please, help finding an efficient solution for inclusion in the manual. We appreciate your input.

Example 7.233 Plugin config: SQL for fetching GTID

```

{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "127.0.0.1",
                "port": "3306"
            }
        },
        "global_transaction_id_injection": {
            "on_commit": "UPDATE test trx SET trx_id = trx_id + 1",
            "fetch_last_gtid" : "SELECT MAX(trx_id) FROM test.trx",
            "report_error":true
        }
    }
}

```

Example 7.234 Obtaining GTID after injection

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* auto commit mode, transaction on master, GTID must be incremented */
if (!$mysqli->query("DROP TABLE IF EXISTS test")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
printf("GTID after transaction %s\n", mysqlnd_ms_get_last_gtid($mysqli));
/* auto commit mode, transaction on master, GTID must be incremented */
if (!$mysqli->query("CREATE TABLE test(id INT)")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
printf("GTID after transaction %s\n", mysqlnd_ms_get_last_gtid($mysqli));
?>
```

The above example will output:

```
GTID after transaction 7
GTID after transaction 8
```

Applications can ask PECL mysqlnd_ms for a global transaction ID which belongs to the last write operation performed by the application. The function `mysqlnd_ms_get_last_gtid` returns the GTID obtained when executing the SQL statement from the `fetch_last_gtid` entry of the `global_transaction_id_injection` section from the plugins configuration file. The function may be called after the GTID has been incremented.

Applications are advised not to run the SQL statement themselves as this bares the risk of accidentally causing an implicit GTID increment. Also, if the function is used, it is easy to migrate an application from one SQL statement for fetching a transaction ID to another, for example, if any MySQL server ever features built-in global transaction ID support.

The quickstart shows a SQL statement which will return a GTID equal or greater to that created for the previous statement. It is exactly the GTID created for the previous statement if no other clients have incremented the GTID in the time span between the statement execution and the `SELECT` to fetch the GTID. Otherwise, it is greater.

Example 7.235 Plugin config: Checking for a certain GTID

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "127.0.0.1",
                "port": "3306"
            }
        },
        "global_transaction_id_injection": {
            "on_commit": "UPDATE test trx SET trx_id = trx_id + 1",
        }
    }
}
```

```
        "fetch_last_gtid" : "SELECT MAX(trx_id) FROM test trx",
        "check_for_gtid" : "SELECT trx_id FROM test trx WHERE trx_id >= #GTID",
        "report_error":true
    }
}
```

Example 7.236 Session consistency service level and GTID combined

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* auto commit mode, transaction on master, GTID must be incremented */
if (! !$mysqli->query("DROP TABLE IF EXISTS test")
    || ! $mysqli->query("CREATE TABLE test(id INT)")
    || ! $mysqli->query("INSERT INTO test(id) VALUES (1)")
) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* GTID as an identifier for the last write */
$gtid = mysqlnd_ms_get_last_gtid($mysqli);
/* Session consistency (read your writes): try to read from slaves not only master */
if (false == mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_SESSION, MYSQLND_MS_QOS_OPTION_GTI
    die(sprintf("[006] [%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Either run on master or a slave which has replicated the INSERT */
if (!($res = $mysqli->query("SELECT id FROM test"))) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
var_dump($res->fetch_assoc());
?>
```

A GTID returned from `mysqlnd_ms_get_last_gtid` can be used as an option for the session consistency service level. Session consistency delivers read your writes. Session consistency can be requested by calling `mysqlnd_ms_set_qos`. In the example, the plugin will execute the `SELECT` statement either on the master or on a slave which has replicated the previous `INSERT` already.

PECL mysqlnd_ms will transparently check every configured slave if it has replicated the `INSERT` by checking the slaves GTID table. The check is done running the SQL set with the `check_for_gtid` option from the `global_transaction_id_injection` section of the plugins configuration file. Please note, that this is a slow and expensive procedure. Applications should try to use it sparsely and only if read load on the master becomes to high otherwise.

Use of the server-side global transaction ID feature

Insufficient server support in MySQL 5.6

The plugin has been developed against a pre-production version of MySQL 5.6. It turns out that all released production versions of MySQL 5.6 do not provide clients with enough information to enforce session consistency based on GTIDs. Please, read the [concepts section](#) for details.

Starting with MySQL 5.6.5-m8 the MySQL Replication system features server-side global transaction IDs. Transaction identifiers are automatically generated and maintained by the server. Users do not need to take care of maintaining them. There is no need to setup any tables in advance, or for setting `on commit`. A client-side emulation is no longer needed.

Clients can continue to use global transaction identifier to achieve session consistency when reading from MySQL Replication slaves in some cases but not all! The algorithm works as described above.

Different SQL statements must be configured for `fetch_last_gtid` and `check_for_gtid`. The statements are given below. Please note, MySQL 5.6.5-m8 is a development version. Details of the server implementation may change in the future and require adoption of the SQL statements shown.

Using the following configuration any of the above described functionality can be used together with the server-side global transaction ID feature. `mysqlnd_ms_get_last_gtid` and `mysqlnd_ms_set_qos` continue to work as described above. The only difference is that the server does not use a simple sequence number but a string containing of a server identifier and a sequence number. Thus, users cannot easily derive an order from GTIDs returned by `mysqlnd_ms_get_last_gtid`.

Example 7.237 Plugin config: using MySQL 5.6.5-m8 built-in GTID feature

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "127.0.0.1",
                "port": "3306"
            }
        },
        "global_transaction_id_injection": {
            "fetch_last_gtid": "SELECT @@GLOBAL.GTID_DONE AS trx_id FROM DUAL",
            "check_for_gtid": "SELECT GTID_SUBSET('#GTID', @@GLOBAL.GTID_DONE) AS trx_id FROM DUAL",
            "report_error": true
        }
    }
}
```

7.7.4.9 Cache integration

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Version requirement, dependencies and status

Please, find more about version requirements, extension load order dependencies and the current status in the [concepts section](#)!

Databases clusters can deliver different levels of consistency. As of PECL/mysqlnd_ms 1.2.0 it is possible to advise the plugin to consider only cluster nodes that can deliver the consistency level requested. For example, if using asynchronous MySQL Replication with its cluster-wide eventual consistency, it is possible to request session consistency (read your writes) at any time using `mysqlnd_ms_set_qos`. Please, see also the [service level and consistency](#) introduction.

Example 7.238 Recap: quality of service to request read your writes

```
/* Request session consistency: read your writes */
if (!mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_SESSION))
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
```

Assuming PECL/mysqlnd has been explicitly told to deliver no consistency level higher than eventual consistency, it is possible to replace a database node read access with a client-side cache using time-to-live (TTL) as its invalidation strategy. Both the database node and the cache may or may not serve current data as this is what eventual consistency defines.

Replacing a database node read access with a local cache access can improve overall performance and lower the database load. If the cache entry is every reused by other clients than the one creating

the cache entry, a database access is saved and thus database load is lowered. Furthermore, system performance can become better if computation and delivery of a database query is slower than a local cache access.

Example 7.239 Plugin config: no special entries for caching

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "127.0.0.1",
                "port": "3306"
            }
        }
    }
}
```

Example 7.240 Caching a slave request

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
if ( !$mysqli->query("DROP TABLE IF EXISTS test")
    || !$mysqli->query("CREATE TABLE test(id INT)")
    || !$mysqli->query("INSERT INTO test(id) VALUES (1)"))
{
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Explicitly allow eventual consistency and caching (TTL <= 60 seconds) */
if (false == mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL, MYSQLND_MS_QOS_OPTION_CAC))
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
/*
 * To make this example work, we must wait for a slave to catch up. Brute force style.
 */
$attempts = 0;
do {
    /* check if slave has the table */
    if ($res = $mysqli->query("SELECT id FROM test")) {
        break;
    } else if ($mysqli->errno) {
        die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
    }
    /* wait for slave to catch up */
    usleep(200000);
} while ($attempts++ < 10);
/* Query has been run on a slave, result is in the cache */
assert($res);
var_dump($res->fetch_assoc());
/* Served from cache */
$res = $mysqli->query("SELECT id FROM test");
?>
```

The example shows how to use the cache feature. First, you have to set the quality of service to eventual consistency and explicitly allow for caching. This is done by calling `mysqlnd_ms_set_qos`. Then, the result set of every read-only statement is cached for upto that many seconds as allowed with `mysqlnd_ms_set_qos`.

The actual TTL is lower or equal to the value set with `mysqlnd_ms_set_qos`. The value passed to the function sets the maximum age (seconds) of the data delivered. To calculate the actual TTL value the replication lag on a slave is checked and subtracted from the given value. If, for example, the maximum age is set to 60 seconds and the slave reports a lag of 10 seconds the resulting TTL is 50 seconds. The TTL is calculated individually for every cached query.

Example 7.241 Read your writes and caching combined

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("%d %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
if (!(!$mysqli->query("DROP TABLE IF EXISTS test")
    || !$mysqli->query("CREATE TABLE test(id INT)")
    || !$mysqli->query("INSERT INTO test(id) VALUES (1)")))
{
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
/* Explicitly allow eventual consistency and caching (TTL <= 60 seconds) */
if (false == mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL, MYSQLND_MS_QOS_OPTION_CACHE,
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error)));
}
/* To make this example work, we must wait for a slave to catch up. Brute force style. */
$attempts = 0;
do {
    /* check if slave has the table */
    if ($res = $mysqli->query("SELECT id FROM test")) {
        break;
    } else if ($mysqli->errno) {
        die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
    }
    /* wait for slave to catch up */
    usleep(200000);
} while ($attempts++ < 10);
assert($res);
/* Query has been run on a slave, result is in the cache */
var_dump($res->fetch_assoc());
/* Served from cache */
if (!($res = $mysqli->query("SELECT id FROM test")))
{
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
var_dump($res->fetch_assoc());
/* Update on master */
if (!$mysqli->query("UPDATE test SET id = 2"))
{
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
/* Read your writes */
if (false == mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_SESSION))
{
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
/* Fetch latest data */
if (!($res = $mysqli->query("SELECT id FROM test")))
{
    die(sprintf("%d %s\n", $mysqli->errno, $mysqli->error));
}
var_dump($res->fetch_assoc());
?>
```

The quality of service can be changed at any time to avoid further cache usage. If needed, you can switch to read your writes (session consistency). In that case, the cache will not be used and fresh data is read.

7.7.4.10 Failover

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By default, the plugin does not attempt to fail over if connecting to a host fails. This prevents pitfalls related to [connection state](#). It is recommended to manually handle connection errors in a way similar to a failed transaction. You should catch the error, rebuild the connection state and rerun your query as shown below.

If connection state is no issue to you, you can alternatively enable automatic and silent failover. Depending on the configuration, the automatic and silent failover will either attempt to fail over to the master before issuing an error or, try to connect to other slaves, given the query allows for it, before attempting to connect to a master. Because [automatic failover](#) is not fool-proof, it is not discussed in the quickstart. Instead, details are given in the concepts section below.

Example 7.242 Manual failover, automatic optional

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "simulate_slave_failure",
                "port": "0"
            },
            "slave_1": {
                "host": "127.0.0.1",
                "port": 3311
            }
        },
        "filters": { "roundrobin": [] }
    }
}
```

Example 7.243 Manual failover

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
$sql = "SELECT 1 FROM DUAL";
/* error handling as it should be done regardless of the plugin */
if (!$res = $link->query($sql)) {
    /* plugin specific: check for connection error */
    switch ($link->errno) {
        case 2002:
        case 2003:
        case 2005:
            printf("Connection error - trying next slave!\n");
            /* load balancer will pick next slave */
            $res = $link->query($sql);
            break;
        default:
            /* no connection error, failover is unlikely to help */
            die(sprintf("SQL error: [%d] %s", $link->errno, $link->error));
            break;
    }
}
if ($res) {
    var_dump($res->fetch_assoc());
}
?>
```

7.7.4.11 Partitioning and Sharding

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Database clustering is done for various reasons. Clusters can improve availability, fault tolerance, and increase performance by applying a divide and conquer approach as work is distributed over many machines. Clustering is sometimes combined with partitioning and sharding to further break up a large complex task into smaller, more manageable units.

The mysqlnd_ms plugin aims to support a wide variety of MySQL database clusters. Some flavors of MySQL database clusters have built-in methods for partitioning and sharding, which could be transparent to use. The plugin supports the two most common approaches: MySQL Replication table filtering, and Sharding (application based partitioning).

MySQL Replication supports partitioning as filters that allow you to create slaves that replicate all or specific databases of the master, or tables. It is then in the responsibility of the application to choose a slave according to the filter rules. You can either use the mysqlnd_ms `node_groups` filter to manually support this, or use the experimental table filter.

Manual partitioning or sharding is supported through the node grouping filter, and SQL hints as of 1.5.0. The `node_groups` filter lets you assign a symbolic name to a group of master and slave servers. In the example, the master `master_0` and `slave_0` form a group with the name `Partition_A`. It is entirely up to you to decide what makes up a group. For example, you may use node groups for sharding, and use the group names to address shards like `Shard_A_Range_0_100`.

Example 7.244 Cluster node groups

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\tmp\mysql.sock"
            }
        },
        "slave": {
            "slave_0": {
                "host": "simulate_slave_failure",
                "port": "0"
            },
            "slave_1": {
                "host": "127.0.0.1",
                "port": 3311
            }
        },
        "filters": {
            "node_groups": {
                "Partition_A" : {
                    "master": [ "master_0" ],
                    "slave": [ "slave_0" ]
                }
            },
            "roundrobin": []
        }
    }
}
```

Example 7.245 Manual partitioning using SQL hints

```
<?php
```

```

function select($mysqli, $msg, $hint = '') {
    /* Note: weak test, two connections to two servers may have the same thread id */
    $sql = sprintf("SELECT CONNECTION_ID() AS _thread, '%s' AS _hint FROM DUAL", $msg);
    if ($hint) {
        $sql = $hint . $sql;
    }
    if (!($res = $mysqli->query($sql))) {
        printf("[%d] %s", $mysqli->errno, $mysqli->error);
        return false;
    }
    $row = $res->fetch_assoc();
    printf("%d - %s - %s\n", $row['_thread'], $row['_hint'], $sql);
    return true;
}
$mysqli = new mysqli("myapp", "user", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error())));
}
/* All slaves allowed */
select($mysqli, "slave_0");
select($mysqli, "slave_1");
/* only servers of node group "Partition_A" allowed */
select($mysqli, "slave_1", "/*Partition_A*/");
select($mysqli, "slave_1", "/*Partition_A*/");
?>

```

```

6804 - slave_0 - SELECT CONNECTION_ID() AS _thread, 'slave1' AS _hint FROM DUAL
2442 - slave_1 - SELECT CONNECTION_ID() AS _thread, 'slave2' AS _hint FROM DUAL
6804 - slave_0 - /*Partition_A*/SELECT CONNECTION_ID() AS _thread, 'slave1' AS _hint FROM DUAL
6804 - slave_0 - /*Partition_A*/SELECT CONNECTION_ID() AS _thread, 'slave1' AS _hint FROM DUAL

```

By default, the plugin will use all configured master and slave servers for query execution. But if a query begins with a SQL hint like `/*node_group*/`, the plugin will only consider the servers listed in the `node_group` for query execution. Thus, `SELECT` queries prefixed with `/*Partition_A*/` will only be executed on `slave_0`.

7.7.4.12 MySQL Fabric

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Version requirement and status

Work on supporting MySQL Fabric started in version 1.6. Please, consider the support to be of pre-alpha quality. The manual may not list all features or feature limitations. This is work in progress.

Sharding is the only use case supported by the plugin to date.

MySQL Fabric concepts

Please, check the MySQL reference manual for more information about MySQL Fabric and how to set it up. The PHP manual assumes that you are familiar with the basic concepts and ideas of MySQL Fabric.

MySQL Fabric is a system for managing farms of MySQL servers to achieve High Availability and optionally support sharding. Technically, it is a middleware to manage and monitor MySQL servers.

Clients query MySQL Fabric to obtain lists of MySQL servers, their state and their roles. For example, clients can request a list of slaves for a MySQL Replication group and whether they are ready to handle SQL requests. Another example is a cluster of sharded MySQL servers where the client seeks to know

which shard to query for a given table and shard key. If configured to use Fabric, the plugin uses XML RCP over HTTP to obtain the list at runtime from a MySQL Fabric host. The XML remote procedure call itself is done in the background and transparent from a developers point of view.

Instead of listing MySQL servers directly in the plugins configuration file it contains a list of one or more MySQL Fabric hosts

Example 7.246 Plugin config: Fabric hosts instead of MySQL servers

```
{
    "myapp": {
        "fabric": {
            "hosts": [
                {
                    "host" : "127.0.0.1",
                    "port" : 8080
                }
            ]
        }
    }
}
```

Users utilize the new functions `mysqlnd_ms_fabric_select_shard` and `mysqlnd_ms_fabric_select_global` to switch to the set of servers responsible for a given shard key. Then, the plugin picks an appropriate server for running queries on. When doing so, the plugin takes care of additional load balancing rules set.

The below example assumes that MySQL Fabric has been setup to shard the table `test.fabrictest` using the `id` column of the table as a shard key.

Example 7.247 Manual partitioning using SQL hints

```
<?php
$mysqli = new mysqli("myapp", "user", "password", "database");
if (!$mysqli) {
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
}
/* Create a global table - a table available on all shards */
mysqlnd_ms_fabric_select_global($mysqli, "test.fabrictest");
if (!$mysqli->query("CREATE TABLE test.fabrictest(id INT NOT NULL PRIMARY KEY)")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Switch connection to appropriate shard and insert record */
mysqlnd_ms_fabric_select_shard($mysqli, "test.fabrictest", 10);
if (!$res = $mysqli->query("INSERT INTO fabrictest(id) VALUES (10)")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
/* Try to read newly inserted record */
mysqlnd_ms_fabric_select_shard($mysqli, "test.fabrictest", 10);
if (!$res = $mysqli->query("SELECT id FROM test WHERE id = 10")) {
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
}
?>
```

The example creates the sharded table, inserts a record and reads the record thereafter. All SQL data definition language (DDL) operations on a sharded table must be applied to the so called global server group. Prior to creating or altering a sharded table, `mysqlnd_ms_fabric_select_global` is called to switch the given connection to the corresponding servers of the global group. Data manipulation (DML) SQL statements must be sent to the shards directly. The `mysqlnd_ms_fabric_select_shard` switches a connection to shards handling a certain shard key.

7.7.5 Concepts

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This explains the architecture and related concepts for this plugin, and describes the impact that MySQL replication and this plugin have on developmental tasks while using a database cluster. Reading and understanding these concepts is required, in order to use this plugin with success.

7.7.5.1 Architecture

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The mysqlnd replication and load balancing plugin is implemented as a PHP extension. It is written in C and operates under the hood of PHP. During the startup of the PHP interpreter, in the module init phase of the PHP engine, it gets registered as a `mysqlnd` plugin to replace selected mysqlnd C methods.

At PHP runtime, it inspects queries sent from mysqlnd (PHP) to the MySQL server. If a query is recognized as read-only, it will be sent to one of the configured slave servers. Statements are considered read-only if they either start with `SELECT`, the SQL hint `/*ms=slave*/` or a slave had been chosen for running the previous query, and the query started with the SQL hint `/*ms=last_used*/`. In all other cases, the query will be sent to the MySQL replication master server.

For better portability, applications should use the `MYSQLND_MS_MASTER_SWITCH`, `MYSQLND_MS_SLAVE_SWITCH`, and `MYSQLND_MS_LAST_USED_SWITCH` predefined `mysqlnd_ms constants`, instead of their literal values, such as `/*ms=slave*/`.

The plugin handles the opening and closing of database connections to both master and slave servers. From an application point of view, there continues to be only one connection handle. However, internally, this one public connection handle represents a pool of network connections that are managed by the plugin. The plugin proxies queries to the master server, and to the slaves using multiple connections.

Database connections have a state consisting of, for example, transaction status, transaction settings, character set settings, and temporary tables. The plugin will try to maintain the same state among all internal connections, whenever this can be done in an automatic and transparent way. In cases where it is not easily possible to maintain state among all connections, such as when using `BEGIN TRANSACTION`, the plugin leaves it to the user to handle.

7.7.5.2 Connection pooling and switching

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The replication and load balancing plugin changes the semantics of a PHP MySQL connection handle. The existing API of the PHP MySQL extensions (`mysqli`, `mysql`, and `PDO_MYSQL`) are not changed in a way that functions are added or removed. But their behavior changes when using the plugin. Existing applications do not need to be adapted to a new API, but they may need to be modified because of the behavior changes.

The plugin breaks the one-by-one relationship between a `mysqli`, `mysql`, and `PDO_MYSQL` connection handle and a MySQL network connection. And a `mysqli`, `mysql`, and `PDO_MYSQL` connection handle represents a local pool of connections to the configured MySQL replication master and MySQL replication slave servers. The plugin redirects queries to the master and slave servers. At some point in time one and the same PHP connection handle may point to the MySQL master server. Later on, it may point to one of the slave servers or still the master. Manipulating and replacing the network connection referenced by a PHP MySQL connection handle is not a transparent operation.

Every MySQL connection has a state. The state of the connections in the connection pool of the plugin can differ. Whenever the plugin switches from one wire connection to another, the current state of the user connection may change. The applications must be aware of this.

The following list shows what the connection state consists of. The list may not be complete.

- Transaction status
- Temporary tables
- Table locks
- Session system variables and session user variables
- The current database set using `USE` and other state chaining SQL commands
- Prepared statements
- `HANDLER` variables
- Locks acquired with `GET_LOCK()`

Connection switches happen right before queries are executed. The plugin does not switch the current connection until the next statement is executed.

Replication issues

See also the MySQL reference manual chapter about [replication features](#) and related issues. Some restrictions may not be related to the PHP plugin, but are properties of the MySQL replication system.

Broadcasted messages

The plugin's philosophy is to align the state of connections in the pool only if the state is under full control of the plugin, or if it is necessary for security reasons. Just a few actions that change the state of the connection fall into this category.

The following is a list of connection client library calls that change state, and are broadcasted to all open connections in the connection pool.

If any of the listed calls below are to be executed, the plugin loops over all open master and slave connections. The loop continues until all servers have been contacted, and the loop does not break if a server indicates a failure. If possible, the failure will propagate to the called user API function, which may be detected depending on which underlying library function was triggered.

Library call	Notes	Version
<code>change_user</code>	Called by the <code>mysqli_change_user</code> user API call. Also triggered upon reuse of a persistent <code>mysqli</code> connection.	Since 1.0.0.
<code>select_db</code>	Called by the following user API calls: <code>mysql_select_db</code> , <code>mysql_list_tables</code> , <code>mysql_db_query</code> , <code>mysql_list_fields</code> , <code>mysqli_select_db</code> . Note, that SQL <code>USE</code> is not monitored.	Since 1.0.0.
<code>set_charset</code>	Called by the following user API calls: <code>mysql_set_charset</code> , <code>mysqli_set_charset</code> . Note, that SQL <code>SET NAMES</code> is not monitored.	Since 1.0.0.
<code>set_server</code>	Called by the following user API calls: <code>mysqli_multi_query</code> , <code>mysqli_real_query</code> , <code>mysqli_query</code> , <code>mysql_query</code> .	Since 1.0.0.
<code>set_client</code>	Called by the following user API calls: <code>mysqli_options</code> , <code>mysqli_ssl_set</code> , <code>mysqli_connect</code> , <code>mysql_connect</code> , <code>mysql_pconnect</code> .	Since 1.0.0.
<code>set_auto_commit</code>	Called by the following user API calls: <code>mysqli_autocommit</code> , <code>PDO::setAttribute(PDO::ATTR_AUTOCOMMIT)</code> .	Since 1.0.0. PHP >= 5.4.0.

Library call	Notes	Version
<code>ssl_set</code>	Called by the following user API calls: <code>mysqli_ssl_set</code> .	Since 1.1.0.

Broadcasting and lazy connections

The plugin does not proxy or “remember” all settings to apply them on connections opened in the future. This is important to remember, if using [lazy connections](#). Lazy connections are connections which are not opened before the client sends the first connection. Use of lazy connections is the default plugin action.

The following connection library calls each changed state, and their execution is recorded for later use when lazy connections are opened. This helps ensure that the connection state of all connections in the connection pool are comparable.

Library call	Notes	Version
<code>change_user</code>	User, password and database recorded for future use.	Since 1.1.0.
<code>select_db</code>	Database recorded for future use.	Since 1.1.0.
<code>set_charset</code>	Calls <code>set_client_option(MYSQL_SET_CHARSET_NAME, charset)</code> on lazy connection to ensure <code>charset</code> will be used upon opening the lazy connection.	Since 1.1.0.
<code>set_auto_commit</code>	Adds <code>SET AUTOCOMMIT=0 1</code> to the list of init commands of a lazy connection using <code>set_client_option(MYSQL_INIT_COMMAND, "SET AUTOCOMMIT=...");</code>	Since 1.1.0. PHP >= 5.4.0.

Connection state

The connection state is not only changed by API calls. Thus, even if PECL mysqlnd_ms monitors all API calls, the application must still be aware. Ultimately, it is the applications responsibility to maintain the connection state, if needed.

Charsets and string escaping

Due to the use of lazy connections, which are a default, it can happen that an application tries to escape a string for use within SQL statements before a connection has been established. In this case string escaping is not possible. The string escape function does not know what charset to use before a connection has been established.

To overcome the problem a new configuration setting `server_charset` has been introduced in version 1.4.0.

Attention has to be paid on escaping strings with a certain charset but using the result on a connection that uses a different charset. Please note, that PECL/mysqlnd_ms manipulates connections and one application level connection represents a pool of multiple connections that all may have different default charsets. It is recommended to configure the servers involved to use the same default charsets. The configuration setting `server_charset` does help with this situation as well. If using `server_charset`, the plugin will set the given charset on all newly opened connections.

7.7.5.3 Local transaction handling

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Transaction handling is fundamentally changed. An SQL transaction is a unit of work that is run on one database server. The unit of work consists of one or more SQL statements.

By default the plugin is not aware of SQL transactions. The plugin may switch connections for load balancing at any point in time. Connection switches may happen in the middle of a transaction. This is against the nature of an SQL transaction. By default, the plugin is not transaction safe.

Any kind of MySQL load balancer must be hinted about the begin and end of a transaction. Hinting can either be done implicitly by monitoring API calls or using SQL hints. Both options are supported by the plugin, depending on your PHP version. API monitoring requires PHP 5.4.0 or newer. The plugin, like any other MySQL load balancer, cannot detect transaction boundaries based on the MySQL Client Server Protocol. Thus, entirely transparent transaction aware load balancing is not possible. The least intrusive option is API monitoring, which requires little to no application changes, depending on your application.

Please, find examples of using SQL hints or the API monitoring in the [examples section](#). The details behind the API monitoring, which makes the plugin transaction aware, are described below.

Beginning with PHP 5.4.0, the `mysqlnd` library allows this plugin to subclass the library C API call `set_autocommit()`, to detect the status of `autocommit` mode.

The PHP MySQL extensions either issue a query (such as `SET AUTOCOMMIT=0|1`), or use the `mysqlnd` library call `set_autocommit()` to control the `autocommit` setting. If an extension makes use of `set_autocommit()`, the plugin can be made transaction aware. Transaction awareness cannot be achieved if using SQL to set the autocommit mode. The library function `set_autocommit()` is called by the `mysqli_autocommit` and `PDO::setAttribute(PDO::ATTR_AUTOCOMMIT)` user API calls.

The plugin configuration option `trx_stickiness=master` can be used to make the plugin transactional aware. In this mode, the plugin stops load balancing if autocommit becomes disabled, and directs all statements to the master until autocommit gets enabled.

An application that does not want to set SQL hints for transactions but wants to use the transparent API monitoring to avoid application changes must make sure that the autocommit settings is changed exclusively through the listed API calls.

API based transaction boundary detection has been improved with PHP 5.5.0 and PECL/mysqlnd_ms 1.5.0 to cover not only calls to `mysqli_autocommit` but also `mysqli_begin`, `mysqli_commit` and `mysqli_rollback`.

7.7.5.4 Error handling

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Applications using PECL/mysqlnd_ms should implement proper error handling for all user API calls. And because the plugin changes the semantics of a connection handle, API calls may return unexpected errors. If using the plugin on a connection handle that no longer represents an individual network connection, but a connection pool, an error code and error message will be set on the connection handle whenever an error occurs on any of the network connections behind.

If using lazy connections, which is the default, connections are not opened until they are needed for query execution. Therefore, an API call for a statement execution may return a connection error. In the example below, an error is provoked when trying to run a statement on a slave. Opening a slave connection fails because the plugin configuration file lists an invalid host name for the slave.

Example 7.248 Provoking a connection error

```
{  
    "myapp": {  
        "master": {  
            "master_0": {  
                "host": "localhost",  
                "socket": "\tmp\mysql.sock"  
            }  
        }  
    }  
}
```

```

        }
    },
    "slave": {
        "slave_0": {
            "host": "invalid_host_name",
        }
    },
    "lazy_connections": 1
}
}

```

The explicit activation of lazy connections is for demonstration purpose only.

Example 7.249 Connection error on query execution

```

<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if ($mysqli->connect_errno())
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", $mysqli->connect_errno(), $mysqli->connect_error()));
/* Connection 1, connection bound SQL user variable, no SELECT thus run on master */
if (!$mysqli->query("SET @myrole='master'")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
/* Connection 2, run on slave because SELECT, provoke connection error */
if (!$res = $mysqli->query("SELECT @myrole AS _role")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
} else {
    $row = $res->fetch_assoc();
    $res->close();
    printf("@myrole = '%s'\n", $row['_role']);
}
$mysqli->close();
?>

```

The above example will output something similar to:

```

PHP Warning:  mysqli::query(): php_network_getaddresses: getaddrinfo failed: Name or service not known
PHP Warning:  mysqli::query(): [2002] php_network_getaddresses: getaddrinfo failed: Name or service not known
[2002] php_network_getaddresses: getaddrinfo failed: Name or service not known

```

Applications are expected to handle possible connection errors by implementing proper error handling.

Depending on the use case, applications may want to handle connection errors differently from other errors. Typical connection errors are 2002 (CR_CONNECTION_ERROR) - Can't connect to local MySQL server through socket '%s' (%d), 2003 (CR_CONN_HOST_ERROR) - Can't connect to MySQL server on '%s' (%d) and 2005 (CR_UNKNOWN_HOST) - Unknown MySQL server host '%s' (%d). For example, the application may test for the error codes and manually perform a fail over. The plugins philosophy is not to offer automatic fail over, beyond master fail over, because fail over is not a transparent operation.

Example 7.250 Provoking a connection error

```

{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
    }
}

```

```
        "slave": {
            "slave_0": {
                "host": "invalid_host_name"
            },
            "slave_1": {
                "host": "192.168.78.136"
            }
        },
        "lazy_connections": 1,
        "filters": {
            "roundrobin": [
            ]
        }
    }
}
```

Explicitly activating lazy connections is done for demonstration purposes, as is round robin load balancing as opposed to the default `random once` type.

Example 7.251 Most basic failover

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if ($mysqli_connect_errno())
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", $mysqli_connect_errno(), $mysqli_connect_error()));
/* Connection 1, connection bound SQL user variable, no SELECT thus run on master */
if (!$mysqli->query("SET @myrole='master'")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
/* Connection 2, first slave */
$res = $mysqli->query("SELECT VERSION() AS _version");
/* Hackish manual fail over */
if (2002 == $mysqli->errno || 2003 == $mysqli->errno || 2004 == $mysqli->errno) {
    /* Connection 3, first slave connection failed, trying next slave */
    $res = $mysqli->query("SELECT VERSION() AS _version");
}
if (!$res) {
    printf("ERROR, [%d] '%s'\n", $mysqli->errno, $mysqli->error);
} else {
    /* Error messages are taken from connection 3, thus no error */
    printf("SUCCESS, [%d] '%s'\n", $mysqli->errno, $mysqli->error);
    $row = $res->fetch_assoc();
    $res->close();
    printf("version = %s\n", $row['_version']);
}
$mysqli->close();
?>
```

The above example will output something similar to:

```
[1045] Access denied for user 'username'@'localhost' (using password: YES)
PHP Warning: mysqli::query(): php_network_getaddresses: getaddrinfo failed: Name or service not known in %
PHP Warning: mysqli::query(): [2002] php_network_getaddresses: getaddrinfo failed: Name or service not kno
SUCCESS, [0] ''
version = 5.6.2-m5-log
```

In some cases, it may not be easily possible to retrieve all errors that occur on all network connections through a connection handle. For example, let's assume a connection handle represents a pool of three open connections. One connection to a master and two connections to the slaves. The application changes the current database using the user API call `mysqli_select_db`, which then calls the mysqld library function to change the schemata. mysqld_ms monitors the function, and tries to

change the current database on all connections to harmonize their state. Now, assume the master succeeds in changing the database, and both slaves fail. Upon the initial error from the first slave, the plugin will set an appropriate error on the connection handle. The same is done when the second slave fails to change the database. The error message from the first slave is lost.

Such cases can be debugged by either checking for errors of the type [E_WARNING](#) (see above) or, if no other option, investigation of the [mysqlnd_ms debug and trace log](#).

7.7.5.5 Transient errors

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Some distributed database clusters make use of transient errors. A transient error is a temporary error that is likely to disappear soon. By definition it is safe for a client to ignore a transient error and retry the failed operation on the same database server. The retry is free of side effects. Clients are not forced to abort their work or to fail over to another database server immediately. They may enter a retry loop before to wait for the error to disappear before giving up on the database server. Transient errors can be seen, for example, when using MySQL Cluster. But they are not bound to any specific clustering solution per se.

[PECL/mysqlnd_ms](#) can perform an automatic retry loop in case of a transient error. This increases distribution transparency and thus makes it easier to migrate an application running on a single database server to run on a cluster of database servers without having to change the source of the application.

The automatic retry loop will repeat the requested operation up to a user configurable number of times and pause between the attempts for a configurable amount of time. If the error disappears during the loop, the application will never see it. If not, the error is forwarded to the application for handling.

In the example below a duplicate key error is provoked to make the plugin retry the failing query two times before the error is passed to the application. Between the two attempts the plugin sleeps for 100 milliseconds.

Example 7.252 Provoking a transient error

```
mysqlnd_ms.enable=1
mysqlnd_ms.collect_statistics=1

{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "transient_error": {
            "mysql_error_codes": [
                1062
            ],
            "max_retries": 2,
            "usleep_retry": 100
        }
    }
}
```

Example 7.253 Transient error retry loop

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
if ($mysqli_connect_errno())
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", $mysqli_connect_errno(), $mysqli_connect_error()));
if (!$mysqli->query("DROP TABLE IF EXISTS test") ||
    !$mysqli->query("CREATE TABLE test(id INT PRIMARY KEY)") ||
    !$mysqli->query("INSERT INTO test(id) VALUES (1)")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
/* Retry loop is completely transparent. Checking statistics is
the only way to know about implicit retries */
$stats = mysqlnd_ms_get_stats();
printf("Transient error retries before error: %d\n", $stats['transient_error_retries']);
/* Provoking duplicate key error to see statistics change */
if (!$mysqli->query("INSERT INTO test(id) VALUES (1)")) {
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
}
$stats = mysqlnd_ms_get_stats();
printf("Transient error retries after error: %d\n", $stats['transient_error_retries']);
$mysqli->close();
?>
```

The above example will output something similar to:

```
Transient error retries before error: 0
[1062] Duplicate entry '1' for key 'PRIMARY'
Transient error retries before error: 2
```

Because the execution of the retry loop is transparent from a users point of view, the example checks the [statistics](#) provided by the plugin to learn about it.

As the example shows, the plugin can be instructed to consider any error transient regardless of the database servers error semantics. The only error that a stock MySQL server considers temporary has the error code [1297](#). When configuring other error codes but [1297](#) make sure your configuration reflects the semantics of your clusters error codes.

The following mysqlnd C API calls are monitored by the plugin to check for transient errors: [query\(\)](#), [change_user\(\)](#), [select_db\(\)](#), [set_charset\(\)](#), [set_server_option\(\)](#), [prepare\(\)](#), [execute\(\)](#), [set_autocommit\(\)](#), [tx_begin\(\)](#), [tx_commit\(\)](#), [tx_rollback\(\)](#), [tx_commit_or_rollback\(\)](#). The corresponding user API calls have similar names.

The maximum time the plugin may sleep during the retry loop depends on the function in question. The a retry loop for [query\(\)](#), [prepare\(\)](#) or [execute\(\)](#) will sleep for up to [max_retries * usleep_retry](#) milliseconds.

However, functions that [control connection state](#) are dispatched to all connections. The retry loop settings are applied to every connection on which the command is to be run. Thus, such a function may interrupt program execution for longer than a function that is run on one server only. For example, [set_autocommit\(\)](#) is dispatched to connections and may sleep up to [\(max_retries * usleep_retry\) * number_of_open_connections](#) milliseconds. Please, keep this in mind when setting long sleep times and large retry numbers. Using the default settings of [max_retries=1](#), [usleep_retry=100](#) and [lazy_connections=1](#) it is unlikely that you will ever see a delay of more than 1 second.

7.7.5.6 Failover

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By default, connection failover handling is left to the user. The application is responsible for checking return values of the database functions it calls and reacting to possible errors. If, for example, the plugin recognizes a query as a read-only query to be sent to the slave servers, and the slave server selected by the plugin is not available, the plugin will raise an error after not executing the statement.

Default: manual failover

It is up to the application to handle the error and, if required, re-issue the query to trigger the selection of another slave server for statement execution. The plugin will make no attempts to failover automatically, because the plugin cannot ensure that an automatic failover will not change the state of the connection. For example, the application may have issued a query which depends on SQL user variables which are bound to a specific connection. Such a query might return incorrect results if the plugin would switch the connection implicitly as part of automatic failover. To ensure correct results, the application must take care of the failover, and rebuild the required connection state. Therefore, by default, no automatic failover is performed by the plugin.

A user that does not change the connection state after opening a connection may activate automatic failover. Please note, that automatic failover logic is limited to connection attempts. Automatic failover is not used for already established connections. There is no way to instruct the plugin to attempt failover on a connection that has been connected to MySQL already in the past.

Automatic failover

The failover policy is configured in the plugins configuration file, by using the [failover](#) configuration directive.

Automatic and silent failover can be enabled through the [failover](#) configuration directive. Automatic failover can either be configured to try exactly one master after a slave failure or, alternatively, loop over slaves and masters before returning an error to the user. The number of connection attempts can be limited and failed hosts can be excluded from future load balancing attempts. Limiting the number of retries and remembering failed hosts are considered experimental features, albeit being reasonable stable. Syntax and semantics may change in future versions.

Please note, since version 1.5.0 automatic failover is disabled for the duration of a transaction if transaction stickiness is enabled and transaction boundaries have been detected. The plugin will not switch connections for the duration of a transaction. It will also not perform automatic and silent failover. Instead an error will be thrown. It is then left to the user to handle the failure of the transaction. Please check, the [trx_stickiness](#) documentation how to do this.

A basic manual failover example is provided within the [error handling](#) section.

Standby servers

Using [weighted load balancing](#), introduced in PECL/mysqlnd 1.4.0, it is possible to configure standby servers that are sparsely used during normal operations. A standby server that is primarily used as a worst-case standby failover target can be assigned a very low weight/priority in relation to all other servers. As long as all servers are up and running the majority of the workload is assigned to the servers which have hight weight values. Few requests will be directed to the standby system which has a very low weight value.

Upon failure of the servers with a high priority, you can still failover to the standby, which has been given a low load balancing priority by assigning a low weight to it. Failover can be some manually or automatically. If done automatically, you may want to combine it with the [remember_failed](#) option.

At this point, it is not possible to instruct the load balancer to direct no requests at all to a standby. This may not be much of a limitation given that the highest weight you can assign to a server is 65535. Given two slaves, of which one shall act as a standby and has been assigned a weight of 1, the standby will have to handle far less than one percent of the overall workload.

Failover and primary copy

Please note, if using a primary copy cluster, such as MySQL Replication, it is difficult to do connection failover in case of a master failure. At any time there is only one master in the cluster for a given dataset. The master is a single point of failure. If the master fails, clients have no target to fail over write requests. In case of a master outage the database administrator must take care of the situation and update the client configurations, if need be.

7.7.5.7 Load balancing

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Four load balancing strategies are supported to distribute statements over the configured MySQL slave servers:

random	Chooses a random server whenever a statement is executed.
random once (default)	Chooses a random server after the first statement is executed, and uses the decision for the rest of the PHP request.
	It is the default, and the lowest impact on the connection state.
round robin	Iterates over the list of configured servers.
user-defined via callback	Is used to implement any other strategy.

The load balancing policy is configured in the plugins configuration file using the [random](#), [roundrobin](#), and [user filters](#).

Servers can be prioritized assigning a weight. A server that has been given a weight of two will get twice as many requests as a server that has been given the default weight of one. Prioritization can be handy in heterogenous environments. For example, you may want to assign more requests to a powerful machine than to a less powerful. Or, you may have configured servers that are close or far from the client, thus expose different latencies.

7.7.5.8 Read-write splitting

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The plugin executes read-only statements on the configured MySQL slaves, and all other queries on the MySQL master. Statements are considered read-only if they either start with `SELECT`, the SQL hint `/*ms=slave*/`, or if a slave had been chosen for running the previous query and the query starts with the SQL hint `/*ms=last_used*/`. In all other cases, the query will be sent to the MySQL replication master server. It is recommended to use the constants `MYSQLND_MS_SLAVE_SWITCH`, `MYSQLND_MS_MASTER_SWITCH` and `MYSQLND_MS_LAST_USED_SWITCH` instead of `/*ms=slave*/`. See also the [list of mysqlnd_ms constants](#).

SQL hints are a special kind of standard compliant SQL comments. The plugin does check every statement for certain SQL hints. The SQL hints are described within the [mysqlnd_ms constants](#) documentation, constants that are exported by the extension. Other systems involved with the statement processing, such as the MySQL server, SQL firewalls, and SQL proxies, are unaffected by the SQL hints, because those systems are designed to ignore SQL comments.

The built-in read-write splitter can be replaced by a user-defined filter, see also the [user filter](#) documentation.

A user-defined read-write splitter can request the built-in logic to send a statement to a specific location, by invoking `mysqlnd_ms_is_select`.

Note

The built-in read-write splitter is not aware of multi-statements. Multi-statements are seen as one statement. The splitter will check the beginning of the

statement to decide where to run the statement. If, for example, a multi-statement begins with `SELECT 1 FROM DUAL; INSERT INTO test(id) VALUES (1); ...` the plugin will run it on a slave although the statement is not read-only.

7.7.5.9 Filter

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Version requirement

Filters exist as of mysqlnd_ms version 1.1.0-beta.

filters. PHP applications that implement a MySQL replication cluster must first identify a group of servers in the cluster which could execute a statement before the statement is executed by one of the candidates. In other words: a defined list of servers must be filtered until only one server is available.

The process of filtering may include using one or more filters, and filters can be chained. And they are executed in the order they are defined in the plugins configuration file.

Explanation: comparing filter chaining to pipes

The concept of chained filters can be compared to using pipes to connect command line utilities on an operating system command shell. For example, an input stream is passed to a processor, filtered, and then transferred to be output. Then, the output is passed as input to the next command, which is connected to the previous using the pipe operator.

Available filters:

- Load balancing filters: `random` and `roundrobin`.
- Selection filter: `user`, `user_multi`, `quality_of_service`.

The `random` filter implements the 'random' and 'random once' load balancing policies. The 'round robin' load balancing can be configured through the `roundrobin` filter. Setting a 'user defined callback' for server selection is possible with the `user` filter. The `quality_of_service` filter finds cluster nodes capable of delivering a certain service, for example, read-your-writes or, not lagging more seconds behind the master than allowed.

Filters can accept parameters to change their behavior. The `random` filter accepts an optional `sticky` parameter. If set to true, the filter changes load balancing from random to random once. Random picks a random server every time a statement is to be executed. Random once picks a random server when the first statement is to be executed and uses the same server for the rest of the PHP request.

One of the biggest strength of the filter concept is the possibility to chain filters. This strength does not become immediately visible because the `random`, `roundrobin` and `user` filters are supposed to output no more than one server. If a filter reduces the list of candidates for running a statement to only one server, it makes little sense to use that one server as input for another filter for further reduction of the list of candidates.

An example filter sequence that will fail:

- Statement to be executed: `SELECT 1 FROM DUAL`. Passed to all filters.
- All configured nodes are passed as input to the first filter. Master nodes: `master_0`. Slave nodes: `slave_0`, `slave_1`
- Filter: `random`, argument `sticky=1`. Picks a random slave once to be used for the rest of the PHP request. Output: `slave_0`.

- Output of `slave_0` and the statement to be executed is passed as input to the next filter. Here: `roundrobin`, server list passed to filter is: `slave_0`.
- Filter: `roundrobin`. Server list consists of one server only, round robin will always return the same server.

If trying to use such a filter sequence, the plugin may emit a warning like `(mysqlnd_ms) Error while creating filter '%s' . Non-multi filter '%s' already created. Stopping in %s on line %d`. Furthermore, an appropriate error on the connection handle may be set.

A second type of filter exists: multi filter. A multi filter emits zero, one or multiple servers after processing. The `quality_of_service` filter is an example. If the service quality requested sets an upper limit for the slave lag and more than one slave is lagging behind less than the allowed number of seconds, the filter returns more than one cluster node. A multi filter must be followed by other to further reduce the list of candidates for statement execution until a candidate is found.

A filter sequence with the `quality_of_service` multi filter followed by a load balancing filter.

- Statement to be executed: `SELECT sum(price) FROM orders WHERE order_id = 1`. Passed to all filters.
- All configured nodes are passed as input to the first filter. Master nodes: `master_0`. Slave nodes: `slave_0, slave_1, slave_2, slave_3`
- Filter: `quality_of_service`, rule set: `session_consistency` (read-your-writes) Output: `master_0`
- Output of `master_0` and the statement to be executed is passed as input to the next filter, which is `roundrobin`.
- Filter: `roundrobin`. Server list consists of one server. Round robin selects `master_0`.

A filter sequence must not end with a multi filter. If trying to use a filter sequence which ends with a multi filter the plugin may emit a warning like `(mysqlnd_ms) Error in configuration. Last filter is multi filter. Needs to be non-multi one. Stopping in %s on line %d`. Furthermore, an appropriate error on the connection handle may be set.

Speculation towards the future: MySQL replication filtering

In future versions, there may be additional multi filters. For example, there may be a `table` filter to support MySQL replication filtering. This would allow you to define rules for which database or table is to be replicated to which node of a replication cluster. Assume your replication cluster consists of four slaves (`slave_0, slave_1, slave_2, slave_3`) two of which replicate a database named `sales` (`slave_0, slave_1`). If the application queries the database `slaves`, the hypothetical `table` filter reduces the list of possible servers to `slave_0` and `slave_1`. Because the output and list of candidates consists of more than one server, it is necessary and possible to add additional filters to the candidate list, for example, using a load balancing filter to identify a server for statement execution.

7.7.5.10 Service level and consistency

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Version requirement

Service levels have been introduced in mysqlnd_ms version 1.2.0-alpha.
`mysqlnd_ms_set_qos` requires PHP 5.4.0 or newer.

The plugin can be used with different kinds of MySQL database clusters. Different clusters can deliver different levels of service to applications. The service levels can be grouped by the data consistency levels that can be achieved. The plugin knows about:

- eventual consistency
- session consistency
- strong consistency

Depending how a cluster is used it may be possible to achieve higher service levels than the default one. For example, a read from an asynchronous MySQL replication slave is eventual consistent. Thus, one may say the default consistency level of a MySQL replication cluster is eventual consistency. However, if the master only is used by a client for reading and writing during a session, session consistency (read your writes) is given. PECL mysqlnd 1.2.0 abstracts the details of choosing an appropriate node for any of the above service levels from the user.

Service levels can be set through the qualify-of-service filter in the [plugins configuration file](#) and at runtime using the function `mysqlnd_ms_set_qos`.

The plugin defines the different service levels as follows.

Eventual consistency is the default service provided by an asynchronous cluster, such as classical MySQL replication. A read operation executed on an arbitrary node may or may not return stale data. The applications view of the data is eventual consistent.

Session consistency is given if a client can always read its own writes. An asynchronous MySQL replication cluster can deliver session consistency if clients always use the master after the first write or never query a slave which has not yet replicated the clients write operation.

The plugins understanding of strong consistency is that all clients always see the committed writes of all other clients. This is the default when using MySQL Cluster or any other cluster offering synchronous data distribution.

Service level parameters

Eventual consistency and session consistency service level accept parameters.

Eventual consistency is the service provided by classical MySQL replication. By default, all nodes qualify for read requests. An optional `age` parameter can be given to filter out nodes which lag more than a certain number of seconds behind the master. The plugin is using `SHOW SLAVE STATUS` to measure the lag. Please, see the MySQL reference manual to learn about accuracy and reliability of the `SHOW SLAVE STATUS` command.

Session consistency (read your writes) accepts an optional `GTID` parameter to consider reading not only from the master but also from slaves which already have replicated a certain write described by its transaction identifier. This way, when using asynchronous MySQL replication, read requests may be load balanced over slaves while still ensuring session consistency.

The latter requires the use of [client-side global transaction id injection](#).

Advantages of the new approach

The new approach supersedes the use of SQL hints and the configuration option `master_on_write` in some respects. If an application running on top of an asynchronous MySQL replication cluster cannot accept stale data for certain reads, it is easier to tell the plugin to choose appropriate nodes than prefixing all read statements in question with the SQL hint to enforce the use of the master. Furthermore, the plugin may be able to use selected slaves for reading.

The `master_on_write` configuration option makes the plugin use the master after the first write (session consistency, read your writes). In some cases, session consistency may not be needed for the rest of the session but only for some, few read operations. Thus, `master_on_write` may result in more read load on the master than necessary. In those cases it is better to request a higher than default service level only for those reads that actually need it. Once the reads are done, the

application can return to default service level. Switching between service levels is only possible using `mysqlnd_ms_set_qos`.

Performance considerations

A MySQL replication cluster cannot tell clients which slaves are capable of delivering which level of service. Thus, in some cases, clients need to query the slaves to check their status. PECL mysqlnd_ms transparently runs the necessary SQL in the background. However, this is an expensive and slow operation. SQL statements are run if eventual consistency is combined with an age (slave lag) limit and if session consistency is combined with a global transaction ID.

If eventual consistency is combined with an maximum age (slave lag), the plugin selects candidates for statement execution and load balancing for each statement as follows. If the statement is a write all masters are considered as candidates. Slaves are not checked and not considered as candidates. If the statement is a read, the plugin transparently executes `SHOW SLAVE STATUS` on every slaves connection. It will loop over all connections, send the statement and then start checking for results. Usually, this is slightly faster than a loop over all connections in which for every connection a query is send and the plugin waits for its results. A slave is considered a candidate if `SHOW SLAVE STATUS` reports `Slave_IO_Running=Yes`, `Slave_SQL_Running=Yes` and `Seconds_Behind_Master` is less or equal than the allowed maximum age. In case of an SQL error, the plugin emits a warning but does not set an error on the connection. The error is not set to make it possible to use the plugin as a drop-in.

If session consistency is combined with a global transaction ID, the plugin executes the SQL statement set with the `fetch_last_gtid` entry of the `global_transaction_id_injection` section from the plugins configuration file. Further details are identical to those described above.

In version 1.2.0 no additional optimizations are done for executing background queries. Future versions may contain optimizations, depending on user demand.

If no parameters and options are set, no SQL is needed. In that case, the plugin consider all nodes of the type shown below.

- eventual consistency, no further options set: all masters, all slaves
- session consistency, no further options set: all masters
- strong consistency (no options allowed): all masters

Throttling

The quality of service filter can be combined with [Global transaction IDs](#) to throttle clients. Throttling does reduce the write load on the master by slowing down clients. If session consistency is requested and global transactions identifier are used to check the status of a slave, the check can be done in two ways. By default a slave is checked and skipped immediately if it does not match the criteria for session consistency. Alternatively, the plugin can wait for a slave to catch up to the master until session consistency is possible. To enable the throttling, you have to set `wait_for_gtid_timeout` configuration option.

7.7.5.11 Global transaction IDs

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Version requirement

Client side global transaction ID injection exists as of mysqlnd_ms version 1.2.0-alpha. Transaction boundaries are detected by monitoring API calls. This is possible as of PHP 5.4.0. Please, see also [Transaction handling](#).

As of MySQL 5.6.5-m8 the MySQL server features built-in global transaction identifiers. The MySQL built-in global transaction ID feature is supported by

[PECL/mysqlnd_ms](#) 1.3.0-alpha or later. Neither are client-side transaction boundary monitoring nor any setup activities required if using the server feature.

Please note, all MySQL 5.6 production versions do not provide clients with enough information to use GTIDs for enforcing session consistency. In the worst case, the plugin will choose the master only.

Idea and client-side emulation

[PECL/mysqlnd_ms](#) can do client-side transparent global transaction ID injection. In its most basic form, a global transaction identifier is a counter which is incremented for every transaction executed on the master. The counter is held in a table on the master. Slaves replicate the counter table.

In case of a master failure a database administrator can easily identify the most recent slave for promoting it as a new master. The most recent slave has the highest transaction identifier.

Application developers can ask the plugin for the global transaction identifier (GTID) for their last successful write operation. The plugin will return an identifier that refers to a transaction no older than that of the clients last write operation. Then, the GTID can be passed as a parameter to the quality of service (QoS) filter as an option for session consistency. Session consistency ensures read your writes. The filter ensures that all reads are either directed to a master or a slave which has replicated the write referenced by the GTID.

When injection is done

The plugin transparently maintains the GTID table on the master. In autocommit mode the plugin injects an [UPDATE](#) statement before executing the users statement for every master use. In manual transaction mode, the injection is done before the application calls [commit\(\)](#) to close a transaction. The configuration option [report_error](#) of the GTID section in the plugins configuration file is used to control whether a failed injection shall abort the current operation or be ignored silently (default).

Please note, the PHP version requirements for [transaction boundary monitoring](#) and their limits.

Limitations

Client-side global transaction ID injection has shortcomings. The potential issues are not specific to [PECL/mysqlnd_ms](#) but are rather of general nature.

- Global transaction ID tables must be deployed on all masters and replicas.
- The GTID can have holes. Only PHP clients using the plugin will maintain the table. Other clients will not.
- Client-side transaction boundary detection is based on API calls only.
- Client-side transaction boundary detection does not take implicit commit into account. Some MySQL SQL statements cause an implicit commit and cannot be rolled back.

Using server-side global transaction identifier

Starting with [PECL/mysqlnd_ms](#) 1.3.0-alpha the MySQL 5.6.5-m8 or newer built-in global transaction identifier feature is supported. Use of the server feature lifts all of the above listed limitations. Please, see the MySQL Reference Manual for limitations and preconditions for using server built-in global transaction identifiers.

Whether to use the client-side emulation or the server built-in functionality is a question not directly related to the plugin, thus it is not discussed in depth. There are no plans to remove the client-side emulation and you can continue to use it, if the server-side solution is no option. This may be the case in heterogeneous environments with old MySQL server or, if any of the server-side solution limitations is not acceptable.

From an applications perspective there is hardly a difference in using one or the other approach. The following properties differ.

- Client-side emulation, as shown in the manual, is using an easy to compare sequence number for global transactions. Multi-master is not handled to keep the manual examples easy.

Server-side built-in feature is using a combination of a server identifier and a sequence number as a global transaction identifier. Comparison cannot use numeric algebra. Instead a SQL function must be used. Please, see the MySQL Reference Manual for details.

Server-side built-in feature of MySQL 5.6 cannot be used to ensure session consistency under all circumstances. Do not use it for the quality-of-service feature. Here is a simple example why it will not give reliable results. There are more edge cases that cannot be covered with limited functionality exported by the server. Currently, clients can ask a MySQL replication master for a list of all executed global transaction IDs only. If a slave is configured not to replicate all transactions, for example, because replication filters are set, then the slave will never show the same set of executed global transaction IDs. Albeit the slave may have replicated a clients writes and it may be a candidate for a consistent read, it will never be considered by the plugin. Upon write the plugin learns from the master that the servers complete transaction history consists of GTID=1..3. There is no way for the plugin to ask for the GTID of the write transaction itself, say GTID=3. Assume that a slave does not replicate the transactions GTID=1..2 but only GTID=3 because of a replication feature. Then, the slaves transaction history is GTID=3. However, the plugin tries to find a node which has a transaction history of GTID=1...3. Albeit the slave has replicated the clients write and session consistency may be achieved when reading from the slave, it will not be considered by the plugin. This is not a fault of the plugin implementation but a feature gap on the server side. Please note, this is a trivial case to illustrate the issue there are other issues. In sum you are asked not to attempt using MySQL 5.6 built-in GTIDs for enforcing session consistency. Sooner or later the load balancing will stop working properly and the plugin will direct all session consistency requests to the master.

- Plugin global transaction ID statistics are only available with client-side emulation because they monitor the emulation.

Global transaction identifiers in distributed systems

Global transaction identifiers can serve multiple purposes in the context of distributed systems, such as a database cluster. Global transaction identifiers can be used for, for example, system wide identification of transactions, global ordering of transactions, heartbeat mechanism and for checking the replication status of replicas. [PECL/mysqlnd_ms](#), a clientside driver based software, does focus on using GTIDs for tasks that can be handled at the client, such as checking the replication status of replicas for asynchronous replication setups.

7.7.5.12 Cache integration

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Version requirement

The feature requires use of [PECL/mysqlnd_ms](#) 1.3.0-beta or later, and [PECL/mysqlnd_qc](#) 1.1.0-alpha or newer. [PECL/mysqlnd_ms](#) must be compiled to support the feature. PHP 5.4.0 or newer is required.

Setup: extension load order

[PECL/mysqlnd_ms](#) must be loaded before [PECL/mysqlnd_qc](#), when using shared extensions.

Feature stability

The cache integration is of beta quality.

Suitable MySQL clusters

The feature is targeted for use with MySQL Replication (primary copy). Currently, no other kinds of MySQL clusters are supported. Users of such cluster must control PECL/mysqlnd_qc manually if they are interested in client-side query caching.

Support for MySQL replication clusters (asynchronous primary copy) is the main focus of [PECL/mysqlnd_ms](#). The slaves of a MySQL replication cluster may or may not reflect the latest updates from the master. Slaves are asynchronous and can lag behind the master. A read from a slave is eventual consistent from a cluster-wide perspective.

The same level of consistency is offered by a local cache using time-to-live (TTL) invalidation strategy. Current data or stale data may be served. Eventually, data searched for in the cache is not available and the source of the cache needs to be accessed.

Given that both a MySQL Replication slave (asynchronous secondary) and a local TTL-driven cache deliver the same level of service it is possible to transparently replace a remote database access with a local cache access to gain better possibility.

As of [PECL/mysqlnd_ms](#) 1.3.0-beta the plugin is capable of transparently controlling [PECL/mysqlnd_ms](#) 1.1.0-alpha or newer to cache a read-only query if explicitly allowed by setting an appropriate quality of service through [mysqlnd_ms_set_qos](#). Please, see the [quickstart](#) for a code example. Both plugins must be installed, [PECL/mysqlnd_ms](#) must be compiled to support the cache feature and PHP 5.4.0 or newer has to be used.

Applications have full control of cache usage and can request fresh data at any time, if need be. The cache usage can be enabled and disabled time during the execution of a script. The cache will be used if [mysqlnd_ms_set_qos](#) sets the quality of service to eventual consistency and enables cache usage. Cache usage is disabled by requesting higher consistency levels, for example, session consistency (read your writes). Once the quality of service has been relaxed to eventual consistency the cache can be used again.

If caching is enabled for a read-only statement, [PECL/mysqlnd_ms](#) may inject [SQL hints to control caching](#) by PECL/mysqlnd_qc. It may modify the SQL statement it got from the application. Subsequent SQL processors are supposed to ignore the SQL hints. A SQL hint is a SQL comment. Comments must not be ignored, for example, by the database server.

The TTL of a cache entry is computed on a per statement basis. Applications set an maximum age for the data they want to retrieve using [mysqlnd_ms_set_qos](#). The age sets an approximate upper limit of how many seconds the data returned may lag behind the master.

The following logic is used to compute the actual TTL if caching is enabled. The logic takes the estimated slave lag into account for choosing a TTL. If, for example, there are two slaves lagging 5 and 10 seconds behind and the maximum age allowed is 60 seconds, the TTL is set to 50 seconds. Please note, the age setting is no more than an estimated guess.

- Check whether the statement is read-only. If not, don't cache.
- If caching is enabled, check the slave lag of all configured slaves. Establish slave connections if none exist so far and lazy connections are used.
- Send `SHOW SLAVE STATUS` to all slaves. Do not wait for the first slave to reply before sending to the second slave. Clients often wait long for replies, thus we send out all requests in a burst before fetching in a second stage.
- Loop over all slaves. For every slave wait for its reply. Do not start checking another slave before the currently waited for slave has replied. Check for `Slave_IO_Running=Yes` and `Slave_SQL_Running=Yes`. If both conditions hold true, fetch the value of `Seconds_Behind_Master`. In case of any errors or if conditions fail, set an error on the slave connection. Skip any such slave connection for the rest of connection filtering.

- Search for the maximum value of `Seconds_Behind_Master` from all slaves that passed the previous conditions. Subtract the value from the maximum age provided by the user with `mysqlnd_ms_set_qos`. Use the result as a TTL.
- The filtering may sort out all slaves. If so, the maximum age is used as TTL, because the maximum lag found equals zero. It is perfectly valid to sort out all slaves. In the following it is up to subsequent filter to decide what to do. The built-in load balancing filter will pick the master.
- Inject the appropriate SQL hints to enable caching by `PECL/mysqlnd_qc`.
- Proceed with the connection filtering, e.g. apply load balancing rules to pick a slave.
- `PECL/mysqlnd_qc` is loaded after `PECL/mysqlnd_ms` by PHP. Thus, it will see all query modifications of `PECL/mysqlnd_ms` and cache the query if instructed to do so.

The algorithm may seem expensive. `SHOW SLAVE STATUS` is a very fast operation. Given a sufficient number of requests and cache hits per second the cost of checking the slaves lag can easily outweigh the costs of the cache decision.

Suggestions on a better algorithm are always welcome.

7.7.5.13 Supported clusters

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Any application using any kind of MySQL cluster is faced with the same tasks:

- Identify nodes capable of executing a given statement with the required service level
- Load balance requests within the list of candidates
- Automatic fail over within candidates, if needed

The plugin is optimized for fulfilling these tasks in the context of a classical asynchronous MySQL replication cluster consisting of a single master and many slaves (primary copy). When using classical, asynchronous MySQL replication all of the above listed tasks need to be mastered at the client side.

Other types of MySQL cluster may have lower requirements on the application side. For example, if all nodes in the cluster can answer read and write requests, no read-write splitting needs to be done (multi-master, update-all). If all nodes in the cluster are synchronous, they automatically provide the highest possible quality of service which makes choosing a node easier. In this case, the plugin may serve the application after some reconfiguration to disable certain features, such as built-in read-write splitting.

Documentation focus

The documentation focusses describing the use of the plugin with classical asynchronous MySQL replication clusters (primary copy). Support for this kind of cluster has been the original development goal. Use of other clusters is briefly described below. Please note, that this is still work in progress.

Primary copy (MySQL Replication)

This is the primary use case of the plugin. Follow the hints given in the descriptions of each feature.

- Configure one master and one or more slaves. [Server configuration details](#) are given in the setup section.
- Use random load balancing policy together with the `sticky` flag.
- If you do not plan to use the `service level` API calls, add the `master on write` flag.

- Please, make yourself aware of the properties of automatic failover before adding a [failover](#) directive.
- Consider the use of [trx_stickiness](#) to execute transactions on the primary only. Please, read carefully how it works before you rely on it.

Example 7.254 Enabling the plugin (php.ini)

```
mysqlnd_ms.enable=1
mysqlnd_ms.config_file=/path/to/mysqlnd_ms_plugin.ini
```

Example 7.255 Basic plugin configuration (mysqlnd_ms_plugin.ini) for MySQL Replication

```
{
  "myapp": {
    "master": {
      "master_1": {
        "host": "localhost",
        "socket": "\/tmp\/mysql57.sock"
      }
    },
    "slave": {
      "slave_0": {
        "host": "127.0.0.1",
        "port": 3308
      },
      "slave_1": {
        "host": "192.168.2.28",
        "port": 3306
      }
    },
    "filters": {
      "random": {
        "sticky": "1"
      }
    }
  }
}
```

Primary copy with multi primaries (MMM - MySQL Multi Master)

MySQL Replication allows you to create cluster topologies with multiple masters (primaries). Write-write conflicts are not handled by the replication system. This is no update anywhere setup. Thus, data must be partitioned manually and clients must redirected in accordance to the partitioning rules. The recommended setup is equal to the sharding setup below.

Manual sharding, possibly combined with primary copy and multiple primaries

Use SQL hints and the node group filter for clusters that use data partitioning but leave query redirection to the client. The example configuration shows a multi master setup with two shards.

Example 7.256 Multiple primaries - multi master (php.ini)

```
mysqlnd_ms.enable=1
mysqlnd_ms.config_file=/path/to/mysqlnd_ms_plugin.ini
mysqlnd_ms.multi_master=1
```

Example 7.257 Primary copy with multiple primaries and partitioning

```
{
  "myapp": {
    "master": {
      "master_1": {
        "host": "localhost",
        "socket": "\tmp\mysql57.sock"
      }
      "master_2": {
        "host": "192.168.2.27",
        "socket": "3306"
      }
    },
    "slave": {
      "slave_1": {
        "host": "127.0.0.1",
        "port": 3308
      },
      "slave_2": {
        "host": "192.168.2.28",
        "port": 3306
      }
    },
    "filters": {
      "node_groups": {
        "Partition_A" : {
          "master": [ "master_1" ],
          "slave": [ "slave_1" ]
        },
        "Partition_B" : {
          "master": [ "master_2" ],
          "slave": [ "slave_2" ]
        }
      },
      "roundrobin": []
    }
  }
}
```

The plugin can also be used with a loose collection of unrelated shards. For such a cluster, configure masters only and disable read write splitting. The nodes of such a cluster are called masters in the plugin configuration as they accept both reads and writes for their partition.

Using synchronous update everywhere clusters such as MySQL Cluster

MySQL Cluster is a synchronous cluster solution. All cluster nodes accept read and write requests. In the context of the plugin, all nodes shall be considered as masters.

Use the load balancing and fail over features only.

- Disable the plugins [built-in read-write splitting](#).
- Configure masters only.
- Consider random once load balancing strategy, which is the plugins default. If random once is used, only masters are configured and no SQL hints are used to force using a certain node, no connection switches will happen for the duration of a web request. Thus, no special handling is required for transactions. The plugin will pick one master at the beginning of the PHP script and use it until the script terminates.
- Do not set the quality of service. All nodes have all the data. This automatically gives you the highest possible service quality (strong consistency).
- Do not enable client-side global transaction injection. It is neither required to help with server-side fail over nor to assist the quality of service filter choosing an appropriate node.

Disabling built-in read-write splitting.

- Set `mysqlnd_ms.disable_rw_split=1`
- Do not use [SQL hints](#) to enforce the use of slaves

Configure masters only.

- Set `mysqlnd_ms.multi_master=1`.
- Do not configure any slaves.
- Set `failover=loop_before_master` in the plugins configuration file to avoid warnings about the empty slave list and to make the failover logic loop over all configured masters before emitting an error.

Please, note the warnings about automatic failover given in the previous sections.

Example 7.258 Multiple primaries - multi master (php.ini)

```
mysqlnd_ms.enable=1
mysqlnd_ms.config_file=/path/to/mysqlnd_ms_plugin.ini
mysqlnd_ms.multi_master=1
mysqlnd_ms.disable_rw_split=1
```

Example 7.259 Synchronous update anywhere cluster

```
"myapp": {
    "master": {
        "master_1": {
            "host": "localhost",
            "socket": "\tmp\mysql57.sock"
        },
        "master_2": {
            "host": "192.168.2.28",
            "port": 3306
        }
    },
    "slave": {
    },
    "filters": {
        "roundrobin": {
        }
    },
    "failover": {
        "strategy": "loop_before_master",
        "remember_failed": true
    }
}
```

If running an update everywhere cluster that has no built-in partitioning to avoid hot spots and high collision rates, consider using the node groups filter to keep updates on a frequently accessed table on one of the nodes. This may help to reduce collision rates and thus improve performance.

7.7.5.14 XA/Distributed transactions

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Version requirement

XA related functions have been introduced in [PECL/mysqlnd_ms](#) version 1.6.0-alpha.

Early adaptors wanted

The feature is currently under development. There may be issues and/or feature limitations. Do not use in production environments, although early lab tests indicate reasonable quality.

Please, contact the development team if you are interested in this feature. We are looking for real life feedback to complement the feature.

Below is a list of some feature restrictions.

- The feature is not yet compatible with the MySQL Fabric support . This limitation is soon to be lifted.

XA transaction identifier are currently restricted to numbers. This limitation will be lifted upon request, it is a simplification used during the initial implementation.

MySQL server restrictions

The XA support by the MySQL server has some restrictions. Most noteably, the servers binary log may lack changes made by XA transactions in case of certain errors. Please, see the MySQL manual for details.

XA/Distributed transactions can spawn multiple MySQL servers. Thus, they may seem like a perfect tool for sharded MySQL clusters, for example, clusters managed with MySQL Fabric. [PECL/mysqlnd_ms](#) hides most of the SQL commands to control XA transactions and performs automatic administrative tasks in cases of errors, to provide the user with a comprehensive API. Users should setup the plugin carefully and be well aware of server restrictions prior to using the feature.

Example 7.260 General pattern for XA transactions

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
/* BEGIN */
mysqlnd_ms_xa_begin($mysqli, 1 /* xa id */);
/* run queries on various servers */
$mysqli->query("UPDATE some_table SET col_a = 1");
...
/* COMMIT */
mysqlnd_ms_xa_commit($link, 1);
?>
```

XA transactions use the two-phase commit protocol. The two-phase commit protocol is a blocking protocol. During the first phase participating servers begin a transaction and the client carries out its work. This phase is followed by a second voting phase. During voting, the servers first make a firm promise that they are ready to commit the work even in case of their possible unexpected failure. Should a server crash in this phase, it will still recall the aborted transaction after recover and wait for the client to decide on whether it shall be committed or rolled back.

Should a client that has initiated a global transaction crash after all the participating servers gave their promise to be ready to commit, then the servers must wait for a decision. The servers are not allowed to unilaterally decide on the transaction.

A client crash or disconnect from a participant, a server crash or server error during the fist phase of the protocol is uncritical. In most cases, the server will forget about the XA transaction and its work is rolled back. Additionally, the plugin tries to reach out to as many participants as it can to instruct the server to roll back the work immediately. It is not possible to disable this implicit rollback carried out by [PECL/mysqlnd_ms](#) in case of errors during the first phase of the protocol. This design decision has been made to keep the implementation simple.

An error during the second phase of the commit protocol can develop into a more severe situation. The servers will not forget about prepared but unfinished transactions in all cases. The plugin will not attempt to solve these cases immediately but waits for optional background garbage collection to ensure progress of the commit protocol. It is assumed that a solution will take significant time as it may include waiting for a participating server to recover from a crash. This time span may be longer than a developer and end user expects when trying to commit a global transaction with `mysqlnd_ms_xa_commit`. Thus, the function returns with the unfinished global transaction still requiring attention. Please, be warned that at this point, it is not yet clear whether the global transaction will be committed or rolled back later on.

Errors during the second phase can be ignored, handled by yourself or solved by the build-int garbage collection logic. Ignoring them is not recommended as you may experience unfinished global transactions on your servers that block resources virtually indefinitely. Handling the errors requires knowing the participants, checking their state and issuing appropriate SQL commands on them. There are no user API calls to expose this very information. You will have to configure a state store and make the plugin record its actions in it to receive the desired facts.

Please, see the [quickstart](#) and related [plugin configuration file settings](#) for an example how to configure a state. In addition to configuring a state store, you have to setup some SQL tables. The table definitions are given in the description of the plugin configuration settings.

Setting up and configuring a state store is also a precondition for using the built-in garbage collection for XA transactions that fail during the second commit phase. Recording information about ongoing XA transactions is an unavoidable extra task. The extra task consists of updating the state store after each and every operation that changes the state of the global transaction itself (started, committed, rolled back, errors and aborts), the addition of participants (host, optionally user and password required to connect) and any changes to a participants state. Please note, depending on configuration and your security policies, these recordings may be considered sensitive. It is therefore recommended to restrict access to the state store. Unless the state store itself becomes overloaded, writing the state information may contribute noteworthy to the runtime but should overall be only a minor factor.

It is possible that the effort it takes to implement your own routines for handling XA transactions that failed during the second commit phase exceeds the benefits of using the XA feature of [PECL/mysqlnd_ms](#) in the first place. Thus, the manual focussed on using the built-on garbage collection only.

Garbage collection can be triggered manually or automatically in the background. You may want to call `mysqlnd_ms_xa_gc` immediately after a commit failure to attempt to solve any failed but still open global transactions as soon as possible. You may also decide to disable the automatic background garbage collection, implement your own rule set for invoking the built-in garbage collection and trigger it when desired.

By default the plugin will start the garbage collection with a certain probability in the extensions internal `RSHUTDOWN` method. The request shutdown is called after your script finished. Whether the garbage collection will be triggered is determined by computing a random value between `1...1000` and comparing it with the configuration setting `probability` (default: 5). If the setting is greater or equal to the random value, the garbage collection will be triggered.

Once started, the garbage collection acts upon up to `max_transactions_per_run` (default: 100) global transactions recorded. Records include successfully finished but also unfinished XA transactions. Records for successful transactions are removed and unfinished transactions are attempted to be solved. There are no statistics that help you finding the right balance between keeping garbage collection runs short by limiting the number of transactions considered per run and preventing the garbage collection to fall behind, resulting in many records.

For each failed XA transaction the garbage collection makes `max_retries` (default: 5) attempts to finish it. After that [PECL/mysqlnd_ms](#) gives up. There are two possible reasons for this. Either a participating server crashed and has not become accessible again within `max_retries` invocations of the garbage collection, or there is a situation that the built-in garbage collection cannot cope with.

Likely, the latter would be considered a bug. However, you can manually force more garbage collection runs calling `mysqlnd_ms_xa_gc` with the appropriate parameter set. Should even those function runs fail to solve the situation, then the problem must be solved by an operator.

The function `mysqlnd_ms_get_stats` provides some statistics on how many XA transactions have been started, committed, failed or rolled back.

7.7.6 Installing/Configuring

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7.7.6.1 Requirements

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`PHP 5.3.6` or newer. Some advanced functionality requires `PHP 5.4.0` or newer.

The `mysqlnd_ms` replication and load balancing plugin supports all PHP applications and all available PHP MySQL extensions (`mysqli`, `mysql`, `PDO_MYSQL`). The PHP MySQL extension must be configured to use `mysqlnd` in order to be able to use the `mysqlnd_ms` plugin for `mysqlnd`.

7.7.6.2 Installation

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This PECL extension is not bundled with PHP.

Information for installing this PECL extension may be found in the manual chapter titled [Installation of PECL extensions](#). Additional information such as new releases, downloads, source files, maintainer information, and a CHANGELOG, can be located here: http://pecl.php.net/package/mysqlnd_ms

A DLL for this PECL extension is currently unavailable. See also the [building on Windows](#) section.

7.7.6.3 Runtime Configuration

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The behaviour of these functions is affected by settings in `php.ini`.

Table 7.42 Mysqlnd_ms Configure Options

Name	Default	Changeable	Changelog
<code>mysqlnd_ms.enable</code>	0	PHP_INI_SYSTEM	
<code>mysqlnd_ms.force_config_usage</code>		PHP_INI_SYSTEM	
<code>mysqlnd_ms.ini_file</code>	" "	PHP_INI_SYSTEM	
<code>mysqlnd_ms.config_file</code>	" "	PHP_INI_SYSTEM	
<code>mysqlnd_ms.collect_statistics</code>	0	PHP_INI_SYSTEM	
<code>mysqlnd_ms.multi_master</code>	0	PHP_INI_SYSTEM	
<code>mysqlnd_ms.disable_rw_split</code>	0	PHP_INI_SYSTEM	

Here's a short explanation of the configuration directives.

`mysqlnd_ms.enable` integer Enables or disables the plugin. If disabled, the extension will not plug into `mysqlnd` to proxy internal `mysqlnd` C API calls.

`mysqlnd_ms.force_config_usage` integer If enabled, the plugin checks if the host (server) parameters value of any MySQL connection attempt, matches a section name from the plugin configuration file. If not, the connection attempt is blocked.

This setting is not only useful to restrict PHP to certain servers but also to debug configuration file problems. The configuration file validity is checked at two different stages. The first check is performed when PHP begins to handle a web request. At this point the plugin reads and decodes the configuration file. Errors thrown at this early stage in an extensions life cycle may not be shown properly to the user. Thus, the plugin buffers the errors, if any, and additionally displays them when establishing a connection to MySQL. By default a buffered startup error will emit an error of type `E_WARNING`. If `force_config_usage` is set, the error type used is `E_RECOVERABLE_ERROR`.

Please, see also [configuration file debugging notes](#).

<code>mysqlnd_ms.ini_file</code> string	Plugin specific configuration file. This setting has been renamed to <code>mysqlnd_ms.config_file</code> in version 1.4.0.
<code>mysqlnd_ms.config_file</code> string	Plugin specific configuration file. This setting superseeds <code>mysqlnd_ms.ini_file</code> since 1.4.0.
<code>mysqlnd_ms.collect_stats</code> integer	Enables or disables the collection of statistics. The collection of statistics is disabled by default for performance reasons. Statistics are returned by the function <code>mysqlnd_ms_get_stats</code> .
<code>mysqlnd_ms.multi_master</code> integer	Enables or disables support of MySQL multi master replication setups. Please, see also supported clusters .
<code>mysqlnd_ms.disable_rw_splitting</code> integer	Enables or disables built-in read write splitting. Controls whether load balancing and lazy connection functionality can be used independently of read write splitting. If read write splitting is disabled, only servers from the master list will be used for statement execution. All configured slave servers will be ignored. The SQL hint <code>MYSQLND_MS_USE_SLAVE</code> will not be recognized. If found, the statement will be redirected to a master.
	Disabling read write splitting impacts the return value of <code>mysqlnd_ms_query_is_select</code> . The function will no longer propose query execution on slave servers.

Multiple master servers

Setting `mysqlnd_ms.multi_master=1` allows the plugin to use multiple master servers, instead of only the first master server of the master list.

Please, see also [supported clusters](#).

7.7.6.4 Plugin configuration file (>=1.1.x)

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The following documentation applies to PECL/mysqlnd_ms >= 1.1.0-beta. It is not valid for prior versions. For documentation covering earlier versions, see the configuration documentation for [mysqlnd_ms 1.0.x and below](#).

Introduction

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Changelog: Feature was added in PECL/mysqlnd_ms 1.1.0-beta

The below description applies to PECL/mysqlnd_ms >= 1.1.0-beta. It is not valid for prior versions.

The plugin uses its own configuration file. The configuration file holds information about the MySQL replication master server, the MySQL replication slave servers, the server pick (load balancing) policy, the failover strategy, and the use of lazy connections.

The plugin loads its configuration file at the beginning of a web request. It is then cached in memory and used for the duration of the web request. This way, there is no need to restart PHP after deploying the configuration file. Configuration file changes will become active almost instantly.

The PHP configuration directive `mysqlnd_ms.config_file` is used to set the plugins configuration file. Please note, that the PHP configuration directive may not be evaluated for every web request. Therefore, changing the plugins configuration file name or location may require a PHP restart. However, no restart is required to read changes if an already existing plugin configuration file is updated.

Using and parsing JSON is efficient, and using JSON makes it easier to express hierarchical data structures than the standard `php.ini` format.

Example 7.261 Converting a PHP array (hash) into JSON format

Or alternatively, a developer may be more familiar with the PHP array syntax, and prefer it. This example demonstrates how a developer might convert a PHP array to JSON.

```
<?php
$config = array(
    "myapp" => array(
        "master" => array(
            "master_0" => array(
                "host" => "localhost",
                "socket" => "/tmp/mysql.sock",
            ),
        ),
        "slave" => array(),
    ),
);
file_put_contents("mysqlnd_ms.ini", json_encode($config, JSON_PRETTY_PRINT));
printf("mysqlnd_ms.ini file created...\n");
printf("Dumping file contents...\n");
printf("%s\n", str_repeat("-", 80));
echo file_get_contents("mysqlnd_ms.ini");
printf("\n%s\n", str_repeat("-", 80));
?>
```

The above example will output:

```
mysqlnd_ms.ini file created...
Dumping file contents...
-----
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost",
                "socket": "\/tmp\/mysql.sock"
            }
        },
        "slave": [
        ]
    }
}
```

A plugin configuration file consists of one or more sections. Sections are represented by the top-level object properties of the object encoded in the JSON file. Sections could also be called *configuration names*.

Applications reference sections by their name. Applications use section names as the host (server) parameter to the various connect methods of the `mysqli`, `mysql` and `PDO_MYSQL` extensions. Upon connect, the `mysqlnd` plugin compares the hostname with all of the section names from the plugin configuration file. If the hostname and section name match, then the plugin will load the settings for that section.

Example 7.262 Using section names example

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.2.27"
            },
            "slave_1": {
                "host": "192.168.2.27",
                "port": 3306
            }
        }
    },
    "localhost": {
        "master": [
            {
                "host": "localhost",
                "socket": "\path\to\mysql.sock"
            }
        ],
        "slave": [
            {
                "host": "192.168.3.24",
                "port": "3305"
            },
            {
                "host": "192.168.3.65",
                "port": "3309"
            }
        ]
    }
}
```

```
<?php
/* All of the following connections will be load balanced */
$mysqli = new mysqli("myapp", "username", "password", "database");
$pdo = new PDO('mysql:host=myapp;dbname=database', 'username', 'password');
$mysql = mysql_connect("myapp", "username", "password");
$mysqli = new mysqli("localhost", "username", "password", "database");
?>
```

Section names are strings. It is valid to use a section name such as `192.168.2.1`, `127.0.0.1` or `localhost`. If, for example, an application connects to `localhost` and a plugin configuration section `localhost` exists, the semantics of the connect operation are changed. The application will no longer

only use the MySQL server running on the host `localhost`, but the plugin will start to load balance MySQL queries following the rules from the `localhost` configuration section. This way you can load balance queries from an application without changing the applications source code. Please keep in mind, that such a configuration may not contribute to overall readability of your applications source code. Using section names that can be mixed up with host names should be seen as a last resort.

Each configuration section contains, at a minimum, a list of master servers and a list of slave servers. The master list is configured with the keyword `master`, while the slave list is configured with the `slave` keyword. Failing to provide a slave list will result in a fatal `E_ERROR` level error, although a slave list may be empty. It is possible to allow no slaves. However, this is only recommended with synchronous clusters, please see also [supported clusters](#). The main part of the documentation focusses on the use of asynchronous MySQL replication clusters.

The master and slave server lists can be optionally indexed by symbolic names for the servers they describe. Alternatively, an array of descriptions for slave and master servers may be used.

Example 7.263 List of anonymous slaves

```
"slave": [
  {
    "host": "192.168.3.24",
    "port": "3305"
  },
  {
    "host": "192.168.3.65",
    "port": "3309"
  }
]
```

An anonymous server list is encoded by the `JSON array` type. Optionally, symbolic names may be used for indexing the slave or master servers of a server list, and done so using the `JSON object` type.

Example 7.264 Master list using symbolic names

```
"master": {
  "master_0": {
    "host": "localhost"
  }
}
```

It is recommended to index the server lists with symbolic server names. The alias names will be shown in error messages.

The order of servers is preserved and taken into account by `mysqlnd_ms`. If, for example, you configure round robin load balancing strategy, the first `SELECT` statement will be executed on the slave that appears first in the slave server list.

A configured server can be described with the `host`, `port`, `socket`, `db`, `user`, `password` and `connect_flags`. It is mandatory to set the database server host using the `host` keyword. All other settings are optional.

Example 7.265 Keywords to configure a server

```
{
  "myapp": {
    "master": {
      "master_0": {
        "host": "db_server_host",
        "port": 3306,
        "socket": null,
        "db": "myapp",
        "user": "myapp",
        "password": "myapp",
        "connect_flags": 0
      }
    }
  }
}
```

```
        "port": "db_server_port",
        "socket": "db_server_socket",
        "db": "database_resp_schema"
        "user": "user",
        "password": "password",
        "connect_flags": 0
    }
},
"slave": {
    "slave_0": {
        "host": "db_server_host",
        "port": "db_server_port",
        "socket": "db_server_socket"
    }
}
}
```

If a setting is omitted, the plugin will use the value provided by the user API call used to open a connection. Please, see the [using section names example](#) above.

The configuration file format has been changed in version 1.1.0-beta to allow for chained filters. Filters are responsible for filtering the configured list of servers to identify a server for execution of a given statement. Filters are configured with the `filter` keyword. Filters are executed by mysqlnd_ms in the order of their appearance. Defining filters is optional. A configuration section in the plugins configuration file does not need to have a `filters` entry.

Filters replace the `pick[]` setting from prior versions. The new `random` and `roundrobin` provide the same functionality.

Example 7.266 New roundrobin filter, old functionality

```
{
  "myapp": {
    "master": {
      "master_0": {
        "host": "localhost"
      }
    },
    "slave": {
      "slave_0": {
        "host": "192.168.78.136",
        "port": "3306"
      },
      "slave_1": {
        "host": "192.168.78.137",
        "port": "3306"
      }
    },
    "filters": {
      "roundrobin": [
      ]
    }
  }
}
```

The function `mysqlnd_ms_set_user_pick_server` has been removed. Setting a callback is now done with the `user` filter. Some filters accept parameters. The `user` filter requires and accepts a mandatory `callback` parameter to set the callback previously set through the function `mysqlnd_ms_set_user_pick_server`.

Example 7.267 The `user` filter replaces `mysqld ms set user pick server`

```
"filters": {
    "user": {
        "callback": "pick_server"
    }
}
```

The validity of the configuration file is checked both when reading the configuration file and later when establishing a connection. The configuration file is read during PHP request startup. At this early stage a PHP extension may not display error messages properly. In the worst case, no error is shown and a connection attempt fails without an adequate error message. This problem has been cured in version 1.5.0.

Example 7.268 Common error message in case of configuration file issues (upto version 1.5.0)

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
?>
```

The above example will output:

```
Warning: mysqli::mysqli(): (mysqlnd_ms) (mysqlnd_ms) Failed to parse config file [s1.json]. Please, verify
Warning: mysqli::mysqli(): (HY000/2002): php_network_getaddresses: getaddrinfo failed: Name or service not
Warning: mysqli::query(): Couldn't fetch mysqli in Command line code on line 1
Fatal error: Call to a member function fetch_assoc() on a non-object in Command line code on line 1
```

Since version 1.5.0 startup errors are additionally buffered and emitted when a connection attempt is made. Use the configuration directive `mysqlnd_ms.force_config_usage` to set the error type used to display buffered errors. By default an error of type `E_WARNING` will be emitted.

Example 7.269 Improved configuration file validation since 1.5.0

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
?>
```

The above example will output:

```
Warning: mysqli::mysqli(): (mysqlnd_ms) (mysqlnd_ms) Failed to parse config file [s1.json]. Please, verify
```

It can be useful to set `mysqlnd_ms.force_config_usage = 1` when debugging potential configuration file errors. This will not only turn the type of buffered startup errors into `E_RECOVERABLE_ERROR` but also help detecting misspelled section names.

Example 7.270 Possibly more precise error due to `mysqlnd_ms.force_config_usage=1`

```
mysqlnd_ms.force_config_usage=1
```

```
<?php
$mysqli = new mysqli("invalid_section", "username", "password", "database");
```

```
?>
```

The above example will output:

```
Warning: mysqli::mysqli(): (mysqlnd_ms) Exclusive usage of configuration enforced but did not find the
```

Configuration Directives

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Here is a short explanation of the configuration directives that can be used.

`master` array or object

List of MySQL replication master servers. The list of either of the `JSON type array` to declare an anonymous list of servers or of the `JSON type object`. Please, see [above](#) for examples.

Setting at least one master server is mandatory. The plugin will issue an error of type `E_ERROR` if the user has failed to provide a master server list for a configuration section. The fatal error may read `(mysqlnd_ms) Section [master] doesn't exist for host [name_of_a_config_section] in %s on line %d.`

A server is described with the `host`, `port`, `socket`, `db`, `user`, `password` and `connect_flags`. It is mandatory to provide at a value for `host`. If any of the other values is not given, it will be taken from the user API connect call, please, see also: [using section names example](#).

Table of server configuration keywords.

Keyword	Description	Version
<code>host</code>	Database server host. This is a mandatory setting. Failing to provide, will cause an error of type <code>E_RECOVERABLE_ERROR</code> when the plugin tries to connect to the server. The error message may read <code>(mysqlnd_ms) Cannot find [host] in [%s] section in config in %s on line %d.</code>	Since 1.1.0.
<code>port</code>	Database server TCP/IP port.	Since 1.1.0.
<code>socket</code>	Database server Unix domain socket.	Since 1.1.0.
<code>db</code>	Database (schemata).	Since 1.1.0.
<code>user</code>	MySQL database user.	Since 1.1.0.
<code>password</code>	MySQL database user password.	Since 1.1.0.
<code>connect_flags</code>	Connection flags.	Since 1.1.0.

The plugin supports using only one master server. An experimental setting exists to enable multi-master support. The details are not documented. The setting is meant for development only.

`slave` array or object

List of one or more MySQL replication slave servers. The syntax is identical to setting master servers, please, see `master` above for details.

The plugin supports using one or more slave servers.

Setting a list of slave servers is mandatory. The plugin will report an error of the type `E_ERROR` if `slave` is not given for a configuration section. The fatal error message may read (`mysqlnd_ms`) `Section [slave] doesn't exist for host [%s] in %s on line %d`. Note, that it is valid to use an empty slave server list. The error has been introduced to prevent accidentally setting no slaves by forgetting about the `slave` setting. A master-only setup is still possible using an empty slave server list.

If an empty slave list is configured and an attempt is made to execute a statement on a slave the plugin may emit a warning like (`mysqlnd_ms`) `Couldn't find the appropriate slave connection. 0 slaves to choose from.` upon statement execution. It is possible that another warning follows such as (`mysqlnd_ms`) `No connection selected by the last filter.`

`global_transaction_id_inject` Global transaction identifier configuration related to both the use of the server built-in global transaction ID feature and the client-side emulation.

Keyword	Description	Version
<code>fetch</code>	SQL statement for accessing the latest global transaction identifier. The SQL statement is run if the plugin needs to know the most recent global transaction identifier. This can be the case, for example, when checking MySQL Replication slave status. Also used with <code>mysqlnd_ms_get_last_gtid</code> .	Since 1.2.0.
<code>check</code>	SQL statement for checking if a replica has replicated all transactions up to and including ones searched for. The SQL statement is run when searching for replicas which can offer a higher level of consistency than eventual consistency. The statement must contain a placeholder <code>#GTID</code> which is to be replaced with the global transaction identifier searched for by the plugin. Please, check the quickstart for examples.	Since 1.2.0.
<code>report_error</code>	Whether to emit an error or type warning if an issue occurs while executing any of the configured SQL statements.	Since 1.2.0.
<code>on_commit</code>	Client-side global transaction ID emulation only. SQL statement to run when a transaction finished to update the global transaction identifier sequence number on the master. Please, see the quickstart for examples.	Since 1.2.0.
<code>wait_time</code>	Instructs the plugin to wait up to <code>wait_for_gtid_timeout</code> seconds for a slave to catch up when searching for slaves that can deliver session consistency. The setting limits the time spend for polling the slave status. If polling the status takes very long, the total clock time spent waiting may	Since 1.4.0.

Keyword	Description	Version
<code>fabric</code>	<p>exceed <code>wait_for_gtid_timeout</code>. The plugin calls <code>sleep(1)</code> to sleep one second between each two polls.</p> <p>The setting can be used both with the plugins client-side emulation and the server-side global transaction identifier feature of MySQL 5.6.</p> <p>Waiting for a slave to replicate a certain GTID needed for session consistency also means throttling the client. By throttling the client the write load on the master is reduced indirectly. A primary copy based replication system, such as MySQL Replication, is given more time to reach a consistent state. This can be desired, for example, to increase the number of data copies for high availability considerations or to prevent the master from being overloaded.</p>	

`fabric` object

MySQL Fabric related settings. If the plugin is used together with MySQL Fabric, then the plugins configuration file no longer contains lists of MySQL servers. Instead, the plugin will ask MySQL Fabric which list of servers to use to perform a certain task.

A minimum plugin configuration for use with MySQL Fabric contains a list of one or more MySQL Fabric hosts that the plugin can query. If more than one MySQL Fabric host is configured, the plugin will use a roundrobin strategy to choose among them. Other strategies are currently not available.

Example 7.271 Minimum pligung configuration for use with MySQL Fabric

```
{
  "myapp": {
    "fabric": {
      "hosts": [
        {
          "host" : "127.0.0.1",
          "port" : 8080
        }
      ]
    }
  }
}
```

Each MySQL Fabric host is described using a JSON object with the following members.

Keyword	Description	Version
<code>host</code>	Host name of the MySQL Fabric host.	Since 1.6.0.

Keyword	Description	Version
<code>port</code>	The TCP/IP port on which the MySQL Fabric host listens for remote procedure calls sent by clients such as the plugin.	Since 1.6.0.

The plugin is using PHP streams to communicate with MySQL Fabric through XML RPC over HTTP. By default no timeouts are set for the network communication. Thus, the plugin defaults to PHP stream default timeouts. Those defaults are out of control of the plugin itself.

An optional timeout value can be set to overrule the PHP streams default timeout setting. Setting the timeout in the plugins configuration file has the same effect as setting a timeout for a PHP user space HTTP connection established through PHP streams.

The plugins Fabric timeout value unit is seconds. The allowed value range is from 0 to 65535. The setting exists since version 1.6.

Example 7.272 Optional timeout for communication with Fabric

```
{
  "myapp": {
    "fabric": {
      "hosts": [
        {
          "host" : "127.0.0.1",
          "port" : 8080
        }
      ],
      "timeout": 2
    }
  }
}
```

[Transaction stickiness](#) and MySQL Fabric logic can collide. The stickiness option disables switching between servers for the duration of a transaction. When using Fabric and sharding the user may (erroneously) start a local transaction on one share and then attempt to switch to a different shard using either `mysqlnd_ms_fabric_select_shard` or `mysqlnd_ms_fabric_select_global`. In this case, the plugin will not reject the request to switch servers in the middle of a transaction but allow the user to switch to another server regardless of the transaction stickiness setting used. It is clearly a user error to write such code.

If transaction stickiness is enabled and you would like to get an error or type warning when calling `mysqlnd_ms_fabric_select_shard` or `mysqlnd_ms_fabric_select_global`, set the boolean flag `trx_warn_server_list_changes`.

Example 7.273 Warnings about the violation of transaction boundaries

```
{
  "myapp": {
```

```

    "fabric": {
        "hosts": [
            {
                "host" : "127.0.0.1",
                "port" : 8080
            }
        ],
        "trx_warn_serverlist_changes": 1
    },
    "trx_stickiness": "on"
}
}

```

```

<?php
$link = new mysqli("myapp", "root", "", "test");
/*
   For the demo the call may fail.
   Failed or not we get into the state
   needed for the example.
*/
@mysqlnd_ms_fabric_select_global($link, 1);
$link->begin_transaction();
@$link->query("DROP TABLE IF EXISTS test");
/*
   Switching servers/shards is a mistake due to open
   local transaction!
*/
mysqlnd_ms_select_global($link, 1);
?>

```

The above example will output:

```
PHP Warning: mysqlnd_ms_fabric_select_global(): (mysqlnd_ms) Fabric se...
```

Please, consider the feature experimental. Changes to syntax and semantics may happen.

filters object

List of filters. A filter is responsible to filter the list of available servers for executing a given statement. Filters can be chained. The `random` and `roundrobin` filter replace the `pick[]` directive used in prior version to select a load balancing policy. The `user` filter replaces the `mysqlnd_ms_set_user_pick_server` function.

Filters may accept parameters to refine their actions.

If no load balancing policy is set, the plugin will default to `random_once`. The `random_once` policy picks a random slave server when running the first read-only statement. The slave server will be used for all read-only statements until the PHP script execution ends. No load balancing policy is set and thus, defaulting takes place, if neither the `random` nor the `roundrobin` are part of a configuration section.

If a filter chain is configured so that a filter which output no more than once server is used as input for a filter which should be given more than one server as input, the plugin may emit a warning upon opening a connection. The warning may read: `(mysqlnd_ms) Error while creating filter '%s' . Non-multi`

`filter '%s' already created. Stopping in %s on line %d.` Furthermore, an error of the error code `2000`, the sql state `HY000` and an error message similar to the warning may be set on the connection handle.

Example 7.274 Invalid filter sequence

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "filters": [
            "roundrobin",
            "random"
        ]
    }
}
```

```
<?php
$link = new mysqli("myapp", "root", "", "test");
printf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error());
$link->query("SELECT 1 FROM DUAL");
?>
```

The above example will output:

```
PHP Warning:  mysqli::mysqli(): (HY000/2000): (mysqlnd_ms) Error while creating filter 'random'. Non-multi filter [2000] (mysqlnd_ms) Error while creating filter 'random' . Non-multi filter
PHP Warning:  mysqli::query(): Couldn't fetch mysqli in filter_warning.php
```

Filter: `random` object

The `random` filter features the random and random once load balancing policies, set through the `pick[]` directive in older versions.

The random policy will pick a random server whenever a read-only statement is to be executed. The random once strategy picks a random slave server once and continues using the slave for the rest of the PHP web request. Random once is a default, if load balancing is not configured through a filter.

If the `random` filter is not given any arguments, it stands for random load balancing policy.

Example 7.275 Random load balancing with `random` filter

```
{
    "myapp": {
        "master": {
            "master_0": {
```

```

        "host": "localhost"
    }
},
"slave": {
    "slave_0": {
        "host": "192.168.78.136",
        "port": "3306"
    },
    "slave_1": {
        "host": "192.168.78.137",
        "port": "3306"
    }
},
"filters": [
    "random"
]
}
}

```

Optionally, the `sticky` argument can be passed to the filter. If the parameter `sticky` is set to the string `1`, the filter follows the random once load balancing strategy.

Example 7.276 Random once load balancing with `random` filter

```

{
    "filters": {
        "random": {
            "sticky": "1"
        }
    }
}

```

Both the `random` and `roundrobin` filters support setting a priority, a weight for a server, since PECL/mysqlnd_ms 1.4.0. If the `weight` argument is passed to the filter, it must assign a weight for all servers. Servers must be given an alias name in the `slave` respectively `master` server lists. The alias must be used to reference servers for assigning a priority with `weight`.

Example 7.277 Referencing error

```
[E_RECOVERABLE_ERROR] mysqli_real_connect(): (mysqlnd_ms) Unknown server
```

Using a wrong alias name with `weight` may result in an error similar to the shown above.

If `weight` is omitted, the default weight of all servers is one.

Example 7.278 Assigning a `weight` for load balancing

```

{
    "myapp": {
        "master": {
            "master1": {
                "host": "localhost",
                "socket": "\\\\var\\\\run\\\\mysql\\\\mysql.sock"
            }
        }
    }
}

```

```

    "slave": {
        "slave1": {
            "host": "192.168.2.28",
            "port": 3306
        },
        "slave2": {
            "host": "192.168.2.29",
            "port": 3306
        },
        "slave3": {
            "host": "192.0.43.10",
            "port": 3306
        }
    },
    "filters": {
        "random": {
            "weights": {
                "slave1": 8,
                "slave2": 4,
                "slave3": 1,
                "master1": 1
            }
        }
    }
}

```

At the average a server assigned a weight of two will be selected twice as often as a server assigned a weight of one. Different weights can be assigned to reflect differently sized machines, to prefer co-located slaves which have a low network latency or, to configure a standby failover server. In the latter case, you may want to assign the standby server a very low weight in relation to the other servers. For example, given the configuration above `slave3` will get only some eight percent of the requests in the average. As long as `slave1` and `slave2` are running, it will be used sparsely, similar to a standby failover server. Upon failure of `slave1` and `slave2`, the usage of `slave3` increases. Please, check the notes on failover before using `weight` this way.

Valid weight values range from 1 to 65535.

Unknown arguments are ignored by the filter. No warning or error is given.

The filter expects one or more servers as input. Outputs one server. A filter sequence such as `random`, `roundrobin` may cause a warning and an error message to be set on the connection handle when executing a statement.

List of filter arguments.

Keyword	Description	Version
<code>sticky</code>	Enables or disabled random once load balancing policy. See above.	Since 1.2.0.
<code>weigh</code>	Assigns a load balancing weight/priority to a server. Please, see above for a description.	Since 1.4.0.

Filter: `roundrobin` object

If using the `roundrobin` filter, the plugin iterates over the list of configured slave servers to pick a server for statement execution.

If the plugin reaches the end of the list, it wraps around to the beginning of the list and picks the first configured slave server.

Example 7.279 `roundrobin` filter

```
{
  "myapp": {
    "master": {
      "master_0": {
        "host": "localhost"
      }
    },
    "slave": {
      "slave_0": {
        "host": "192.168.78.136",
        "port": "3306"
      }
    },
    "filters": [
      "roundrobin"
    ]
  }
}
```

Expects one or more servers as input. Outputs one server. A filter sequence such as `roundrobin`, `random` may cause a warning and an error message to be set on the connection handle when executing a statement.

List of filter arguments.

Keyword	Description	Version
<code>weigh</code>	Assigns a load balancing weight/priority to a server. Please, find a description above .	Since 1.4.0.

Filter: `user` object

The `user` replaces `mysqlnd_ms_set_user_pick_server` function, which was removed in 1.1.0-beta. The filter sets a callback for user-defined read/write splitting and server selection.

The plugins built-in read/write query split mechanism decisions can be overwritten in two ways. The easiest way is to prepend a query string with the SQL hints `MYSQLND_MS_MASTER_SWITCH`, `MYSQLND_MS_SLAVE_SWITCH` or `MYSQLND_MS_LAST_USED_SWITCH`. Using SQL hints one can control, for example, whether a query shall be send to the MySQL replication master server or one of the slave servers. By help of SQL hints it is not possible to pick a certain slave server for query execution.

Full control on server selection can be gained using a callback function. Use of a callback is recommended to expert users only because the callback has to cover all cases otherwise handled by the plugin.

The plugin will invoke the callback function for selecting a server from the lists of configured master and slave servers. The callback function inspects the query to run and picks a server for query

execution by returning the hosts URI, as found in the master and slave list.

If the lazy connections are enabled and the callback chooses a slave server for which no connection has been established so far and establishing the connection to the slave fails, the plugin will return an error upon the next action on the failed connection, for example, when running a query. It is the responsibility of the application developer to handle the error. For example, the application can re-run the query to trigger a new server selection and callback invocation. If so, the callback must make sure to select a different slave, or check slave availability, before returning to the plugin to prevent an endless loop.

Example 7.280 Setting a callback

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "filters": {
            "user": {
                "callback": "pick_server"
            }
        }
    }
}
```

The callback is supposed to return a host to run the query on. The host URI is to be taken from the master and slave connection lists passed to the callback function. If callback returns a value neither found in the master nor in the slave connection lists the plugin will emit an error of the type `E_RECOVERABLE_ERROR`. The error may read like `(mysqlnd_ms) User filter callback has returned an unknown server. The server 'server that is not in master or slave list' can neither be found in the master list nor in the slave list.` If the application catches the error to ignore it, follow up errors may be set on the connection handle, for example, `(mysqlnd_ms) No connection selected by the last filter` with the error code `2000` and the sqlstate `HY000`. Furthermore a warning may be emitted.

Referencing a non-existing function as a callback will result in any error of the type `E_RECOVERABLE_ERROR` whenever the plugin tries to callback function. The error message may reads like: `(mysqlnd_ms) Specified callback (pick_server) is not a valid callback.` If the application catches the error to ignore it, follow up errors may be set on the connection handle, for example, `(mysqlnd_ms) Specified callback (pick_server) is not a valid callback` with the error

code `2000` and the sqlstate `HY000`. Furthermore a warning may be emitted.

The following parameters are passed from the plugin to the callback.

Param	Description	Version
<code>connection</code>	URI of the currently connected database server.	Since 1.1.0.
<code>query</code>	Query string of the statement for which a server needs to be picked.	Since 1.1.0.
<code>masters</code>	List of master servers to choose from. Note, that the list of master servers may not be identical to the list of configured master servers if the filter is not the first in the filter chain. Previously run filters may have reduced the master list already.	Since 1.1.0.
<code>slaves</code>	List of slave servers to choose from. Note, that the list of slave servers may not be identical to the list of configured slave servers if the filter is not the first in the filter chain. Previously run filters may have reduced the slave list already.	Since 1.1.0.
<code>last_server</code>	URI of the server of the connection used to execute the previous statement on.	Since 1.1.0.
<code>in_transaction</code>	Boolean flag indicating whether the statement is part of an open transaction. If autocommit mode is turned off, this will be set to <code>TRUE</code> . Otherwise it is set to <code>FALSE</code> . Transaction detection is based on monitoring the mysqld library call <code>set_autocommit</code> . Monitoring is not possible before PHP 5.4.0. Please, see connection pooling and switching concepts discussion for further details.	Since 1.1.0.

Example 7.281 Using a callback

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.2.27",
                "port": "3306"
            },
            "slave_1": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "filters": {
            "user": {
                "callback": "pick_server"
            }
        }
    }
}
```

```

<?php
function pick_server($connected, $query, $masters, $slaves, $last_used_connection)
{
    static $slave_idx = 0;
    static $num_slaves = NULL;
    if (is_null($num_slaves))
        $num_slaves = count($slaves);
    /* default: fallback to the plugins build-in logic */
    $ret = NULL;
    printf("User has connected to '%s'...\n", $connected);
    printf("... deciding where to run '%s'\n", $query);
    $where = mysqlnd_ms_query_is_select($query);
    switch ($where)
    {
        case MySQLND_MS_QUERY_USE_MASTER:
            printf(".... using master\n");
            $ret = $masters[0];
            break;
        case MySQLND_MS_QUERY_USE_SLAVE:
            /* SELECT or SQL hint for using slave */
            if (stristr($query, "FROM table_on_slave_a_only"))
            {
                /* a table which is only on the first configured slave */
                printf("... access to table available only on slave A detected\n");
                $ret = $slaves[0];
            }
            else
            {
                /* round robin */
                printf("... some read-only query for a slave\n");
                $ret = $slaves[$slave_idx++ % $num_slaves];
            }
            break;
        case MySQLND_MS_QUERY_LAST_USED:
            printf(".... using last used server\n");
            $ret = $last_used_connection;
            break;
    }
    printf("... ret = '%s'\n", $ret);
    return $ret;
}
$mysqli = new mysqli("myapp", "root", "", "test");
if (!$res = $mysqli->query("SELECT 1 FROM DUAL"))
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
else
    $res->close();
if (!$res = $mysqli->query("SELECT 2 FROM DUAL"))
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
else
    $res->close();
if (!$res = $mysqli->query("SELECT * FROM table_on_slave_a_only"))
    printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
else
    $res->close();
$mysqli->close();
?>

```

The above example will output:

```

User has connected to 'myapp'...
... deciding where to run 'SELECT 1 FROM DUAL'
... some read-only query for a slave
... ret = 'tcp://192.168.2.27:3306'
User has connected to 'myapp'...
... deciding where to run 'SELECT 2 FROM DUAL'

```

```

... some read-only query for a slave
... ret = 'tcp://192.168.78.136:3306'
User has connected to 'myapp'...
... deciding where to run 'SELECT * FROM table_on_slave_a_only'
... access to table available only on slave A detected
... ret = 'tcp://192.168.2.27:3306'

```

Filter: `user_multi` object

The `user_multi` differs from the `user` only in one aspect. Otherwise, their syntax is identical. The `user` filter must pick and return exactly one node for statement execution. A filter chain usually ends with a filter that emits only one node. The filter chain shall reduce the list of candidates for statement execution down to one. This, only one node left, is the case after the `user` filter has been run.

The `user_multi` filter is a multi filter. It returns a list of slave and a list of master servers. This list needs further filtering to identify exactly one node for statement execution. A multi filter is typically placed at the top of the filter chain. The `quality_of_service` filter is another example of a multi filter.

The return value of the callback set for `user_multi` must be an array with two elements. The first element holds a list of selected master servers. The second element contains a list of selected slave servers. The lists shall contain the keys of the slave and master servers as found in the slave and master lists passed to the callback. The below example returns random master and slave lists extracted from the functions input.

Example 7.282 Returning random masters and slaves

```

<?php
function pick_server($connected, $query, $masters, $slaves, $last_used)
{
    $picked_masters = array()
    foreach ($masters as $key => $value) {
        if (mt_rand(0, 2) > 1)
            $picked_masters[] = $key;
    }
    $picked_slaves = array()
    foreach ($slaves as $key => $value) {
        if (mt_rand(0, 2) > 1)
            $picked_slaves[] = $key;
    }
    return array($picked_masters, $picked_slaves);
}
?>

```

The plugin will issue an error of type `E_RECOVERABLE` if the callback fails to return a server list. The error may read `(mysqlnd_ms) User multi filter callback has not returned a list of servers to use. The callback must return an array in %s on line %d.` In case the server list is not empty but has invalid servers key/ids in it, an error of type `E_RECOVERABLE` will be thrown with an error message like `(mysqlnd_ms) User multi filter callback has`

`returned an invalid list of servers to use. Server id is negative in %s on line %d, or similar.`

Whether an error is emitted in case of an empty slave or master list depends on the configuration. If an empty master list is returned for a write operation, it is likely that the plugin will emit a warning that may read `(mysqlnd_ms) Couldn't find the appropriate master connection. 0 masters to choose from.` `Something is wrong in %s on line %d.` Typically a follow up error of type `E_ERROR` will happen. In case of a read operation and an empty slave list the behavior depends on the fail over configuration. If fail over to master is enabled, no error should appear. If fail over to master is deactivated the plugin will emit a warning that may read `(mysqlnd_ms) Couldn't find the appropriate slave connection. 0 slaves to choose from.` `Something is wrong in %s on line %d.`

Filter: `node_groups` object

The `node_groups` filter lets you group cluster nodes and query selected groups, for example, to support data partitioning. Data partitioning can be required for manual sharding, primary copy based clusters running multiple masters, or to avoid hot spots in update everywhere clusters that have no built-in partitioning. The filter is a multi filter which returns zero, one or multiple of its input servers. Thus, it must be followed by other filters to reduce the number of candidates down to one for statement execution.

Keyword	Description	Version
<code>user defined node group name</code>	<p>One or more node groups must be defined. A node group can have an arbitrary user defined name. The name is used in combination with a SQL hint to restrict query execution to the nodes listed for the node group. To run a query on any of the servers of a node group, the query must begin with the SQL hint <code>/ *user defined node group name*/.</code> Please note, no white space is allowed around <code>user defined node group name</code>. Because <code>user defined node group name</code> is used as-is as part of a SQL hint, you should choose the name that is compliant with the SQL language.</p> <p>Each node group entry must contain a list of <code>master</code> servers. Additional <code>slave</code> servers are allowed. Failing to provide a list of <code>master</code> for a node group <code>name_of_group</code> may cause an error of type <code>E_RECOVERABLE_ERROR</code> like <code>(mysqlnd_ms) No masters configured in node group 'name_of_group' for 'node_groups' filter.</code></p> <p>The list of master and slave servers must reference corresponding entries in the <code>global master</code> respectively <code>slave</code> server list. Referencing an unknown server in either of the both server lists may cause an <code>E_RECOVERABLE_ERROR</code> error like <code>(mysqlnd_ms) Unknown master</code></p>	Since 1.5.0.

Keyword	Description	Version
	<p>'server_alias_name' (section 'name_of_group') in 'node_groups' filter configuration.</p> <p>Example 7.283 Manual partitioning</p> <pre>{ "myapp": { "master": { "master_0": { "host": "localhost", "socket": "\tmp\mysql.sock" } }, "slave": { "slave_0": { "host": "192.168.2.28", "port": 3306 }, "slave_1": { "host": "127.0.0.1", "port": 3311 } }, "filters": { "node_groups": { "Partition_A" : { "master": ["master_0"], "slave": ["slave_0"] } }, "roundrobin": [] } } }</pre> <p>Please note, if a filter chain generates an empty slave list and the PHP configuration directive <code>mysqlnd_ms.multi_master=0</code> is used, the plugin may emit a warning.</p>	

Filter: `quality_of_service` object

The `quality_of_service` identifies cluster nodes capable of delivering a certain quality of service. It is a multi filter which returns zero, one or multiple of its input servers. Thus, it must be followed by other filters to reduce the number of candidates down to one for statement execution.

The `quality_of_service` filter has been introduced in 1.2.0-alpha. In the 1.2 series the filters focus is on the consistency aspect of service quality. Different types of clusters offer different default data consistencies. For example, an asynchronous MySQL replication slave offers eventual consistency. The slave may not be able to deliver requested data because it has not replicated the write, it may serve stale database because its lagging behind or it may serve current information. Often, this is acceptable. In some cases higher consistency levels are needed for the application to work correct. In those cases, the `quality_of_service` can filter

out cluster nodes which cannot deliver the necessary quality of service.

The `quality_of_service` filter can be replaced or created at runtime. A successful call to `mysqlnd_ms_set_qos` removes all existing `qos` filter entries from the filter list and installs a new one at the very beginning. All settings that can be made through `mysqlnd_ms_set_qos` can also be in the plugins configuration file. However, use of the function is by far the most common use case. Instead of setting session consistency and strong consistency service levels in the plugins configuration file it is recommended to define only masters and no slaves. Both service levels will force the use of masters only. Using an empty slave list shortens the configuration file, thus improving readability. The only service level for which there is a case of defining in the plugins configuration file is the combination of eventual consistency and maximum slave lag.

Keyword	Description	Version
<code>eventual_consistency</code>	<p>Request eventual consistency. Allows the use of all master and slave servers. Data returned may or may not be current.</p> <p>Eventual consistency accepts an optional <code>age</code> parameter. If <code>age</code> is given the plugin considers only slaves for reading for which MySQL replication reports a slave lag less or equal to <code>age</code>. The replication lag is measured using <code>SHOW SLAVE STATUS</code>. If the plugin fails to fetch the replication lag, the slave tested is skipped. Implementation details and tips are given in the quality of service concepts section.</p> <p>Please note, if a filter chain generates an empty slave list and the PHP configuration directive <code>mysqlnd_ms.multi_master=0</code> is used, the plugin may emit a warning.</p>	Since 1.2.0.

Example 7.284 Global limit on slave lag

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.2.27",
                "port": "3306"
            },
            "slave_1": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "filters": {
            "quality_of_service": {
                "eventual_consistency": {
                    "age":123
                }
            }
        }
    }
}
```

Keyword	Description	Version
	}	
<code>session</code>	<p>Request session consistency (read your writes). Allows use of all masters and all slaves which are in sync with the master. If no further parameters are given slaves are filtered out as there is no reliable way to test if a slave has caught up to the master or is lagging behind. Please note, if a filter chain generates an empty slave list and the PHP configuration directive <code>mysqlnd_ms.multi_master=0</code> is used, the plugin may emit a warning.</p> <p>Session consistency temporarily requested using <code>mysqlnd_ms_set_qos</code> is a valuable alternative to using <code>master_on_write</code>. <code>master_on_write</code> is likely to send more statements to the master than needed. The application may be able to continue operation at a lower consistency level after it has done some critical reads.</p>	Since 1.1.0.
<code>strong</code>	Request strong consistency. Only masters will be used.	Since 1.2.0.

`failover` Up to and including 1.3.x: string. Since 1.4.0: object.

Failover policy. Supported policies: `disabled` (default), `master`, `loop_before_master` (Since 1.4.0).

If no failover policy is set, the plugin will not do any automatic failover (`failover=disabled`). Whenever the plugin fails to connect a server it will emit a warning and set the connections error code and message. Thereafter it is up to the application to handle the error and, for example, resent the last statement to trigger the selection of another server.

Please note, the automatic failover logic is applied when opening connections only. Once a connection has been opened no automatic attempts are made to reopen it in case of an error. If, for example, the server a connection is connected to is shut down and the user attempts to run a statement on the connection, no automatic failover will be tried. Instead, an error will be reported.

If using `failover=master` the plugin will implicitly failover to a master, if available. Please check the concepts documentation to learn about potential pitfalls and risks of using `failover=master`.

Example 7.285 Optional master failover when failing to connect to slave (PECL/mysqlnd_ms < 1.4.0)

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        }
    }
}
```

```

        },
        "slave": {
            "slave_0": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "failover": "master"
    }
}

```

Since PECL/mysqlnd_ms 1.4.0 the failover configuration keyword refers to an object.

Example 7.286 New syntax since 1.4.0

```

{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "failover": {"strategy": "master"}
    }
}

```

Keyword	Description	Version
<code>strategy</code>	<p>Failover policy. Possible values: <code>disabled</code> (default), <code>master</code>, <code>loop_before_master</code></p> <p>A value of <code>disabled</code> disables automatic failover.</p> <p>Setting <code>master</code> instructs the plugin to try to connect to a master in case of a slave connection error. If the master connection attempt fails, the plugin exits the failover loop and returns an error to the user.</p> <p>If using <code>loop_before_master</code> and a slave request is made, the plugin tries to connect to other slaves before failing over to a master. If multiple master are given and multi master is enabled, the plugin also loops over the list of masters and attempts to connect before returning an error to the user.</p>	Since 1.4.0.
<code>remember_failed</code>	<p>Remember failures for the duration of a web request. Default: <code>false</code>.</p> <p>If set to <code>true</code> the plugin will remember failed hosts and skip the hosts in all future load</p>	Since 1.4.0. The feature is only available together with the

Keyword	Description	Version
	balancing made for the duration of the current web request.	<code>random</code> and <code>roundrobin</code> load balancing filter. Use of the setting is recommended.
<code>max_r</code>	Maximum number of connection attempts before skipping host. Default: <code>0</code> (no limit). The setting is used to prevent hosts from being dropped off the host list upon the first failure. If set to <code>n > 0</code> , the plugin will keep the node in the node list even after a failed connection attempt. The node will not be removed immediately from the slave respectively master lists after the first connection failure but instead be tried to connect to up to <code>n</code> times in future load balancing rounds before being removed.	Since 1.4.0. The feature is only available together with the <code>random</code> and <code>roundrobin</code> load balancing filter.

Setting `failover` to any other value but `disabled`, `master` or `loop_before_master` will not emit any warning or error.

`lazy_connections` bool

Controls the use of lazy connections. Lazy connections are connections which are not opened before the client sends the first connection. Lazy connections are a default.

It is strongly recommended to use lazy connections. Lazy connections help to keep the number of open connections low. If you disable lazy connections and, for example, configure one MySQL replication master server and two MySQL replication slaves, the plugin will open three connections upon the first call to a connect function although the application might use the master connection only.

Lazy connections bare a risk if you make heavy use of actions which change the state of a connection. The plugin does not dispatch all state changing actions to all connections from the connection pool. The few dispatched actions are applied to already opened connections only. Lazy connections opened in the future are not affected. Only some settings are "remembered" and applied when lazy connections are opened.

Example 7.287 Disabling lazy connection

```
{
  "myapp": {
    "master": {
      "master_0": {
        "host": "localhost"
      }
    },
    "slave": {
      "slave_0": {
        "host": "192.168.78.136",
        "port": "3306"
      }
    }
  }
}
```

```
        "lazy_connections": 0
    }
}
```

Please, see also [server_charset](#) to overcome potential problems with string escaping and servers using different default charsets.

`server_charset` string

The setting has been introduced in 1.4.0. It is recommended to set it if using lazy connections.

The [server_charset](#) setting serves two purposes. It acts as a fallback charset to be used for string escaping done before a connection has been established and it helps to avoid escaping pitfalls in heterogeneous environments which servers using different default charsets.

String escaping takes a connections charset into account. String escaping is not possible before a connection has been opened and the connections charset is known. The use of lazy connections delays the actual opening of connections until a statement is send.

An application using lazy connections may attempt to escape a string before sending a statement. In fact, this should be a common case as the statement string may contain the string that is to be escaped. However, due to the lazy connection feature no connection has been opened yet and escaping fails. The plugin may report an error of the type [E_WARNING](#) and a message like [\(mysqlnd_ms\) string escaping doesn't work without established connection. Possible solution is to add server_charset to your configuration](#) to inform you of the pitfall.

Setting [server_charset](#) makes the plugin use the given charset for string escaping done on lazy connection handles before establishing a network connection to MySQL. Furthermore, the plugin will enforce the use of the charset when the connection is established.

Enforcing the use of the configured charset used for escaping is done to prevent tapping into the pitfall of using a different charset for escaping than used later for the connection. This has the additional benefit of removing the need to align the charset configuration of all servers used. No matter what the default charset on any of the servers is, the plugin will set the configured one as a default.

The plugin does not stop the user from changing the charset at any time using the [set_charset](#) call or corresponding SQL statements. Please, note that the use of SQL is not recommended as it cannot be monitored by the plugin. The user can, for example, change the charset on a lazy connection handle after escaping a string and before the actual connection is opened. The charset set by the user will be used for any subsequent escaping before the connection is established. The connection will be established using the configured charset, no matter what the server charset is or

what the user has set before. Once a connection has been opened, `set_charset` is of no meaning anymore.

Example 7.288 String escaping on a lazy connection handle

```
{
  "myapp": {
    "master": {
      "master_0": {
        "host": "localhost"
      }
    },
    "slave": {
      "slave_0": {
        "host": "192.168.78.136",
        "port": "3306"
      }
    },
    "lazy_connections": 1,
    "server_charset" : "utf8"
  }
}
```

```
<?php
$mysqli = new mysqli("myapp", "username", "password", "database");
$mysqli->real_escape("this will be escaped using the server_charset set");
$mysqli->set_charset("latin1");
$mysqli->real_escape("this will be escaped using latin1");
/* server_charset implicitly set - utf8 connection */
$mysqli->query("SELECT 'This connection will be set to server_charset will be latin1 used from now on'");
$mysqli->set_charset("latin1");
?>
```

`master_on_write` bool

If set, the plugin will use the master server only after the first statement has been executed on the master. Applications can still send statements to the slaves using SQL hints to overrule the automatic decision.

The setting may help with replication lag. If an application runs an `INSERT` the plugin will, by default, use the master to execute all following statements, including `SELECT` statements. This helps to avoid problems with reads from slaves which have not replicated the `INSERT` yet.

Example 7.289 Master on write for consistent reads

```
{
  "myapp": {
    "master": {
      "master_0": {
        "host": "localhost"
      }
    },
    "slave": {
      "slave_0": {
        "host": "192.168.78.136",
        "port": "3306"
      }
    },
    "master_on_write": 1
  }
}
```

```
}
```

Please, note the `quality_of_service` filter introduced in version 1.2.0-alpha. It gives finer control, for example, for achieving read-your-writes and, it offers additional functionality introducing `service levels`.

All `transaction stickiness` settings, including `trx_stickiness=on`, are overruled by `master_on_write=1`.

`trx_stickiness` string

Transaction stickiness policy. Supported policies: `disabled` (default), `master`.

The setting requires 5.4.0 or newer. If used with PHP older than 5.4.0, the plugin will emit a warning like (`mysqlnd_ms`) `trx_stickiness strategy is not supported before PHP 5.3.99.`

If no transaction stickiness policy is set or, if setting `trx_stickiness=disabled`, the plugin is not transaction aware. Thus, the plugin may load balance connections and switch connections in the middle of a transaction. The plugin is not transaction safe. SQL hints must be used avoid connection switches during a transaction.

As of PHP 5.4.0 the mysqlnd library allows the plugin to monitor the `autocommit` mode set by calls to the libraries `set_autocommit()` function. If setting `set_stickiness=master` and `autocommit` gets disabled by a PHP MySQL extension invoking the `mysqlnd` library internal function call `set_autocommit()`, the plugin is made aware of the begin of a transaction. Then, the plugin stops load balancing and directs all statements to the master server until `autocommit` is enabled. Thus, no SQL hints are required.

An example of a PHP MySQL API function calling the `mysqlnd` library internal function call `set_autocommit()` is `mysqli_autocommit`.

Although setting `trx_stickiness=master`, the plugin cannot be made aware of `autocommit` mode changes caused by SQL statements such as `SET AUTOCOMMIT=0` or `BEGIN`.

As of PHP 5.5.0, the mysqlnd library features additional C API calls to control transactions. The level of control matches the one offered by SQL statements. The `mysqli` API has been modified to use these calls. Since version 1.5.0, PECL/mysqlnd_ms can monitor not only `mysqli_autocommit`, but also `mysqli_begin`, `mysqli_commit` and `mysqli_rollback` to detect transaction boundaries and stop load balancing for the duration of a transaction.

Example 7.290 Using master to execute transactions

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        }
    }
}
```

```

        },
        "slave": {
            "slave_0": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "trx_stickiness": "master"
    }
}

```

Since version 1.5.0 automatic and silent failover is disabled for the duration of a transaction. If the boundaries of a transaction have been properly detected, transaction stickiness is enabled and a server fails, the plugin will not attempt to fail over to the next server, if any, regardless of the failover policy configured. The user must handle the error manually. Depending on the configuration, the plugin may emit an error of type `E_WARNING` reading like `(mysqlnd_ms) Automatic failover is not permitted in the middle of a transaction`. This error may then be overwritten by follow up errors such as `(mysqlnd_ms) No connection selected by the last filter`. Those errors will be generated by the failing query function.

Example 7.291 No automatic failover, error handling pitfall

```

<?php
/* assumption: automatic failover configured */
$mysqli = new mysqli("myapp", "username", "password", "database");
/* sets plugin internal state in_trx = 1 */
$mysqli->autocommit(false);
/* assumption: server fails */
if (!$res = $mysqli->query("SELECT 'Assume this query fails' AS _msg F
/* handle failure of transaction, plugin internal state is still in_trx */
printf("[%d] %s", $mysqli->errno, $mysqli->error);
/*
   If using autocommit() based transaction detection it is a
   MUST to call autocommit(true). Otherwise the plugin assumes
   the current transaction continues and connection
   changes remain forbidden.
*/
$mysqli->autocommit(true);
/* Likewise, you'll want to start a new transaction */
$mysqli->autocommit(false);
}
/* latin1 used from now on */
$mysqli->set_charset("latin1");
?>

```

If a server fails in the middle of a transaction the plugin continues to refuse to switch connections until the current transaction has been finished. Recall that the plugin monitors API calls to detect transaction boundaries. Thus, you have to, for example, enable auto commit mode to end the current transaction before the plugin continues load balancing and switches the server. Likewise, you will want to start a new transaction immediately thereafter and disable auto commit mode again.

Not handling failed queries and not ending a failed transaction using API calls may cause all following commands emit errors such as

`Commands out of sync; you can't run this command now.` Thus, it is important to handle all errors.

`transient_error` object

The setting has been introduced in 1.6.0.

A database cluster node may reply a transient error to a client. The client can then repeat the operation on the same node, fail over to a different node or abort the operation. Per definition is it safe for a client to retry the same operation on the same node before giving up.

PECL/`mysqlnd_ms` can perform the retry loop on behalf of the application. By configuring `transient_error` the plugin can be instructed to repeat operations failing with a certain error code for a certain maximum number of times with a pause between the retries. If the transient error disappears during loop execution, it is hidden from the application. Otherwise, the error is forwarded to the application by the end of the loop.

Example 7.292 Retry loop for transient errors

```
{
    "myapp": {
        "master": {
            "master_0": {
                "host": "localhost"
            }
        },
        "slave": {
            "slave_0": {
                "host": "192.168.78.136",
                "port": "3306"
            }
        },
        "transient_error": {
            "mysql_error_codes": [
                1297
            ],
            "max_retries": 2,
            "usleep_retry": 100
        }
    }
}
```

Keyword	Description	Version
<code>mysql</code>	List of transient error codes. You may add any MySQL error code to the list. It is possible to consider any error as transient not only <code>1297 (HY000 (ER_GET_TEMPORARY_ERRMSG), Message: Got temporary error %d '%s' from %s)</code> . Before adding other codes but <code>1297</code> to the list, make sure your cluster supports a new attempt without impacting the state of your application.	Since 1.6.0.
<code>max_retries</code>	How often to retry an operation which fails with a transient error before forwarding the failure to the user. Default: 1	Since 1.6.0.

Keyword	Description	Version
<code>usleep</code>	Milliseconds to sleep between transient error retries. The value is passed to the C function <code>usleep</code> , hence the name. Default: 100	Since 1.6.0.

`xa` object

The setting has been introduced in 1.6.0.

Experimental

The feature is currently under development. There may be issues and/or feature limitations. Do not use in production environments.

state_store

record_participant_credentials

Whether to store the username and password of a global transaction participant in the participant table. If disabled, the garbage collector will use the default username and password when connecting to the participant. Unless you are using a different username and password,

for each of your MySQL servers, you can use the default and avoid storing the sensible information in state store.

Please note, username and password are stored in clear text when using the MySQL state store, which is the only one available. It is in your responsibility to protect this sensible information.

Default:
`false`

participant_localhost_ip

During XA garbage collection the plugin may find a participant server for which the host `localhost` has been recorded. If the garbage collection takes place on another host but the host that has written the participant record to the state store, the host name `localhost` now resolves to a different host. Therefore when recording a participant servers

host
name
in
the
state
store,
a
value
of
`localhost`
must
be
replaced
with
the
actual
IP
address
of
`localhost`

Setting
`participate`
should
be
considered
only
if
using
`localhost`
cannot
be
avoided.
From
a
garbage
collection
point
of
view
only,
it
is
preferable
not
to
configure
any
socket
connection
but
to
provide
an
IP
address
and
port

for
a
node.

mysql

The
MySQL
state
store
is
the
only
state
store
availab

global_

participant_

garbag

host

user

password

db

port

socket

rollback_on_close

Whether to automatically rollback an open global transaction when a connection is closed. If enabled, it mimics the default behaviour of local transactions. Should a client disconnect, the server rolls back any open and unfinished transactions.

Default: `true`

garbage_collection**max_retries**

Maximum number of garbage collection runs before giving up. Allowed values are from 0 to 100. A setting of 0 means no limit, unless the state store enforces a limit. Should the state store

enforce
a
limit,
it
can
be
supposed
to
be
significantly
higher
than
[100](#).
Available
since
1.6.0.

Please
note,
it
is
important
to
end
failed
XA
transaction
within
reasonable
time
to
make
participating
servers
free
resources
bound
to
the
transaction.
The
built-
in
garbage
collection
is
not
expected
to
fail
for
a
long
period
as
long
as
crashed

servers
become
available
again
quickly.
Still,
a
situation
may
arise
where
a
human
is
required
to
act
because
the
built-
in
garbage
collection
stopped
or
failed.
In
this
case,
you
may
first
want
to
check
if
the
transaction
still
cannot
be
fixed
by
forcing
`mysql`
to
ignore
the
setting,
prior
to
handling
it
manually.

Default
5

probability

Garbage collection probability. Allowed values are from 0 to 1000. A setting of 0 disables automatic background garbage collection. Despite a setting of 0 it is still possible to trigger garbage collection by calling `mysqlnd_u`. Available since 1.6.0.

The automatic garbage collection of stalled XA transactions is only available if a state store have been configured.

The state store is responsible to keep track of XA transactions. Based on its records, it can find blocked XA transactions where the client has crashed, connected to the participants and rollback the unfinished transactions.

The garbage collector is triggered as part of PHP's request shutdown procedure at the end of a web request. That is after

your
PHP
script
has
finished
working.
Do
decide
whether
to
run
the
garbage
collection
a
random
value
between
`0`
and
`1000`
is
computed.
If
the
`probabil`
value
is
higher
or
equal
to
the
random
value,
the
state
stores
garbage
collection
routines
are
invoked.

Default:
`5`

`max_transactions_per_run`

Maximum
number
of
unfinished
XA
transaction
considered
by
the
garbage
collection

during
one
run.
Allowed
values
are
from
[1](#)
to
[32768](#).
Available
since
1.6.0.

Cleaning
up
an
unfinished
XA
transaction
takes
considerable
amount
of
time
and
resources.
The
garbage
collection
routine
may
have
to
connect
to
several
participants
of
a
failed
global
transaction
to
issue
the
SQL
command
for
rolling
back
the
unfinished
transaction.

Default:
[100](#)

Plugin configuration file (<= 1.0.x)

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Note

The below description applies to PECL/mysqlnd_ms < 1.1.0-beta. It is not valid for later versions.

The plugin is using its own configuration file. The configuration file holds information on the MySQL replication master server, the MySQL replication slave servers, the server pick (load balancing) policy, the failover strategy and the use of lazy connections.

The PHP configuration directive `mysqlnd_ms.ini_file` is used to set the plugins configuration file.

The configuration file mimics standard the `php.ini` format. It consists of one or more sections. Every section defines its own unit of settings. There is no global section for setting defaults.

Applications reference sections by their name. Applications use section names as the host (server) parameter to the various connect methods of the `mysqli`, `mysql` and `PDO_MYSQL` extensions.

Upon connect the `mysqlnd` plugin compares the hostname with all section names from the plugin configuration file. If hostname and section name match, the plugin will load the sections settings.

Example 7.296 Using section names example

```
[myapp]
master[] = localhost
slave[] = 192.168.2.27
slave[] = 192.168.2.28:3306
[localhost]
master[] = localhost:/tmp/mysql/mysql.sock
slave[] = 192.168.3.24:3305
slave[] = 192.168.3.65:3309
```

```
<?php
/* All of the following connections will be load balanced */
$mysqli = new mysqli("myapp", "username", "password", "database");
$pdo = new PDO('mysql:host=myapp;dbname=database', 'username', 'password');
$mysql = mysql_connect("myapp", "username", "password");
$mysqli = new mysqli("localhost", "username", "password", "database");
?>
```

Section names are strings. It is valid to use a section name such as `192.168.2.1`, `127.0.0.1` or `localhost`. If, for example, an application connects to `localhost` and a plugin configuration section `[localhost]` exists, the semantics of the connect operation are changed. The application will no longer only use the MySQL server running on the host `localhost` but the plugin will start to load balance MySQL queries following the rules from the `[localhost]` configuration section. This way you can load balance queries from an application without changing the applications source code.

The `master[]`, `slave[]` and `pick[]` configuration directives use a list-like syntax. Configuration directives supporting list-like syntax may appear multiple times in a configuration section. The plugin maintains the order in which entries appear when interpreting them. For example, the below example shows two `slave[]` configuration directives in the configuration section `[myapp]`. If doing round-robin load balancing for read-only queries, the plugin will send the first read-only query to the MySQL server `mysql_slave_1` because it is the first in the list. The second read-only query will be send to the MySQL server `mysql_slave_2` because it is the second in the list. Configuration directives supporting list-like syntax result are ordered from top to bottom in accordance to their appearance within a configuration section.

Example 7.297 List-like syntax

```
[myapp]
master[ ] = mysql_master_server
slave[ ] = mysql_slave_1
slave[ ] = mysql_slave_2
```

Here is a short explanation of the configuration directives that can be used.

<code>master[]</code> string	URI of a MySQL replication master server. The URI follows the syntax <code>hostname[:port unix_domain_socket]</code> . The plugin supports using only one master server. Setting a master server is mandatory. The plugin will report a warning upon connect if the user has failed to provide a master server for a configuration section. The warning may read <code>(mysqlnd_ms) Cannot find master section in config</code> . Furthermore the plugin may set an error code for the connection handle such as <code>HY000/2000 (CR_UNKNOWN_ERROR)</code> . The corresponding error message depends on your language settings.
<code>slave[]</code> string	URI of one or more MySQL replication slave servers. The URI follows the syntax <code>hostname[:port unix_domain_socket]</code> . The plugin supports using one or more slave servers. Setting a slave server is mandatory. The plugin will report a warning upon connect if the user has failed to provide at least one slave server for a configuration section. The warning may read <code>(mysqlnd_ms) Cannot find slaves section in config</code> . Furthermore the plugin may set an error code for the connection handle such as <code>HY000/2000 (CR_UNKNOWN_ERROR)</code> . The corresponding error message depends on your language settings.
<code>pick[]</code> string	Load balancing (server picking) policy. Supported policies: <code>random</code> , <code>random_once</code> (default), <code>roundrobin</code> , <code>user</code> . If no load balancing policy is set, the plugin will default to <code>random_once</code> . The <code>random_once</code> policy picks a random slave server when running the first read-only statement. The slave server will be used for all read-only statements until the PHP script execution ends. The <code>random</code> policy will pick a random server whenever a read-only statement is to be executed. If using <code>roundrobin</code> the plugin iterates over the list of configured slave servers to pick a server for statement execution. If the plugin reaches the end of the list, it wraps around to the beginning of the list and picks the first configured slave server. Setting more than one load balancing policy for a configuration section makes only sense in conjunction with <code>user</code> and <code>mysqlnd_ms_set_user_pick_server</code> . If the user defined callback fails to pick a server, the plugin falls back to the second configured load balancing policy.
<code>failover</code> string	Failover policy. Supported policies: <code>disabled</code> (default), <code>master</code> .

If no failover policy is set, the plugin will not do any automatic failover (`failover=disabled`). Whenever the plugin fails to connect a server it will emit a warning and set the connections error code and message. Thereafter it is up to the application to handle the error and, for example, resent the last statement to trigger the selection of another server.

If using `failover=master` the plugin will implicitly failover to a slave, if available. Please check the concepts documentation to learn about potential pitfalls and risks of using `failover=master`.

`lazy_connections` bool

Controls the use of lazy connections. Lazy connections are connections which are not opened before the client sends the first connection.

It is strongly recommended to use lazy connections. Lazy connections help to keep the number of open connections low. If you disable lazy connections and, for example, configure one MySQL replication master server and two MySQL replication slaves, the plugin will open three connections upon the first call to a connect function although the application might use the master connection only.

Lazy connections bare a risk if you make heavy use of actions which change the state of a connection. The plugin does not dispatch all state changing actions to all connections from the connection pool. The few dispatched actions are applied to already opened connections only. Lazy connections opened in the future are not affected. If, for example, the connection character set is changed using a PHP MySQL API call, the plugin will change the character set of all currently opened connection. It will not remember the character set change to apply it on lazy connections opened in the future. As a result the internal connection pool would hold connections using different character sets. This is not desired. Remember that character sets are taken into account for escaping.

`master_on_write` bool

If set, the plugin will use the master server only after the first statement has been executed on the master. Applications can still send statements to the slaves using SQL hints to overrule the automatic decision.

The setting may help with replication lag. If an application runs an `INSERT` the plugin will, by default, use the master to execute all following statements, including `SELECT` statements. This helps to avoid problems with reads from slaves which have not replicated the `INSERT` yet.

`trx_stickiness` string

Transaction stickiness policy. Supported policies: `disabled` (default), `master`.

Experimental feature.

The setting requires 5.4.0 or newer. If used with PHP older than 5.4.0, the plugin will emit a warning like (`mysqlnd_ms`) `trx_stickiness strategy is not supported before PHP 5.3.99`.

If no transaction stickiness policy is set or, if setting `trx_stickiness=disabled`, the plugin is not transaction

aware. Thus, the plugin may load balance connections and switch connections in the middle of a transaction. The plugin is not transaction safe. SQL hints must be used avoid connection switches during a transaction.

As of PHP 5.4.0 the mysqlnd library allows the plugin to monitor the `autocommit` mode set by calls to the libraries `trx_autocommit()` function. If setting `trx_stickiness=master` and `autocommit` gets disabled by a PHP MySQL extension invoking the `mysqlnd` library internal function call `trx_autocommit()`, the plugin is made aware of the begin of a transaction. Then, the plugin stops load balancing and directs all statements to the master server until `autocommit` is enabled. Thus, no SQL hints are required.

An example of a PHP MySQL API function calling the `mysqlnd` library internal function call `trx_autocommit()` is `mysqli_autocommit`.

Although setting `trx_stickiness=master`, the plugin cannot be made aware of `autocommit` mode changes caused by SQL statements such as `SET AUTOCOMMIT=0`.

Testing

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Note

The section applies to mysqlnd_ms 1.1.0 or newer, not the 1.0 series.

The PECL/mysqlnd_ms test suite is in the `tests/` directory of the source distribution. The test suite consists of standard phpt tests, which are described on the PHP Quality Assurance Teams website.

Running the tests requires setting up one to four MySQL servers. Some tests don't connect to MySQL at all. Others require one server for testing. Some require two distinct servers. In some cases two servers are used to emulate a replication setup. In other cases a master and a slave of an existing MySQL replication setup are required for testing. The tests will try to detect how many servers and what kind of servers are given. If the required servers are not found, the test will be skipped automatically.

Before running the tests, edit `tests/config.inc` to configure the MySQL servers to be used for testing.

The most basic configuration is as follows.

```
putenv( "MYSQL_TEST_HOST=localhost" );
putenv( "MYSQL_TEST_PORT=3306" );
putenv( "MYSQL_TEST_USER=root" );
putenv( "MYSQL_TEST_PASSWD=" );
putenv( "MYSQL_TEST_DB=test" );
putenv( "MYSQL_TEST_ENGINE=MyISAM" );
putenv( "MYSQL_TEST_SOCKET=" );
putenv( "MYSQL_TEST_SKIP_CONNECT_FAILURE=1" );
putenv( "MYSQL_TEST_CONNECT_FLAGS=0" );
putenv( "MYSQL_TEST_EXPERIMENTAL=0" );
/* replication cluster emulation */
putenv( "MYSQL_TEST_EMULATED_MASTER_HOST=". getenv( "MYSQL_TEST_HOST" ) );
putenv( "MYSQL_TEST_EMULATED_SLAVE_HOST=". getenv( "MYSQL_TEST_HOST" ) );
/* real replication cluster */
putenv( "MYSQL_TEST_MASTER_HOST=". getenv( "MYSQL_TEST_EMULATED_MASTER_HOST" ) );
putenv( "MYSQL_TEST_SLAVE_HOST=". getenv( "MYSQL_TEST_EMULATED_SLAVE_HOST" ) );
```

`MYSQL_TEST_HOST`, `MYSQL_TEST_PORT` and `MYSQL_TEST_SOCKET` define the hostname, TCP/IP port and Unix domain socket of the default database server. `MYSQL_TEST_USER` and `MYSQL_TEST_PASSWD` contain the user and password needed to connect to the database/schema configured with `MYSQL_TEST_DB`. All configured servers must have the same database user configured to give access to the test database.

Using `host`, `host:port` or `host:/path/to/socket` syntax one can set an alternate host, host and port or host and socket for any of the servers.

```
putenv("MYSQL_TEST_SLAVE_HOST=192.168.78.136:3307");
putenv("MYSQL_TEST_MASTER_HOST=myserver_hostname:/path/to/socket");
```

Debugging and Tracing

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The mysqlnd debug log can be used to debug and trace the activities of PECL/mysqlnd_ms. As a mysqlnd PECL/mysqlnd_ms adds trace information to the mysqlnd library debug file. Please, see the [mysqlnd.debug](#) PHP configuration directive documentation for a detailed description on how to configure the debug log.

Configuration setting example to activate the debug log:

```
mysqlnd.debug=d:t:x:0,/tmp/mysqlnd.trace
```

Note

This feature is only available with a debug build of PHP. Works on Microsoft Windows if using a debug build of PHP and PHP was built using Microsoft Visual C version 9 and above.

The debug log shows mysqlnd library and PECL/mysqlnd_ms plugin function calls, similar to a trace log. Mysqlnd library calls are usually prefixed with `mysqlnd_`. PECL/mysqlnd internal calls begin with `mysqlnd_ms`.

Example excerpt from the debug log (connect):

```
[...]
>mysqlnd_connect
| info : host=myapp user=root db=test port=3306 flags=131072
| >mysqlnd_ms::connect
| | >mysqlnd_ms_config_json_section_exists
| | | info : section=[myapp] len=[5]
| | | >mysqlnd_ms_config_json_sub_section_exists
| | | | info : section=[myapp] len=[5]
| | | | info : ret=1
| | | <mysqlnd_ms_config_json_sub_section_exists
| | | info : ret=1
| | <mysqlnd_ms_config_json_section_exists
[...]
```

The debug log is not only useful for plugin developers but also to find the cause of user errors. For example, if your application does not do proper error handling and fails to record error messages,

checking the debug and trace log may help finding the cause. Use of the debug log to debug application issues should be considered only if no other option is available. Writing the debug log to disk is a slow operation and may have negative impact on the application performance.

Example excerpt from the debug log (connection failure):

```
[...]
| | | | | info : adding error [Access denied for user 'root'@'localhost' (using password: YES)] to
| | | | | info : PACKET_FREE(0)
| | | | | info : PACKET_FREE(0x7f3ef6323f50)
| | | | | info : PACKET_FREE(0x7f3ef6324080)
| | | <mysqlnd_auth_handshake
| | | | info : switch_to_auth_protocol=n/a
| | | | info : conn->error_info.error_no = 1045
| | | <mysqlnd_connect_run_authentication
| | | info : PACKET_FREE(0x7f3ef63236d8)
| | | >mysqlnd_conn::free_contents
| | | | >mysqlnd_net::free_contents
| | | <mysqlnd_net::free_contents
| | | info : Freeing memory of members
| | | info : scheme=unix:///tmp/mysql.sock
| | | >mysqlnd_error_list_pdto
| | | <mysqlnd_error_list_pdto
| | | | <mysqlnd_conn::free_contents
| | | <mysqlnd_conn::connect
[...]
```

The trace log can also be used to verify correct behaviour of PECL/mysqlnd_ms itself, for example, to check which server has been selected for query execution and why.

Example excerpt from the debug log (plugin decision):

```
[...]
>mysqlnd_ms::query
| info : query=DROP TABLE IF EXISTS test
| >_mysqlnd_plugin_get_plugin_connection_data
| | info : plugin_id=5
| <_mysqlnd_plugin_get_plugin_connection_data
| >mysqlnd_ms_pick_server_ex
| | info : conn_data=0x7fb6a7d3e5a0 *conn_data=0x7fb6a7d410d0
| | >mysqlnd_ms_select_servers_all
| | <mysqlnd_ms_select_servers_all
| | >mysqlnd_ms_choose_connection_rr
| | | >mysqlnd_ms_query_is_select
[...]
| | | <mysqlnd_ms_query_is_select
[...]
| | | info : Init the master context
| | | info : list(0x7fb6a7d3f598) has 1
| | | info : Using master connection
| | | >mysqlnd_ms_advanced_connect
| | | | >mysqlnd_conn::connect
| | | | | info : host=localhost user=root db=test port=3306 flags=131072 persistent=0 state=0
```

In this case the statement `DROP TABLE IF EXISTS test` has been executed. Note that the statement string is shown in the log file. You may want to take measures to restrict access to the log for security considerations.

The statement has been load balanced using round robin policy, as you can easily guess from the functions name `>mysqlnd_ms_choose_connection_rr`. It has been sent to a master server running on `host=localhost user=root db=test port=3306 flags=131072 persistent=0 state=0`.

Monitoring

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Plugin activity can be monitored using the mysqlnd trace log, mysqlnd statistics, mysqlnd_ms plugin statistics and external PHP debugging tools. Use of the trace log should be limited to debugging. It is recommended to use the plugins statistics for monitoring.

Writing a trace log is a slow operation. If using an external PHP debugging tool, please refer to the vendors manual about its performance impact and the type of information collected. In many cases, external debugging tools will provide call stacks. Often, a call stack or a trace log is more difficult to interpret than the statistics provided by the plugin.

Plugin statistics tell how often which kind of cluster node has been used (slave or master), why the node was used, if lazy connections have been used and if global transaction ID injection has been performed. The monitoring information provided enables user to verify plugin decisions and to plan their cluster resources based on usage pattern. The function [mysqlnd_ms_get_stats](#) is used to access the statistics. Please, see the functions description for a list of available statistics.

Statistics are collected on a per PHP process basis. Their scope is a PHP process. Depending on the PHP deployment model a process may serve one or multiple web requests. If using CGI model, a PHP process serves one web request. If using FastCGI or pre-fork web server models, a PHP process usually serves multiple web requests. The same is the case with a threaded web server. Please, note that threads running in parallel can update the statistics in parallel. Thus, if using a threaded PHP deployment model, statistics can be changed by more than one script at a time. A script cannot rely on the fact that it sees only its own changes to statistics.

Example 7.298 Verify plugin activity in a non-threaded deployment model

```
mysqlnd_ms.enable=1
mysqlnd_ms.collect_statistics=1

<?php
/* Load balanced following "myapp" section rules from the plugins config file (not shown) */
$mysqli = new mysqli("myapp", "username", "password", "database");
if ($mysqli_connect_errno())
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", $mysqli_connect_errno(), $mysqli_connect_error()));
$stmts_before = mysqlnd_ms_get_stats();
if ($res = $mysqli->query("SELECT 'Read request' FROM DUAL")) {
    var_dump($res->fetch_all());
}
$stmts_after = mysqlnd_ms_get_stats();
if ($stmts_after['use_slave'] <= $stmts_before['use_slave']) {
    echo "According to the statistics the read request has not been run on a slave!";
}
?>
```

Statistics are aggregated for all plugin activities and all connections handled by the plugin. It is not possible to tell how much a certain connection handle has contributed to the overall statistics.

Utilizing PHPs [register_shutdown_function](#) function or the [auto_append_file](#) PHP configuration directive it is easily possible to dump statistics into, for example, a log file when a script finishes. Instead of using a log file it is also possible to send the statistics to an external monitoring tool for recording and display.

Example 7.299 Recording statistics during shutdown

```
mysqlnd_ms.enable=1
mysqlnd_ms.collect_statistics=1
error_log=/tmp/php_errors.log
```

```
<?php
function check_stats() {
    $msg = str_repeat("-", 80) . "\n";
    $msg .= var_export(mysqlnd_ms_get_stats(), true) . "\n";
    $msg .= str_repeat("-", 80) . "\n";
    error_log($msg);
}
register_shutdown_function("check_stats");
?>
```

7.7.7 Predefined Constants

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The constants below are defined by this extension, and will only be available when the extension has either been compiled into PHP or dynamically loaded at runtime.

SQL hint related

Example 7.300 Example demonstrating the usage of mysqlnd_ms constants

The mysqlnd replication and load balancing plugin ([mysqlnd_ms](#)) performs read/write splitting. This directs write queries to a MySQL master server, and read-only queries to the MySQL slave servers. The plugin has a built-in read/write split logic. All queries which start with [SELECT](#) are considered read-only queries, which are then sent to a MySQL slave server that is listed in the plugin configuration file. All other queries are directed to the MySQL master server that is also specified in the plugin configuration file.

User supplied SQL hints can be used to overrule automatic read/write splitting, to gain full control on the process. SQL hints are standards compliant SQL comments. The plugin will scan the beginning of a query string for an SQL comment for certain commands, which then control query redirection. Other systems involved in the query processing are unaffected by the SQL hints because other systems will ignore the SQL comments.

The plugin supports three SQL hints to direct queries to either the MySQL slave servers, the MySQL master server, or the last used MySQL server. SQL hints must be placed at the beginning of a query to be recognized by the plugin.

For better portability, it is recommended to use the string constants [MYSQLND_MS_MASTER_SWITCH](#), [MYSQLND_MS_SLAVE_SWITCH](#) and [MYSQLND_MS_LAST_USED_SWITCH](#) instead of their literal values.

```
<?php
/* Use constants for maximum portability */
$master_query = /*/* . MYSQLND_MS_MASTER_SWITCH . */SELECT id FROM test";
/* Valid but less portable: using literal instead of constant */
$slave_query = /*ms=slave*/SHOW TABLES";
printf("master_query = '%s'\n", $master_query);
printf("slave_query = '%s'\n", $slave_query);
?>
```

The above examples will output:

```
master_query = /*ms=master*/SELECT id FROM test
```

```
slave_query = /*ms=slave*/SHOW TABLES
```

<code>MYSQLND_MS_MASTER_SWITCH</code> (string)	SQL hint used to send a query to the MySQL replication master server.
<code>MYSQLND_MS_SLAVE_SWITCH</code> (string)	SQL hint used to send a query to one of the MySQL replication slave servers.
<code>MYSQLND_MS_LAST_USED_SWITCH</code> (string)	SQL hint used to send a query to the last used MySQL server. The last used MySQL server can either be a master or a slave server in a MySQL replication setup.

`mysqlnd_ms_query_is_select` related

<code>MYSQLND_MS_QUERY_USE_MASTER</code> (integer)	If <code>mysqlnd_ms_is_select</code> returns <code>MYSQLND_MS_QUERY_USE_MASTER</code> for a given query, the built-in read/write split mechanism recommends sending the query to a MySQL replication master server.
---	---

<code>MYSQLND_MS_QUERY_USE_SLAVE</code> (integer)	If <code>mysqlnd_ms_is_select</code> returns <code>MYSQLND_MS_QUERY_USE_SLAVE</code> for a given query, the built-in read/write split mechanism recommends sending the query to a MySQL replication slave server.
--	---

<code>MYSQLND_MS_QUERY_USE_LAST_USED</code> (integer)	If <code>mysqlnd_ms_is_select</code> returns <code>MYSQLND_MS_QUERY_USE_LAST_USED</code> for a given query, the built-in read/write split mechanism recommends sending the query to the last used server.
--	---

`mysqlnd_ms_set_qos`, quality of service filter and service level related

<code>MYSQLND_MS_QOS_CONSISTENCY</code> (integer)	Used to request the service level eventual consistency from the <code>mysqlnd_ms_set_qos</code> . Eventual consistency is the default quality of service when reading from an asynchronous MySQL replication slave. Data returned in this service level may or may not be stale, depending on whether the selected slaves happen to have replicated the latest changes from the MySQL replication master or not.
--	--

<code>MYSQLND_MS_QOS_CONSISTENCY</code> (integer)	Used to request the service level session consistency from the <code>mysqlnd_ms_set_qos</code> . Session consistency is defined as read your writes. The client is guaranteed to see his latest changes.
--	--

<code>MYSQLND_MS_QOS_CONSISTENCY</code> (integer)	Used to request the service level strong consistency from the <code>mysqlnd_ms_set_qos</code> . Strong consistency is used to ensure all clients see each others changes.
--	---

<code>MYSQLND_MS_QOS_OPTION_GTID</code> (integer)	Used as a service level option with <code>mysqlnd_ms_set_qos</code> to parameterize session consistency.
--	--

<code>MYSQLND_MS_QOS_OPTION_AGE</code> (integer)	Used as a service level option with <code>mysqlnd_ms_set_qos</code> to parameterize eventual consistency.
---	---

Other

The plugins version number can be obtained using `MYSQLND_MS_VERSION` or `MYSQLND_MS_VERSION_ID`. `MYSQLND_MS_VERSION` is the string representation of the numerical version number `MYSQLND_MS_VERSION_ID`, which is an integer such as 10000. Developers can calculate the version number as follows.

Version (part)	Example
Major*10000	$1*10000 = 10000$
Minor*100	$0*100 = 0$
Patch	$0 = 0$
MYSQLND_MS_VERSION_ID	10000

`MYSQLND_MS_VERSION` (string) Plugin version string, for example, “1.0.0-prototype”.

`MYSQLND_MS_VERSION_ID` (integer) Plugin version number, for example, 10000.

7.7.8 Mysqlnd_ms Functions

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7.7.8.1 `mysqlnd_ms_dump_servers`

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- `mysqlnd_ms_dump_servers`

Returns a list of currently configured servers

Description

```
array mysqlnd_ms_dump_servers(
    mixed connection);
```

Returns a list of currently configured servers.

Parameters

`connection`

A MySQL connection handle obtained from any of the connect functions of the [mysqli](#), [mysql](#) or [PDO_MYSQL](#) extensions.

Return Values

`FALSE` on error. Otherwise, returns an array with two entries `masters` and `slaves` each of which contains an array listing all corresponding servers.

The function can be used to check and debug the list of servers currently used by the plugin. It is mostly useful when the list of servers changes at runtime, for example, when using MySQL Fabric.

`masters` and `slaves` server entries

Key	Description	Version
<code>name_from_config</code>	Server entry name from config, if applicable. NULL if no configuration name is available.	Since 1.6.0.
<code>hostname</code>	Host name of the server.	Since 1.6.0.
<code>user</code>	Database user used to authenticate against the server.	Since 1.6.0.
<code>port</code>	TCP/IP port of the server.	Since 1.6.0.
<code>socket</code>	Unix domain socket of the server.	Since 1.6.0.

Notes

Note

`mysqlnd_ms_dump_servers` requires PECL `mysqlnd_ms >> 1.6.0`.

Examples

Example 7.301 mysqlnd_ms_dump_servers example

```
{
    "myapp": {
        "master": {
            "master1": {
                "host": "master1_host",
                "port": "master1_port",
                "socket": "master1_socket",
                "db": "master1_db",
                "user": "master1_user",
                "password": "master1_pw"
            }
        },
        "slave": {
            "slave_0": {
                "host": "slave0_host",
                "port": "slave0_port",
                "socket": "slave0_socket",
                "db": "slave0_db",
                "user": "slave0_user",
                "password": "slave0_pw"
            },
            "slave_1": {
                "host": "slave1_host"
            }
        }
    }
}
```

```
<?php
$link = mysqli_connect("myapp", "global_user", "global_pass", "global_db", 1234, "global_socket");
var_dump(mysqlnd_ms_dump_servers($link));
?>
```

The above example will output:

```
array(2) {
    ["masters"]=>
    array(1) {
        [0]=>
        array(5) {
            ["name_from_config"]=>
            string(7) "master1"
            ["hostname"]=>
            string(12) "master1_host"
            ["user"]=>
            string(12) "master1_user"
            ["port"]=>
            int(3306)
            ["socket"]=>
            string(14) "master1_socket"
        }
    }
    ["slaves"]=>
    array(2) {
        [0]=>
        array(5) {
            ["name_from_config"]=>
            string(7) "slave_0"
            ["hostname"]=>
            string(11) "slave0_host"
            ["user"]=>
```

```

        string(11) "slave0_user"
        [ "port"]=>
        int(3306)
        [ "socket"]=>
        string(13) "slave0_socket"
    }
[1]=>
array(5) {
    [ "name_from_config"]=>
    string(7) "slave_1"
    [ "hostname"]=>
    string(11) "slave1_host"
    [ "user"]=>
    string(12) "global_user"
    [ "port"]=>
    int(1234)
    [ "socket"]=>
    string(13) "global_socket"
}
}
}

```

7.7.8.2 mysqlnd_ms_fabric_select_global

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- `mysqlnd_ms_fabric_select_global`

Switch to global sharding server for a given table

Description

```
array mysqlnd_ms_fabric_select_global(
    mixed connection,
    mixed table_name);
```

Warning

This function is currently not documented; only its argument list is available.

MySQL Fabric related.

Switch the connection to the nodes handling global sharding queries for the given table name.

Parameters

connection

A MySQL connection handle obtained from any of the connect functions of the [mysqli](#), [mysql](#) or [PDO_MYSQL](#) extensions.

table_name

The table name to ask Fabric about.

Return Values

`FALSE` on error. Otherwise, `TRUE`

Notes

Note

`mysqlnd_ms_fabric_select_global` requires PECL `mysqlnd_ms` >> 1.6.0.

7.7.8.3 mysqlnd_ms_fabric_select_shard

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- `mysqlnd_ms_fabric_select_shard`

Switch to shard

Description

```
array mysqlnd_ms_fabric_select_shard(
    mixed connection,
    mixed table_name,
    mixed shard_key);
```

Warning

This function is currently not documented; only its argument list is available.

MySQL Fabric related.

Switch the connection to the shards responsible for the given table name and shard key.

Parameters

<code>connection</code>	A MySQL connection handle obtained from any of the connect functions of the mysqli , mysql or PDO_MYSQL extensions.
<code>table_name</code>	The table name to ask Fabric about.
<code>shard_key</code>	The shard key to ask Fabric about.

Return Values

`FALSE` on error. Otherwise, `TRUE`

Notes

Note

`mysqlnd_ms_fabric_select_shard` requires PECL mysqlnd_ms >> 1.6.0.

7.7.8.4 `mysqlnd_ms_get_last_gtid`

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- `mysqlnd_ms_get_last_gtid`

Returns the latest global transaction ID

Description

```
string mysqlnd_ms_get_last_gtid(
    mixed connection);
```

Returns a global transaction identifier which belongs to a write operation no older than the last write performed by the client. It is not guaranteed that the global transaction identifier is identical to that one created for the last write transaction performed by the client.

Parameters

<code>connection</code>	A PECL/mysqlnd_ms connection handle to a MySQL server of the type PDO_MYSQL , mysqli > or ext/mysql . The connection handle is obtained when opening a connection with a host name that matches a mysqlnd_ms configuration file entry using any of the above three MySQL driver extensions.
-------------------------	---

Return Values

Returns a global transaction ID (GTID) on success. Otherwise, returns `FALSE`.

The function `mysqlnd_ms_get_last_gtid` returns the GTID obtained when executing the SQL statement from the `fetch_last_gtid` entry of the `global_transaction_id_injection` section from the plugins configuration file.

The function may be called after the GTID has been incremented.

Notes

Note

`mysqlnd_ms_get_last_gtid` requires PHP $\geq 5.4.0$ and PECL mysqlnd_ms $\geq 1.2.0$. Internally, it is using a `mysqlnd` library C functionality not available with PHP 5.3.

Please note, all MySQL 5.6 production versions do not provide clients with enough information to use GTIDs for enforcing session consistency. In the worst case, the plugin will choose the master only.

Examples

Example 7.302 `mysqlnd_ms_get_last_gtid` example

```
<?php
/* Open mysqlnd_ms connection using mysqli, PDO_MySQL or mysql extension */
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli)
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
/* auto commit mode, transaction on master, GTID must be incremented */
if (!$mysqli->query("DROP TABLE IF EXISTS test"))
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
printf("GTID after transaction %s\n", mysqlnd_ms_get_last_gtid($mysqli));
/* auto commit mode, transaction on master, GTID must be incremented */
if (!$mysqli->query("CREATE TABLE test(id INT)"))
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
printf("GTID after transaction %s\n", mysqlnd_ms_get_last_gtid($mysqli));
?>
```

See Also

[Global Transaction IDs](#)

7.7.8.5 `mysqlnd_ms_get_last_used_connection`

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- [`mysqlnd_ms_get_last_used_connection`](#)

Returns an array which describes the last used connection

Description

```
array mysqlnd_ms_get_last_used_connection(
    mixed connection);
```

Returns an array which describes the last used connection from the plugins connection pool currently pointed to by the user connection handle. If using the plugin, a user connection handle represents a pool of database connections. It is not possible to tell from the user connection handles properties to which database server from the pool the user connection handle points.

The function can be used to debug or monitor PECL mysqlnd_ms.

Parameters

connection

A MySQL connection handle obtained from any of the connect functions of the [mysqli](#), [mysql](#) or [PDO_MYSQL](#) extensions.

Return Values

`FALSE` on error. Otherwise, an array which describes the connection used to execute the last statement on.

Array which describes the connection.

Property	Description	Version
<code>scheme</code>	Connection scheme. Either <code>tcp://host:port</code> or <code>unix://host:socket</code> . If you want to distinguish connections from each other use a combination of <code>scheme</code> and <code>thread_id</code> as a unique key. Neither <code>scheme</code> nor <code>thread_id</code> alone are sufficient to distinguish two connections from each other. Two servers may assign the same <code>thread_id</code> to two different connections. Thus, connections in the pool may have the same <code>thread_id</code> . Also, do not rely on uniqueness of <code>scheme</code> in a pool. Your QA engineers may use the same MySQL server instance for two distinct logical roles and add it multiple times to the pool. This hack is used, for example, in the test suite.	Since 1.1.0.
<code>host</code>	Database server host used with the connection. The host is only set with TCP/IP connections. It is empty with Unix domain or Windows named pipe connections,	Since 1.1.0.
<code>host_info</code>	A character string representing the server hostname and the connection type.	Since 1.1.2.
<code>port</code>	Database server port used with the connection.	Since 1.1.0.
<code>socket_unix_domain</code>	Unix domain socket or Windows named pipe used with the connection. The value is empty for TCP/IP connections.	Since 1.1.2.
<code>thread_id</code>	Connection thread id.	Since 1.1.0.
<code>last_message</code>	Info message obtained from the MySQL C API function <code>mysql_info()</code> . Please, see mysqli_info for a description.	Since 1.1.0.
<code>errno</code>	Error code.	Since 1.1.0.
<code>error</code>	Error message.	Since 1.1.0.
<code>sqlstate</code>	Error SQLstate code.	Since 1.1.0.

Notes

Note

`mysqlnd_ms_get_last_used_connection` requires PHP >= 5.4.0 and PECL mysqlnd_ms >> 1.1.0. Internally, it is using a `mysqlnd` library C call not available with PHP 5.3.

Examples

The example assumes that `myapp` refers to a plugin configuration file section and represents a connection pool.

Example 7.303 `mysqlnd_ms_get_last_used_connection` example

```
<?php
$link = new mysqli("myapp", "user", "password", "database");
```

```
$res = $link->query("SELECT 1 FROM DUAL");
var_dump(mysqlnd_ms_get_last_used_connection($link));
?>
```

The above example will output:

```
array(10) {
    ["scheme"]=>
    string(22) "unix:///tmp/mysql.sock"
    ["host_info"]=>
    string(25) "Localhost via UNIX socket"
    ["host"]=>
    string(0) ""
    ["port"]=>
    int(3306)
    ["socket_or_pipe"]=>
    string(15) "/tmp/mysql.sock"
    ["thread_id"]=>
    int(46253)
    ["last_message"]=>
    string(0) ""
    ["errno"]=>
    int(0)
    ["error"]=>
    string(0) ""
    ["sqlstate"]=>
    string(5) "00000"
}
```

7.7.8.6 mysqlnd_ms_get_stats

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- [mysqlnd_ms_get_stats](#)

Returns query distribution and connection statistics

Description

```
array mysqlnd_ms_get_stats();
```

Returns an array of statistics collected by the replication and load balancing plugin.

The PHP configuration setting [mysqlnd_ms.collect_statistics](#) controls the collection of statistics. The collection of statistics is disabled by default for performance reasons.

The scope of the statistics is the [PHP](#) process. Depending on your deployment model a [PHP](#) process may handle one or multiple requests.

Statistics are aggregated for all connections and all storage handler. It is not possible to tell how much queries originating from [mysqli](#), [PDO_MySQL](#) or [mysql](#) API calls have contributed to the aggregated data values.

Parameters

This function has no parameters.

Return Values

Returns [NULL](#) if the PHP configuration directive [mysqlnd_ms.enable](#) has disabled the plugin. Otherwise, returns array of statistics.

Array of statistics

Statistic	Description	Version
<code>use_slave</code>	<p>The semantics of this statistic has changed between 1.0.1 - 1.1.0.</p> <p>The meaning for version 1.0.1 is as follows. Number of statements considered as read-only by the built-in query analyzer. Neither statements which begin with a SQL hint to force use of slave nor statements directed to a slave by an user-defined callback are included. The total number of statements sent to the slaves is <code>use_slave + use_slave_sql_hint + use_slave_callback</code>.</p> <p>PECL/mysqlnd_ms 1.1.0 introduces a new concept of chained filters. The statistics is now set by the internal load balancing filter. With version 1.1.0 the load balancing filter is always the last in the filter chain, if used. In future versions a load balancing filter may be followed by other filters causing another change in the meaning of the statistic. If, in the future, a load balancing filter is followed by another filter it is no longer guaranteed that the statement, which increments <code>use_slave</code>, will be executed on the slaves.</p> <p>The meaning for version 1.1.0 is as follows. Number of statements sent to the slaves. Statements directed to a slave by the user filter (an user-defined callback) are not included. The latter are counted by <code>use_slave_callback</code>.</p>	Since 1.0.0.
<code>use_master</code>	<p>The semantics of this statistic has changed between 1.0.1 - 1.1.0.</p> <p>The meaning for version 1.0.1 is as follows. Number of statements not considered as read-only by the built-in query analyzer. Neither statements which begin with a SQL hint to force use of master nor statements directed to a master by an user-defined callback are included. The total number of statements sent to the master is <code>use_master + use_master_sql_hint + use_master_callback</code>.</p> <p>PECL/mysqlnd_ms 1.1.0 introduces a new concept of chained filters. The statictics is now set by the internal load balancing filter. With version 1.1.0 the load balancing filter is always the last in the filter chain, if used. In future versions a load balancing filter may be followed by other filters causing another change in the meaning of the statistic. If, in the future, a load balancing filter is followed by another filter it is no longer guaranteed that the statement, which increments <code>use_master</code>, will be executed on the slaves.</p> <p>The meaning for version 1.1.0 is as follows. Number of statements sent to the masters. Statements directed to a master by the user filter (an user-defined callback) are not included. The latter are counted by <code>use_master_callback</code>.</p>	Since 1.0.0.
<code>use_slave荐</code>	Number of statements the built-in query analyzer recommends sending to a slave because they contain no SQL hint to force use of a certain server. The recommendation may be overruled in the following. It is not guaranteed whether the statement will be executed on a slave or not. This is how often the internal <code>is_select</code> function has guessed that a slave shall be used. Please, see also the user space function <code>mysqlnd_ms_query_is_select</code> .	Since 1.1.0.
<code>use_master荐</code>	Number of statements the built-in query analyzer recommends sending to a master because they contain no SQL hint to force use of a certain server. The recommendation may be overruled in the following. It is not guaranteed whether the statement will be executed on a slave or	Since 1.1.0.

Statistic	Description	Version
	not. This is how often the internal <code>is_select</code> function has guessed that a master shall be used. Please, see also the user space function <code>mysqlnd_ms_query_is_select</code> .	
<code>use_slave</code>	Number of statements sent to a slave because statement begins with the SQL hint to force use of slave.	Since 1.0.0.
<code>use_master</code>	Number of statements sent to a master because statement begins with the SQL hint to force use of master.	Since 1.0.0.
<code>use_last</code>	Number of statements sent to server which has run the previous statement, because statement begins with the SQL hint to force use of previously used server.	Since 1.0.0.
<code>use_slave_cb</code>	Number of statements sent to a slave because an user-defined callback has chosen a slave server for statement execution.	Since 1.0.0.
<code>use_master_cb</code>	Number of statements sent to a master because an user-defined callback has chosen a master server for statement execution.	Since 1.0.0.
<code>non_lazy</code>	Number of successfully opened slave connections from configurations not using <code>lazy connections</code> . The total number of successfully opened slave connections is <code>non_lazy_connections_slave_success + lazy_connections_slave_success</code>	Since 1.0.0.
<code>non_lazy_slave</code>	Number of failed slave connection attempts from configurations not using <code>lazy connections</code> . The total number of failed slave connection attempts is <code>non_lazy_connections_slave_failure + lazy_connections_slave_failure</code>	Since 1.0.0.
<code>non_lazy_master</code>	Number of successfully opened master connections from configurations not using <code>lazy connections</code> . The total number of successfully opened master connections is <code>non_lazy_connections_master_success + lazy_connections_master_success</code>	Since 1.0.0.
<code>non_lazy_master_failure</code>	Number of failed master connection attempts from configurations not using <code>lazy connections</code> . The total number of failed master connection attempts is <code>non_lazy_connections_master_failure + lazy_connections_master_failure</code>	Since 1.0.0.
<code>lazy_connections_slave</code>	Number of successfully opened slave connections from configurations using <code>lazy connections</code> .	Since 1.0.0.
<code>lazy_connections_slave_failure</code>	Number of failed slave connection attempts from configurations using <code>lazy connections</code> .	Since 1.0.0.
<code>lazy_connections_master</code>	Number of successfully opened master connections from configurations using <code>lazy connections</code> .	Since 1.0.0.
<code>lazy_connections_master_failure</code>	Number of failed master connection attempts from configurations using <code>lazy connections</code> .	Since 1.0.0.
<code>trx_autocommit</code>	Number of <code>autocommit</code> mode activations via API calls. This figure may be used to monitor activity related to the plugin configuration setting <code>trx_stickiness</code> . If, for example, you want to know if a certain API call invokes the <code>mysqlnd</code> library function <code>trx_autocommit()</code> , which is a requirement for <code>trx_stickiness</code> , you may call the user API function in question and check if the statistic has changed. The statistic is modified only by the plugins internal subclassed <code>trx_autocommit()</code> method.	Since 1.0.0.
<code>trx_autocommit_deactivation</code>	Number of <code>autocommit</code> mode deactivations via API calls.	Since 1.0.0.

Statistic	Description	Version
<code>trx_master_injections</code>	Number of statements redirected to the master while <code>trx_stickiness=master</code> and <code>autocommit</code> mode is disabled.	Since 1.0.0.
<code>gtid_autocommit_injections</code>	Number of successful SQL injections in autocommit mode as part of the plugins client-side <code>global transaction id emulation</code> .	Since 1.2.0.
<code>gtid_autocommit_error_injections</code>	Number of failed SQL injections in autocommit mode as part of the plugins client-side <code>global transaction id emulation</code> .	Since 1.2.0.
<code>gtid_commit_injections</code>	Number of successful SQL injections in commit mode as part of the plugins client-side <code>global transaction id emulation</code> .	Since 1.2.0.
<code>gtid_commit_error_injections</code>	Number of failed SQL injections in commit mode as part of the plugins client-side <code>global transaction id emulation</code> .	Since 1.2.0.
<code>gtid_implicit_injections</code>	Number of successful SQL injections when implicit commit is detected as part of the plugins client-side <code>global transaction id emulation</code> . Implicit commit happens, for example, when autocommit has been turned off, a query is executed and autocommit is enabled again. In that case, the statement will be committed by the server and SQL to maintain is injected before the autocommit is re-enabled. Another sequence causing an implicit commit is <code>begin()</code> , <code>query()</code> , <code>begin()</code> . The second call to <code>begin()</code> will implicitly commit the transaction started by the first call to <code>begin()</code> . <code>begin()</code> refers to internal library calls not actual PHP user API calls.	Since 1.2.0.
<code>gtid_implicit_error_injections</code>	Number of failed SQL injections when implicit commit is detected as part of the plugins client-side <code>global transaction id emulation</code> . Implicit commit happens, for example, when autocommit has been turned off, a query is executed and autocommit is enabled again. In that case, the statement will be committed by the server and SQL to maintain is injected before the autocommit is re-enabled.	Since 1.2.0.
<code>transient_error_retries</code>	How often an operation has been retried when a transient error was detected. See also, <code>transient_error</code> plugin configuration file setting.	Since 1.6.0.
<code>fabric_sharding_successful_calls</code>	Number of successful <code>sharding.lookup_servers</code> remote procedure calls to MySQL Fabric. A call is considered successful if the plugin could reach MySQL Fabric and got any reply. The reply itself may or may not be understood by the plugin. Success refers to the network transport only. If the reply was not understood or indicates a valid error condition, <code>fabric_sharding_lookup_servers_xml_failure</code> gets incremented.	Since 1.6.0.
<code>fabric_sharding_failed_calls</code>	Number of failed <code>sharding.lookup_servers</code> remote procedure calls to MySQL Fabric. A remote procedure call is considered failed if there was a network error in connecting to, writing to or reading from MySQL Fabric.	Since 1.6.0.
<code>fabric_sharding_time_spent</code>	Time spent connecting to, writing to and reading from MySQL Fabric during the <code>sharding.lookup_servers</code> remote procedure call. The value is aggregated for all calls. Time is measured in microseconds.	Since 1.6.0.
<code>fabric_sharding_total_bytes_received</code>	Total number of bytes received from MySQL Fabric in reply to <code>sharding.lookup_servers</code> calls.	Since 1.6.0.
<code>fabric_sharding_error_replies</code>	How often a reply from MySQL Fabric to <code>sharding.lookup_servers</code> calls was not understood. Please note, the current experimental implementation does not distinguish between valid errors returned and malformed replies.	Since 1.6.0.

Statistic	Description	Version
<code>xa_begin</code>	How many XA/distributed transactions have been started using <code>mysqlnd_ms_xa_begin</code> .	Since 1.6.0.
<code>xa_commi</code>	How many XA/distributed transactions have been successfully committed using <code>mysqlnd_ms_xa_commit</code> .	Since 1.6.0.
<code>xa_commf</code>	How many XA/distributed transactions failed to commit during <code>mysqlnd_ms_xa_commit</code> .	Since 1.6.0.
<code>xa_rollback</code>	How many XA/distributed transactions have been successfully rolled back using <code>mysqlnd_ms_xa_rollback</code> . The figure does not include implicit rollbacks performed as a result of <code>mysqlnd_ms_xa_commit</code> failure.	Since 1.6.0.
<code>xa_rollbackf</code>	How many XA/distributed transactions could not be rolled back. This includes failures of <code>mysqlnd_ms_xa_rollback</code> but also failures during rollback when closing a connection, if <code>rollback_on_close</code> is set. Please, see also <code>xa_rollback_on_close</code> below.	Since 1.6.0.
<code>xa_partic</code>	Total number of participants in any XA transaction started with <code>mysqlnd_ms_xa_begin</code> .	Since 1.6.0.
<code>xa_rollbacki</code>	How many XA transactions have been rolled back implicitly when a connection was closed and <code>rollback_on_close</code> is set. Depending on your coding policies, this may hint a flaw in your code as you may prefer to explicitly clean up resources.	Since 1.6.0.
<code>pool_master</code>	Number of master servers (connections) in the internal connection pool.	Since 1.6.0.
<code>pool_slave</code>	Number of slave servers (connections) in the internal connection pool.	Since 1.6.0.
<code>pool_master_c</code>	Number of master servers (connections) from the internal connection pool which are currently used for picking a connection.	Since 1.6.0.
<code>pool_slave_c</code>	Number of slave servers (connections) from the internal connection pool which are currently used for picking a connection.	Since 1.6.0.
<code>pool_update</code>	How often the active connection list has been replaced and a new set of master and slave servers had been installed.	Since 1.6.0.
<code>pool_master_r</code>	How often a master connection has been reused after being flushed from the active list.	Since 1.6.0.
<code>pool_slave_r</code>	How often a slave connection has been reused after being flushed from the active list.	Since 1.6.0.

Examples

Example 7.304 `mysqlnd_ms_get_stats` example

```
<?php
printf("mysqlnd_ms.enable = %d\n", ini_get("mysqlnd_ms.enable"));
printf("mysqlnd_ms.collect_statistics = %d\n", ini_get("mysqlnd_ms.collect_statistics"));
var_dump(mysqlnd_ms_get_stats());
?>
```

The above example will output:

```
mysqlnd_ms.enable = 1
mysqlnd_ms.collect_statistics = 1
array(26) {
    ["use_slave"]=>
    string(1) "0"
```

```
[ "use_master" ]=>
string(1) "0"
[ "use_slave_guess" ]=>
string(1) "0"
[ "use_master_guess" ]=>
string(1) "0"
[ "use_slave_sql_hint" ]=>
string(1) "0"
[ "use_master_sql_hint" ]=>
string(1) "0"
[ "use_last_used_sql_hint" ]=>
string(1) "0"
[ "use_slave_callback" ]=>
string(1) "0"
[ "use_master_callback" ]=>
string(1) "0"
[ "non_lazy_connections_slave_success" ]=>
string(1) "0"
[ "non_lazy_connections_slave_failure" ]=>
string(1) "0"
[ "non_lazy_connections_master_success" ]=>
string(1) "0"
[ "non_lazy_connections_master_failure" ]=>
string(1) "0"
[ "lazy_connections_slave_success" ]=>
string(1) "0"
[ "lazy_connections_slave_failure" ]=>
string(1) "0"
[ "lazy_connections_master_success" ]=>
string(1) "0"
[ "lazy_connections_master_failure" ]=>
string(1) "0"
[ "trx_autocommit_on" ]=>
string(1) "0"
[ "trx_autocommit_off" ]=>
string(1) "0"
[ "trx_master_forced" ]=>
string(1) "0"
[ "gtid_autocommit_injections_success" ]=>
string(1) "0"
[ "gtid_autocommit_injections_failure" ]=>
string(1) "0"
[ "gtid_commit_injections_success" ]=>
string(1) "0"
[ "gtid_commit_injections_failure" ]=>
string(1) "0"
[ "gtid_implicit_commit_injections_success" ]=>
string(1) "0"
[ "gtid_implicit_commit_injections_failure" ]=>
string(1) "0"
[ "transient_error_retries" ]=>
string(1) "0"
}
}
```

See Also

[Runtime configuration](#)
[mysqlnd_ms.collect_statistics](#)
[mysqlnd_ms.enable](#)
[Monitoring](#)

7.7.8.7 mysqlnd_ms_match_wild

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- [mysqlnd_ms_match_wild](#)

Finds whether a table name matches a wildcard pattern or not

Description

```
bool mysqlnd_ms_match_wild(
    string table_name,
    string wildcard);
```

Finds whether a table name matches a wildcard pattern or not.

This function is not of much practical relevance with PECL mysqlnd_ms 1.1.0 because the plugin does not support MySQL replication table filtering yet.

Parameters

table_name The table name to check if it is matched by the wildcard.

wildcard The wildcard pattern to check against the table name. The wildcard pattern supports the same placeholders as MySQL replication filters do.

MySQL replication filters can be configured by using the MySQL Server configuration options `--replicate-wild-do-table` and `--replicate-wild-do-db`. Please, consult the MySQL Reference Manual to learn more about this MySQL Server feature.

The supported placeholders are:

- `%` - zero or more literals
- `_` - one literal

Placeholders can be escaped using `\`.

Return Values

Returns `TRUE` *table_name* is matched by *wildcard*. Otherwise, returns `FALSE`

Examples

Example 7.305 `mysqlnd_ms_match_wild` example

```
<?php
var_dump(mysqlnd_ms_match_wild("schema_name.table_name", "schema%"));
var_dump(mysqlnd_ms_match_wild("abc", "_"));
var_dump(mysqlnd_ms_match_wild("table1", "table_"));
var_dump(mysqlnd_ms_match_wild("asia_customers", "%customers"));
var_dump(mysqlnd_ms_match_wild("funny%table", "funny\%table"));
var_dump(mysqlnd_ms_match_wild("funnytable", "funny%table"));
?>
```

The above example will output:

```
bool(true)
bool(false)
bool(true)
bool(true)
bool(true)
bool(true)
```

7.7.8.8 `mysqlnd_ms_query_is_select`

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- `mysqlnd_ms_query_is_select`

Find whether to send the query to the master, the slave or the last used MySQL server

Description

```
int mysqlnd_ms_query_is_select(
    string query);
```

Finds whether to send the query to the master, the slave or the last used MySQL server.

The plugins built-in read/write split mechanism will be used to analyze the query string to make a recommendation where to send the query. The built-in read/write split mechanism is very basic and simple. The plugin will recommend sending all queries to the MySQL replication master server but those which begin with `SELECT`, or begin with a SQL hint which enforces sending the query to a slave server. Due to the basic but fast algorithm the plugin may propose to run some read-only statements such as `SHOW TABLES` on the replication master.

Parameters

<code>query</code>	Query string to test.
--------------------	-----------------------

Return Values

A return value of `MYSQLND_MS_QUERY_USE_MASTER` indicates that the query should be send to the MySQL replication master server. The function returns a value of `MYSQLND_MS_QUERY_USE_SLAVE` if the query can be run on a slave because it is considered read-only. A value of `MYSQLND_MS_QUERY_USE_LAST_USED` is returned to recommend running the query on the last used server. This can either be a MySQL replication master server or a MySQL replication slave server.

If read write splitting has been disabled by setting `mysqlnd_ms.disable_rw_split`, the function will always return `MYSQLND_MS_QUERY_USE_MASTER` or `MYSQLND_MS_QUERY_USE_LAST_USED`.

Examples

Example 7.306 `mysqlnd_ms_query_is_select` example

```
<?php
function is_select($query)
{
    switch (mysqlnd_ms_query_is_select($query))
    {
        case MYSQLND_MS_QUERY_USE_MASTER:
            printf("'%s' should be run on the master.\n", $query);
            break;
        case MYSQLND_MS_QUERY_USE_SLAVE:
            printf("'%s' should be run on a slave.\n", $query);
            break;
        case MYSQLND_MS_QUERY_USE_LAST_USED:
            printf("'%s' should be run on the server that has run the previous query\n", $query);
            break;
        default:
            printf("No suggestion where to run the '%s', fallback to master recommended\n", $query);
            break;
    }
}
is_select("INSERT INTO test(id) VALUES (1)");
is_select("SELECT 1 FROM DUAL");
is_select("/*" . MYSQLND_MS_LAST_USED_SWITCH . "*/SELECT 2 FROM DUAL");
?>
```

The above example will output:

```
INSERT INTO test(id) VALUES (1) should be run on the master.
SELECT 1 FROM DUAL should be run on a slave.
/*ms=last_used*/SELECT 2 FROM DUAL should be run on the server that has run the previous query
```

See Also[Predefined Constants](#)[user filter](#)[Runtime configuration](#)[mysqld_ms.disable_rw_split](#)[mysqld_ms.enable](#)

7.7.8.9 [mysqld_ms_set_qos](#)

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- [mysqld_ms_set_qos](#)

Sets the quality of service needed from the cluster

Description

```
bool mysqld_ms_set_qos(
    mixed connection,
    int service_level,
    int service_level_option,
    mixed option_value);
```

Sets the quality of service needed from the cluster. A database cluster delivers a certain quality of service to the user depending on its architecture. A major aspect of the quality of service is the consistency level the cluster can offer. An asynchronous MySQL replication cluster defaults to eventual consistency for slave reads: a slave may serve stale data, current data, or it may have not the requested data at all, because it is not synchronous to the master. In a MySQL replication cluster, only master accesses can give strong consistency, which promises that all clients see each others changes.

PECL/mysqld_ms hides the complexity of choosing appropriate nodes to achieve a certain level of service from the cluster. The "Quality of Service" filter implements the necessary logic. The filter can either be configured in the plugins configuration file, or at runtime using [mysqld_ms_set_qos](#).

Similar results can be achieved with PECL mysqld_ms < 1.2.0, if using SQL hints to force the use of a certain type of node or using the [master_on_write](#) plugin configuration option. The first requires more code and causes more work on the application side. The latter is less refined than using the quality of service filter. Settings made through the function call can be reversed, as shown in the example below. The example temporarily switches to a higher service level (session consistency, read your writes) and returns back to the clusters default after it has performed all operations that require the better service. This way, read load on the master can be minimized compared to using [master_on_write](#), which would continue using the master after the first write.

Since 1.5.0 calls will fail when done in the middle of a transaction if [transaction stickiness](#) is enabled and transaction boundaries have been detected. properly.

Parameters

connection

A PECL/mysqld_ms connection handle to a MySQL server of the type [PDO_MYSQL](#), [mysqli](#) or [ext/mysql](#) for which a service level is to be set. The connection handle is obtained when opening a connection with a host name that matches a mysqld_ms configuration file entry using any of the above three MySQL driver extensions.

service_level

The requested service level:

`MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL`,
`MYSQLND_MS_QOS_CONSISTENCY_SESSION` or
`MYSQLND_MS_QOS_CONSISTENCY_STRONG`.

service_level_option

An option to parameterize the requested service level. The option can either be `MYSQLND_MS_QOS_OPTION_GTID` or `MYSQLND_MS_QOS_OPTION_AGE`.

The option `MYSQLND_MS_QOS_OPTION_GTID` can be used to refine the service level `MYSQLND_MS_QOS_CONSISTENCY_SESSION`. It must be combined with a fourth function parameter, the *option_value*. The *option_value* shall be a global transaction ID obtained from `mysqlnd_ms_get_last_gtid`. If set, the plugin considers both master servers and asynchronous slaves for session consistency (read your writes). Otherwise, only masters are used to achieve session consistency. A slave is considered up-to-date and checked if it has already replicated the global transaction ID from *option_value*. Please note, searching appropriate slaves is an expensive and slow operation. Use the feature sparsely, if the master cannot handle the read load alone.

The `MYSQLND_MS_QOS_OPTION_AGE` option can be combined with the `MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL` service level, to filter out asynchronous slaves that lag more seconds behind the master than *option_value*. If set, the plugin will only consider slaves for reading if `SHOW SLAVE STATUS` reports `Slave_IO_Running=Yes`, `Slave_SQL_Running=Yes` and `Seconds_Behind_Master <= option_value`. Please note, searching appropriate slaves is an expensive and slow operation. Use the feature sparsely in version 1.2.0. Future versions may improve the algorithm used to identify candidates. Please, see the MySQL reference manual about the precision, accuracy and limitations of the MySQL administrative command `SHOW SLAVE STATUS`.

option_value

Parameter value for the service level option. See also the *service_level_option* parameter.

Return Values

Returns `TRUE` if the connections service level has been switched to the requested. Otherwise, returns `FALSE`

Notes

Note

`mysqlnd_ms_set_qos` requires PHP \geq 5.4.0 and PECL mysqlnd_ms \geq 1.2.0. Internally, it is using a `mysqlnd` library C functionality not available with PHP 5.3.

Please note, all MySQL 5.6 production versions do not provide clients with enough information to use GTIDs for enforcing session consistency. In the worst case, the plugin will choose the master only.

Examples

Example 7.307 `mysqlnd_ms_set_qos` example

```
<?php
/* Open mysqlnd_ms connection using mysqli, PDO_MySQL or mysql extension */
$mysqli = new mysqli("myapp", "username", "password", "database");
if (!$mysqli)
    /* Of course, your error handling is nicer... */
    die(sprintf("[%d] %s\n", mysqli_connect_errno(), mysqli_connect_error()));
/* Session consistency: read your writes */
$ret = mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_SESSION);
if (!$ret)
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
/* Will use master and return fresh data, client can see his last write */
if (!$res = $mysqli->query("SELECT item, price FROM orders WHERE order_id = 1"))
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
/* Back to default: use of all slaves and masters permitted, stale data can happen */
if (!$ret = mysqlnd_ms_set_qos($mysqli, MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL))
    die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
?>
```

See Also

[mysqlnd_ms_get_last_gtid](#)
[Service level and consistency concept](#)
[Filter concept](#)

7.7.8.10 mysqlnd_ms_set_user_pick_server

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- [mysqlnd_ms_set_user_pick_server](#)

Sets a callback for user-defined read/write splitting

Description

```
bool mysqlnd_ms_set_user_pick_server(
    string function);
```

Sets a callback for user-defined read/write splitting. The plugin will call the callback only if `pick[]=user` is the default rule for server picking in the relevant section of the plugins configuration file.

The plugins built-in read/write query split mechanism decisions can be overwritten in two ways. The easiest way is to prepend the query string with the SQL hints `MYSQLND_MS_MASTER_SWITCH`, `MYSQLND_MS_SLAVE_SWITCH` or `MYSQLND_MS_LAST_USED_SWITCH`. Using SQL hints one can control, for example, whether a query shall be send to the MySQL replication master server or one of the slave servers. By help of SQL hints it is not possible to pick a certain slave server for query execution.

Full control on server selection can be gained using a callback function. Use of a callback is recommended to expert users only because the callback has to cover all cases otherwise handled by the plugin.

The plugin will invoke the callback function for selecting a server from the lists of configured master and slave servers. The callback function inspects the query to run and picks a server for query execution by returning the hosts URI, as found in the master and slave list.

If the lazy connections are enabled and the callback chooses a slave server for which no connection has been established so far and establishing the connection to the slave fails, the plugin will return an error upon the next action on the failed connection, for example, when running a query. It is the responsibility of the application developer to handle the error. For example, the application can re-run the query to trigger a new server selection and callback invocation. If so, the callback must make sure to select a different slave, or check slave availability, before returning to the plugin to prevent an endless loop.

Parameters

function

The function to be called. Class methods may also be invoked statically using this function by passing `array($classname, $methodname)` to this parameter. Additionally class methods of an object instance may be called by passing `array($objectinstance, $methodname)` to this parameter.

Return Values

Host to run the query on. The host URI is to be taken from the master and slave connection lists passed to the callback function. If callback returns a value neither found in the master nor in the slave connection lists the plugin will fallback to the second pick method configured via the `pick[]` setting in the plugin configuration file. If not second pick method is given, the plugin falls back to the build-in default pick method for server selection.

Notes

Note

`mysqlnd_ms_set_user_pick_server` is available with PECL mysqlnd_ms < 1.1.0. It has been replaced by the `user` filter. Please, check the [Change History](#) for upgrade notes.

Examples

Example 7.308 `mysqlnd_ms_set_user_pick_server` example

```
[myapp]
master[] = localhost
slave[] = 192.168.2.27:3306
slave[] = 192.168.78.136:3306
pick[] = user
```

```
<?php
function pick_server($connected, $query, $master, $slaves, $last_used)
{
    static $slave_idx = 0;
    static $num_slaves = NULL;
    if (is_null($num_slaves))
        $num_slaves = count($slaves);
    /* default: fallback to the plugins build-in logic */
    $ret = NULL;
    printf("User has connected to '%s'...\n", $connected);
    printf("... deciding where to run '%s'\n", $query);
    $where = mysqlnd_ms_query_is_select($query);
    switch ($where)
    {
        case MYSQLND_MS_QUERY_USE_MASTER:
            printf("... using master\n");
            $ret = $master[0];
            break;
        case MYSQLND_MS_QUERY_USE_SLAVE:
            /* SELECT or SQL hint for using slave */
            if (strpos($query, "FROM table_on_slave_a_only"))
            {
                /* a table which is only on the first configured slave */
                printf("... access to table available only on slave A detected\n");
                $ret = $slaves[0];
            }
            else
            {
                /* round robin */

```

```

    printf("... some read-only query for a slave\n");
    $ret = $slaves[$slave_idx++ % $num_slaves];
}
break;
case MYSQLND_MS_QUERY_LAST_USED:
printf("... using last used server\n");
$ret = $last_used;
break;
}
printf("... ret = '%s'\n", $ret);
return $ret;
}
mysqlnd_ms_set_user_pick_server("pick_server");
$mysqli = new mysqli("myapp", "root", "root", "test");
if (!($res = $mysqli->query("SELECT 1 FROM DUAL")))
printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
else
$res->close();
if (!($res = $mysqli->query("SELECT 2 FROM DUAL")))
printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
else
$res->close();
if (!($res = $mysqli->query("SELECT * FROM table_on_slave_a_only")))
printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
else
$res->close();
$mysqli->close();
?>

```

The above example will output:

```

User has connected to 'myapp'...
... deciding where to run 'SELECT 1 FROM DUAL'
... some read-only query for a slave
... ret = 'tcp://192.168.2.27:3306'
User has connected to 'myapp'...
... deciding where to run 'SELECT 2 FROM DUAL'
... some read-only query for a slave
... ret = 'tcp://192.168.78.136:3306'
User has connected to 'myapp'...
... deciding where to run 'SELECT * FROM table_on_slave_a_only'
... access to table available only on slave A detected
... ret = 'tcp://192.168.2.27:3306'

```

See Also

[mysqlnd_ms_query_is_select](#)
[Filter concept](#)
[user filter](#)

7.7.8.11 mysqlnd_ms_xa_begin

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- [mysqlnd_ms_xa_begin](#)

Starts a distributed/XA transaction among MySQL servers

Description

```

int mysqlnd_ms_xa_begin(
    mixed connection,
    string gtid,
    int timeout);

```

Starts a XA transaction among MySQL servers. PECL/mysqlnd_ms acts as a transaction coordinator for the distributed transaction.

Once a global transaction has been started, the plugin injects appropriate `XA BEGIN` SQL statements on all MySQL servers used in the following. The global transaction is either ended by calling `mysqlnd_ms_xa_commit`, `mysqlnd_ms_xa_rollback` or by an implicit rollback in case of an error.

During a global transaction, the plugin tracks all server switches, for example, when switching from one MySQL shard to another MySQL shard. Immediately before a query is run on a server that has not been participating in the global transaction yet, `XA BEGIN` is executed on the server. From a users perspective the injection happens during a call to a query execution function such as `mysqli_query`. Should the injection fail an error is reported to the caller of the query execution function. The failing server does not become a participant in the global transaction. The user may retry executing a query on the server and hereby retry injecting `XA BEGIN`, abort the global transaction because not all required servers can participate, or ignore and continue the global without the failed server.

Reasons to fail executing `XA BEGIN` include but are not limited to a server being unreachable or the server having an open, concurrent XA transaction using the same xid.

Please note, global and local transactions are mutually exclusive. You cannot start a XA transaction when you have a local transaction open. The local transaction must be ended first. The plugin tries to detect this conflict as early as possible. It monitors API calls for controlling local transactions to learn about the current state. However, if using SQL statements for local transactions such as `BEGIN`, the plugin may not know the current state and the conflict is not detected before `XA BEGIN` is injected and executed.

The use of other XA resources but MySQL servers is not supported by the function. To carry out a global transaction among, for example, a MySQL server and another vendors database system, you should issue the systems SQL commands yourself.

Experimental

The feature is currently under development. There may be issues and/or feature limitations. Do not use in production environments.

Parameters

`connection`

A MySQL connection handle obtained from any of the connect functions of the `mysqli`, `mysql` or `PDO_MYSQL` extensions.

`gtrid`

Global transaction identifier (gtrid). The gtrid is a binary string up to 64 bytes long. Please note, depending on your character set settings, 64 characters may require more than 64 bytes to store.

In accordance with the MySQL SQL syntax, XA transactions use identifiers made of three parts. An xid consists of a global transaction identifier (gtrid), a branch qualifier (bqual) and a format identifier (formatID). Only the global transaction identifier can and needs to be set.

The branch qualifier and format identifier are set automatically. The details should be considered implementation dependent, which may change without prior notice. In version 1.6 the branch qualifier is consecutive number which is incremented whenever a participant joins the global transaction.

`timeout`

Timeout in seconds. The default value is 60 seconds.

The timeout is a hint to the garbage collection. If a transaction is recorded to take longer than expected, the garbage collection begins checking the transactions status.

Setting a low value may make the garbage collection check the progress too often. Please note, checking the status of a global transaction may involve connecting to all recorded participants and possibly issuing queries on the servers.

Return Values

Returns `TRUE` if there is no open local or global transaction and a new global transaction can be started. Otherwise, returns `FALSE`.

See Also

[Quickstart XA/Distributed transactions](#)
[Runtime configuration](#)
[mysqlnd_ms_get_stats](#)

7.7.8.12 `mysqlnd_ms_xa_commit`

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- [mysqlnd_ms_xa_commit](#)

Commits a distributed/XA transaction among MySQL servers

Description

```
int mysqlnd_ms_xa_commit(
    mixed connection,
    string gtrid);
```

Commits a global transaction among MySQL servers started by [mysqlnd_ms_xa_begin](#).

If any of the global transaction participants fails to commit an implicit rollback is performed. It may happen that not all cases can be handled during the rollback. For example, no attempts will be made to reconnect to a participant after the connection to the participant has been lost. Solving cases that cannot easily be rolled back is left to the garbage collection.

Experimental

The feature is currently under development. There may be issues and/or feature limitations. Do not use in production environments.

Parameters

connection

A MySQL connection handle obtained from any of the connect functions of the [mysqli](#), [mysql](#) or [PDO_MYSQL](#) extensions.

gtrid

Global transaction identifier (gtrid).

Return Values

Returns `TRUE` if the global transaction has been committed. Otherwise, returns `FALSE`.

See Also

[Quickstart XA/Distributed transactions](#)
[Runtime configuration](#)
[mysqlnd_ms_get_stats](#)

7.7.8.13 `mysqlnd_ms_xa_gc`

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- `mysqlnd_ms_xa_gc`

Garbage collects unfinished XA transactions after severe errors

Description

```
int mysqlnd_ms_xa_gc(
    mixed connection,
    string gtrid,
    bool ignore_max_retries);
```

Garbage collects unfinished XA transactions.

The XA protocol is a blocking protocol. There exist cases when servers participating in a global transaction cannot make progress when the transaction coordinator crashes or disconnects. In such a case, the MySQL servers keep waiting for instructions to finish the XA transaction in question. Because transactions occupy resources, transactions should always be terminated properly.

Garbage collection requires configuring a state store to track global transactions. Should a PHP client crash in the middle of a transaction and a new PHP client be started, then the built-in garbage collection can learn about the aborted global transaction and terminate it. If you do not configure a state store, the garbage collection cannot perform any cleanup tasks.

The state store should be crash-safe and be highly available to survive its own crash. Currently, only MySQL is supported as a state store.

Garbage collection can also be performed automatically in the background. See the plugin configuration directive [garbage_collection](#) for details.

Experimental

The feature is currently under development. There may be issues and/or feature limitations. Do not use in production environments.

Parameters

`connection`

A MySQL connection handle obtained from any of the connect functions of the `mysqli`, `mysql` or `PDO_MYSQL` extensions.

`gtrid`

Global transaction identifier (gtrid). If given, the garbage collection considers the transaction only. Otherwise, the state store is scanned for any unfinished transaction.

`ignore_max_retries`

Whether to ignore the plugin configuration `max_retries` setting. If garbage collection continuously fails and the `max_retries` limit is reached prior to finishing the failed global transaction, you can attempt further runs prior to investigating the cause and solving the issue manually by issuing appropriate SQL statements on the participants. Setting the parameter has the same effect as temporarily setting `max_retries = 0`.

Return Values

Returns `TRUE` if garbage collection was successful. Otherwise, returns `FALSE`

See Also

[Quickstart XA/Distributed transactions](#)

[Runtime configuration](#)

[State store configuration](#)

[mysqlnd_ms_get_stats](#)

7.7.8.14 `mysqlnd_ms_xa_rollback`

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- `mysqlnd_ms_xa_rollback`

Rolls back a distributed/XA transaction among MySQL servers

Description

```
int mysqlnd_ms_xa_rollback(
    mixed connection,
    string gtrid);
```

Rolls back a global transaction among MySQL servers started by `mysqlnd_ms_xa_begin`.

If any of the global transaction participants fails to rollback the situation is left to be solved by the garbage collection.

Experimental

The feature is currently under development. There may be issues and/or feature limitations. Do not use in production environments.

Parameters

`connection` A MySQL connection handle obtained from any of the connect functions of the `mysqli`, `mysql` or `PDO_MYSQL` extensions.

`gtrid` Global transaction identifier (gtrid).

Return Values

Returns `TRUE` if the global transaction has been rolled back. Otherwise, returns `FALSE`.

See Also

[Quickstart XA/Distributed transactions](#)

[Runtime configuration](#)

[mysqlnd_ms_get_stats](#)

7.7.9 Change History

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This change history is a high level summary of selected changes that may impact applications and/or break backwards compatibility.

See also the `CHANGES` file in the source distribution for a complete list of changes.

7.7.9.1 PECL/mysqlnd_ms 1.6 series

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1.6.0-alpha

- Release date: TBD
- Motto/theme: Maintenance and initial MySQL Fabric support

Note

This is the current development series. All features are at an early stage. Changes may happen at any time without prior notice. Please, do not use this version in production environments.

■ The documentation may not reflect all changes yet.

Bug fixes

- Won't fix: #66616 R/W split fails: QOS with mysqlnd_get_last_gtid with built-in MySQL GTID

This is not a bug in the plugins implementation but a server side feature limitation not considered and documented before. MySQL 5.6 built-in GTIDs cannot be used to ensure session consistency when reading from slaves in all cases. In the worst case the plugin will not consider using the slaves and fallback to using the master. There will be no wrong results but no benefit from doing GTID checks either.

- Fixed #66064 - Random once load balancer ignoring weights

Due to a config parsing bug random load balancing has ignored node weights if, and only if, the sticky flag was set (random once).

- Fixed #65496 - Wrong check for slave delay

The quality of service filter has erroneously ignored slaves that lag for zero (0) seconds if a any maximum lag had been set. Although a slave was not lagging behind, it was excluded from the load balancing list if a maximum age was set by the QoS filter. This was due to using the wrong comparison operator in the source of the filter.

- Fixed #65408 - Compile failure with -Werror=format-security

Feature changes

- Introduced an internal connection pool. When using Fabric and switching from shard group A to shard group B, we are replacing the entire list of masters and slaves. This troubles the connections state alignment logic and some filters. Some filters cache information on the master and slave lists. The new internal connection pool abstraction allows us to inform the filters of changes, hence they can update their caches.

Later on, the pool can also be used to reduce connection overhead. Assume you are switching from a shard group to another and back again. Whenever the switch is done, the pool's active server (and connection) lists are replaced. However, no longer used connections are not necessarily closed immediately but can be kept in the pool for later reuse.

Please note, the connection pool is internal at this point. There are some new statistics to monitor it. However, you cannot yet configure pool size or behaviour.

- Added a basic distributed transaction abstraction. XA transactions can now be supported ever since using standard SQL calls. This is inconvenient as XA participants must be managed manually. PECL/mysqlnd_ms introduces API calls to control XA transaction among MySQL servers. When using the new functions, PECL/mysqlnd_ms acts as a transaction coordinator. After starting a distributed transaction, the plugin tracks all servers involved until the transaction is ended and issues appropriate SQL statements on the XA participants.

This is useful, for example, when using Fabric and sharding. When using Fabric the actual shard servers involved in a business transaction may not be known in advance. Thus, manually controlling a transaction that spawns multiple shards becomes difficult. Please, be warned about [current limitations](#).

- Introduced automatic retry loop for [transient errors](#) and [corresponding statistic](#) to count the number of implicit retries. Some distributed database clusters use transient errors to hint a client to retry its operation in a bit. Most often, the client is then supposed to halt execution (sleep) for a short moment before retrying the desired operation. Immediately failing over to another node is not necessary in response to the error. Instead, a retry loop can be performed. Common situation when using MySQL Cluster.

- Introduced automatic retry loop for [transient errors](#) and [corresponding statistic](#) to count the number of implicit retries. Some distributed database clusters use transient errors to hint a client to retry its operation in a bit. Most often, the client is then supposed to halt execution (sleep) for a short moment before retrying the desired operation. Immediately failing over to another node is not necessary in response to the error. Instead, a retry loop can be performed. Common situation when using MySQL Cluster.

- Introduced [most basic support](#) for the MySQL Fabric High Availability and sharding framework.

Please, consider this pre-alpha quality. Both the server side framework and the client side code is supposed to work flawless considering the MySQL Fabric quickstart examples only. However, testing has not been performed to the level of prior plugin alpha releases. Either sides are moving targets, API changes may happen at any time without prior warning.

As this is work in progress, the manual may not yet reflect allow feature limitations and known bugs.

- New [statistics](#) to monitor the Fabric XML RPC call `sharding.lookup_servers`:

`fabric_sharding_lookup_servers_success,`
`fabric_sharding_lookup_servers_failure,`
`fabric_sharding_lookup_servers_time_total,`
`fabric_sharding_lookup_servers_bytes_total,`
`fabric_sharding_lookup_servers_xml_failure.`

- New functions related to MySQL Fabric: `mysqlnd_ms_fabric_select_shard`,
`mysqlnd_ms_fabric_select_global`, `mysqlnd_ms_dump_servers`.

7.7.9.2 PECL/mysqlnd_ms 1.5 series

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1.5.1-stable

- Release date: 06/2013
- Motto/theme: Sharding support, improved transaction support

Note

This is the current stable series. Use this version in production environments.

The documentation is complete.

1.5.0-alpha

- Release date: 03/2013
- Motto/theme: Sharding support, improved transaction support

Bug fixes

- Fixed #60605 PHP segmentation fault when mysqlnd_ms is enabled.
- Setting transaction stickiness disables all load balancing, including automatic failover, for the duration of a transaction. So far connection switches could have happened in the middle of a transaction in multi-master configurations and during automatic failover although transaction monitoring had detected transaction boundaries properly.
- BC break and bug fix. SQL hints enforcing the use of a specific kind of server (`MYSQLND_MS_MASTER_SWITCH`, `MYSQLND_MS_SLAVE_SWITCH`, `MYSQLND_MS_LAST_USED_SWITCH`) are ignored for the duration of a transaction of transaction stickiness is enabled and transaction boundaries have been detected properly.

This is a change in behaviour. However, it is also a bug fix and a step to align behaviour. If, in previous versions, transaction stickiness, one of the above listed SQL hints and the quality of service filtering was combined it could have happened that the SQL hints got ignored. In some cases the SQL hints did work, in other cases they did not. The new behaviour is more consistent. SQL hints will always be ignored for the duration of a transaction, if [transaction stickiness](#) is enabled.

Please note, transaction boundary detection continues to be based on API call monitoring. SQL commands controlling transactions are not monitored.

- BC break and bug fix. Calls to `mysqlnd_ms_set_qos` will fail when done in the middle of a transaction if [transaction stickiness](#) is enabled. Connection switches are not allowed for the duration of a transaction. Changing the quality of service likely results in a different set of servers qualifying for query execution, possibly making it necessary to switch connections. Thus, the call is not allowed in during an active transaction. The quality of service can, however, be changed in between transactions.

Feature changes

- Introduced the `node_group` filter. The filter lets you organize servers (master and slaves) into groups. Queries can be directed to a certain group of servers by prefixing the query statement with a SQL hint/comment that contains the group's configured name. Grouping can be used for partitioning and sharding, and also to optimize for local caching. In the case of sharding, a group name can be thought of like a shard key. All queries for a given shard key will be executed on the configured shard. Note: both the client and server must support sharding for sharding to function with `mysqlnd_ms`.
- Extended configuration file validation during PHP startup (RINIT). An `E_WARNING` level error will be thrown if the configuration file cannot be read (permissions), is empty, or the file (JSON) could not be parsed. Warnings may appear in log files, which depend on how PHP is configured.

Distributions that aim to provide a pre-configured setup, including a configuration file stub, are asked to put `{}` into the configuration file to prevent this warning about an invalid configuration file.

Further configuration file validation is done when parsing sections upon opening a connection. Please, note that there may still be situations when an invalid plugin configuration file does not lead to proper error messages but a failure to connect.

- As of PHP 5.5.0, improved support for transaction boundaries detection was added for `mysqli`. The `mysqli` extension has been modified to use the new C API calls of the `mysqlnd` library to begin, commit, and rollback a transaction or savepoint. If `trx_stickiness` is used to enable transaction aware load balancing, the `mysqli_begin`, `mysqli_commit` and `mysqli_rollback` functions will now be monitored by the plugin, to go along with the `mysqli_autocommit` function that was already supported. All SQL features to control transactions are also available through the improved `mysqli` transaction control related functions. This means that it is not required to issue SQL statements instead of using API calls. Applications using the appropriate API calls can be load balanced by PECL/`mysqlnd_ms` in a completely transaction-aware way.

Please note, `PDO_MySQL` has not been updated yet to utilize the new `mysqlnd` API calls. Thus, transaction boundary detection with `PDO_MySQL` continues to be limited to the monitoring by passing in `PDO::ATTR_AUTOCOMMIT` to `PDO::setAttribute`.

- Introduced `trx_stickiness=on`. This `trx_stickiness` option differs from `trx_stickiness=master` as it tries to execute a read-only transaction on a slave, if quality of service (consistency level) allows the use of a slave. Read-only transactions were introduced in MySQL 5.6, and they offer performance gains.
- Query cache support is considered beta if used with the `mysqli` API. It should work fine with primary copy based clusters. For all other APIs, this feature continues to be called experimental.
- The code examples in the `mysqlnd_ms` source were updated.

7.7.9.3 PECL/mysqlnd_ms 1.4 series

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1.4.2-stable

- Release date: 08/2012
- Motto/theme: Tweaking based on user feedback

1.4.1-beta

- Release date: 08/2012
- Motto/theme: Tweaking based on user feedback

Bug fixes

- Fixed build with PHP 5.5

1.4.0-alpha

- Release date: 07/2012
- Motto/theme: Tweaking based on user feedback

Feature changes

- BC break: Renamed plugin configuration setting `ini_file` to `config_file`. In early versions the plugin configuration file used ini style. Back then the configuration setting was named accordingly. It has now been renamed to reflect the newer file format and to distinguish it from PHP's own ini file (configuration directives file).
- Introduced new default charset setting `server_charset` to allow proper escaping before a connection is opened. This is most useful when using lazy connections, which are a default.
- Introduced `wait_for_gtid_timeout` setting to throttle slave reads that need session consistency. If global transaction identifier are used and the service level is set to session consistency, the plugin tries to find up-to-date slaves. The slave status check is done by a SQL statement. If nothing else is set, the slave status is checked only one can the search for more up-to-date slaves continues immediately thereafter. Setting `wait_for_gtid_timeout` instructs the plugin to poll a slaves status for `wait_for_gtid_timeout` seconds if the first execution of the SQL statement has shown that the slave is not up-to-date yet. The poll will be done once per second. This way, the plugin will wait for slaves to catch up and throttle the client.
- New failover strategy `loop_before_master`. By default the plugin does no failover. It is possible to enable automatic failover if a connection attempt fails. Upto version 1.3 only `master` strategy existed to failover to a master if a slave connection fails. `loop_before_master` is similar but tries all other slaves before attempting to connect to the master if a slave connection fails.

The number of attempts can be limited using the `max_retries` option. Failed hosts can be remembered and skipped in load balancing for the rest of the web request. `max_retries` and `remember_failed` are considered experimental although decent stability is given. Syntax and semantics may change in the future without prior notice.

7.7.9.4 PECL/mysqlnd_ms 1.3 series

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1.3.2-stable

- Release date: 04/2012

- Motto/theme: see 1.3.0-alpha

Bug fixes

- Fixed problem with multi-master where although in a transaction the queries to the master weren't sticky and were spread all over the masters (RR). Still not sticky for Random. Random_once is not affected.

1.3.1-beta

- Release date: 04/2012
- Motto/theme: see 1.3.0-alpha

Bug fixes

- Fixed problem with building together with QC.

1.3.0-alpha

- Release date: 04/2012
- Motto/theme: Query caching through quality-of-service concept

The 1.3 series aims to improve the performance of applications and the overall load of an asynchronous MySQL cluster, for example, a MySQL cluster using MySQL Replication. This is done by transparently replacing a slave access with a local cache access, if the application allows it by setting an appropriate quality of service flag. When using MySQL replication a slave can serve stale data. An application using MySQL replication must continue to work correctly with stale data. Given that the application is known to work correctly with stale data, the slave access can transparently be replaced with a local cache access.

[PECL/mysqlnd_qc](#) serves as a cache backend. PECL/mysqlnd_qc supports use of various storage locations, among others main memory, [APC](#) and [MEMCACHE](#).

Feature changes

- Added cache option to quality-of-service (QoS) filter.
 - New configure option `enable-mysqlnd-ms-cache-support`
 - New constant `MYSQLND_MS_HAVE_CACHE_SUPPORT`.
 - New constant `MYSQLND_MS_QOS_OPTION_CACHE` to be used with `mysqlnd_ms_set_qos`.
- Support for built-in global transaction identifier feature of MySQL 5.6.5-m8 or newer.

7.7.9.5 PECL/mysqlnd_ms 1.2 series

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1.2.1-beta

- Release date: 01/2012
- Motto/theme: see 1.2.0-alpha

Minor test changes.

1.2.0-alpha

- Release date: 11/2011

- Moto/theme: Global Transaction ID injection and quality-of-service concept

In version 1.2 the focus continues to be on supporting MySQL database clusters with asynchronous replication. The plugin tries to make using the cluster introducing a quality-of-service filter which applications can use to define what service quality they need from the cluster. Service levels provided are eventual consistency with optional maximum age/slave lag, session consistency and strong consistency.

Additionally the plugin can do client-side global transaction id injection to make manual master failover easier.

Feature changes

- Introduced quality-of-service (QoS) filter. Service levels provided by QoS filter:
 - eventual consistency, optional option slave lag
 - session consistency, optional option GTID
 - strong consistency
- Added the `mysqlnd_ms_set_qos` function to set the required connection quality at runtime. The new constants related to `mysqlnd_ms_set_qos` are:
 - `MYSQLND_MS_QOS_CONSISTENCY_STRONG`
 - `MYSQLND_MS_QOS_CONSISTENCY_SESSION`
 - `MYSQLND_MS_QOS_CONSISTENCY_EVENTUAL`
 - `MYSQLND_MS_QOS_OPTION_GTID`
 - `MYSQLND_MS_QOS_OPTION_AGE`
- Added client-side global transaction id injection (GTID).
- New statistics related to GTID:
 - `gtid_autocommit_injections_success`
 - `gtid_autocommit_injections_failure`
 - `gtid_commit_injections_success`
 - `gtid_commit_injections_failure`
 - `gtid_implicit_commit_injections_success`
 - `gtid_implicit_commit_injections_failure`
- Added `mysqlnd_ms_get_last_gtid` to fetch the last global transaction id.
- Enabled support for multi master without slaves.

7.7.9.6 PECL/mysqlnd_ms 1.1 series

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1.1.0

- Release date: 09/2011
- Moto/theme: Cover replication basics with production quality

The 1.1 and 1.0 series expose a similar feature set. Internally, the 1.1 series has been refactored to plan for future feature additions. A new configuration file format has been introduced, and limitations have been lifted. And the code quality and quality assurance has been improved.

Feature changes

- Added the (chainable) [filter concept](#):
 - BC break: `mysqlnd_ms_set_user_pick_server` has been removed. The http://svn.php.net/viewvc/pecl/mysqlnd_ms/trunk/ `user` filter has been introduced to replace it. The filter offers similar functionality, but see below for an explanation of the differences.
- New powerful JSON based configuration syntax.
- [Lazy connections improved](#): security relevant, and state changing commands are covered.
- Support for (native) prepared statements.
- New statistics: `use_master_guess`, `use_slave_guess`.
 - BC break: Semantics of statistics changed for `use_slave`, `use_master`. Future changes are likely. Please see, [mysqlnd_ms_get_stats](#).
- List of broadcasted messages extended by `ssl_set`.
- Library calls now monitored to remember settings for lazy connections: `change_user`, `select_db`, `set_charset`, `set_autocommit`.
- Introduced `mysqlnd_ms.disable_rw_split`. The configuration setting allows using the load balancing and lazy connection functionality independently of read write splitting.

Bug fixes

- Fixed PECL #22724 - Server switching (`mysqlnd_ms_query_is_select()` case sensitive)
- Fixed PECL #22784 - Using `mysql_connect` and `mysql_select_db` did not work
- Fixed PECL #59982 - Unusable extension with `--enable-mysqlnd-ms-table-filter`. Use of the option is NOT supported. You must not used it. Added note to m4.
- Fixed Bug #60119 - host="localhost" lost in `mysqlnd_ms_get_last_used_connection()`

The `mysqlnd_ms_set_user_pick_server` function was removed, and replaced in favor of a new `user` filter. You can no longer set a callback function using `mysqlnd_ms_set_user_pick_server` at runtime, but instead have to configure it in the plugins configuration file. The `user` filter will pass the same arguments to the callback as before. Therefore, you can continue to use the same procedural function as a callback. It is no longer possible to use static class methods, or class methods of an object instance, as a callback. Doing so will cause the function executing a statement handled by the plugin to emit an `E_RECOVERABLE_ERROR` level error, which might look like: "`(mysqlnd_ms) Specified callback (picker) is not a valid callback.`" Note: this may halt your application.

7.7.9.7 PECL/mysqlnd_ms 1.0 series

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1.0.1-alpha

- Release date: 04/2011
- Motto/theme: bug fix release

1.0.0-alpha

- Release date: 04/2011
- Motto/theme: Cover replication basics to test user feedback

The first release of practical use. It features basic automatic read-write splitting, SQL hints to overrule automatic redirection, load balancing of slave requests, lazy connections, and optional, automatic use of the master after the first write.

The public feature set is close to that of the 1.1 release.

1.0.0-pre-alpha

- Release date: 09/2010
- Motto/theme: Proof of concept

Initial check-in. Essentially a demo of the [mysqld](#) plugin API.

7.8 Mysqld query result cache plugin

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The mysqld query result cache plugin adds easy to use client-side query caching to all PHP MySQL extensions using [mysqld](#).

As of version PHP 5.3.3 the MySQL native driver for PHP ([mysqld](#)) features an internal plugin C API. C plugins, such as the query cache plugin, can extend the functionality of [mysqld](#).

Mysqld plugins such as the query cache plugin operate transparent from a user perspective. The cache plugin supports all PHP applications and all PHP MySQL extensions ([mysqli](#), [mysql](#), [PDO_MYSQL](#)). It does not change existing APIs.

No significant application changes are required to cache a query. The cache has two operation modes. It will either cache all queries (not recommended) or only those queries marked with a certain SQL hint (recommended).

7.8.1 Key Features

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- Transparent and therefore easy to use
 - supports all PHP MySQL extensions
 - no API changes
 - very little application changes required
- Flexible invalidation strategy
 - Time-to-Live (TTL)
 - user-defined
- Storage with different scope and life-span
 - Default (Hash, process memory)
 - APC
 - MEMCACHE

- sqlite
- user-defined
- Built-in slam defense to prevent cache stampeding.

7.8.2 Limitations

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The current 1.0.1 release of PECL mysqlnd_qc does not support PHP 5.4. Version 1.1.0-alpha lifts this limitation.

Prepared statements and unbuffered queries are fully supported. Thus, the plugin is capable of caching all statements issued with [mysqli](#) or [PDO_MySQL](#), which are the only two PHP MySQL APIs to offer prepared statement support.

7.8.3 On the name

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The shortcut `mysqlnd_qc` stands for `mysqlnd query cache plugin`. The name was chosen for a quick-and-dirty proof-of-concept. In the beginning the developers did not expect to continue using the code base. Sometimes PECL/mysqlnd_qc has also been called `client-side query result set cache`.

7.8.4 Quickstart and Examples

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The mysqlnd query cache plugin is easy to use. This quickstart will demo typical use-cases, and provide practical advice on getting started.

It is strongly recommended to read the reference sections in addition to the quickstart. It is safe to begin with the quickstart. However, before using the plugin in mission critical environments we urge you to read additionally the background information from the reference sections.

Most of the examples use the [mysqli](#) extension because it is the most feature complete PHP MySQL extension. However, the plugin can be used with any PHP MySQL extension that is using the [mysqlnd](#) library.

7.8.4.1 Architecture and Concepts

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The query cache plugin is implemented as a PHP extension. It is written in C and operates under the hood of PHP. During the startup of the PHP interpreter, it gets registered as a [mysqlnd](#) plugin to replace selected mysqlnd C methods. Hereby, it can change the behaviour of any PHP MySQL extension ([mysqli](#), [PDO_MYSQL](#), [mysql](#)) compiled to use the mysqlnd library without changing the extensions API. This makes the plugin compatible with each and every PHP MySQL application. Because existing APIs are not changed, it is almost transparent to use. Please, see the [mysqlnd plugin API description](#) for a discussion of the advantages of the plugin architecture and a comparison with proxy based solutions.

Transparent to use

At PHP run time PECL/mysqlnd_qc can proxy queries send from PHP ([mysqlnd](#)) to the MySQL server. It then inspects the statement string to find whether it shall cache its results. If so, result set is cached

using a storage handler and further executions of the statement are served from the cache for a user-defined period. The Time to Live (TTL) of the cache entry can either be set globally or on a per statement basis.

A statement is either cached if the plugin is instructed to cache all statements globally using a or, if the query string starts with the SQL hint (`/*qc=on*/`). The plugin is capable of caching any query issued by calling appropriate API calls of any of the existing PHP MySQL extensions.

Flexible storage: various storage handler

Various storage handler are supported to offer different scopes for cache entries. Different scopes allow for different degrees in sharing cache entries among clients.

- `default` (built-in): process memory, scope: process, one or more web requests depending on PHP deployment model used
- `APC`: shared memory, scope: single server, multiple web requests
- `SQLite`: memory or file, scope: single server, multiple web requests
- `MEMCACHE`: main memory, scope: single or multiple server, multiple web requests
- `user` (built-in): user-defined - any, scope: user-defined - any

Support for the `APC`, `SQLite` and `MEMCACHE` storage handler has to be enabled at compile time. The `default` and `user` handler are built-in. It is possible to switch between compiled-in storage handlers on a per query basis at run time. However, it is recommended to pick one storage handler and use it for all cache entries.

Built-in slam defense to avoid overloading

To avoid overload situations the cache plugin has a built-in slam defense mechanism. If a popular cache entries expires many clients using the cache entries will try to refresh the cache entry. For the duration of the refresh many clients may access the database server concurrently. In the worst case, the database server becomes overloaded and it takes more and more time to refresh the cache entry, which in turn lets more and more clients try to refresh the cache entry. To prevent this from happening the plugin has a slam defense mechanism. If slam defense is enabled and the plugin detects an expired cache entry it extends the life time of the cache entry before it refreshes the cache entry. This way other concurrent accesses to the expired cache entry are still served from the cache for a certain time. The other concurrent accesses do not trigger a concurrent refresh. Ideally, the cache entry gets refreshed by the client which extended the cache entries lifespan before other clients try to refresh the cache and potentially cause an overload situation.

Unique approach to caching

PECL/mysqlnd_qc has a unique approach to caching result sets that is superior to application based cache solutions. Application based solutions first fetch a result set into PHP variables. Then, the PHP variables are serialized for storage in a persistent cache, and then unserialized when fetching. The mysqlnd query cache stores the raw wire protocol data sent from MySQL to PHP in its cache and replays it, if still valid, on a cache hit. This way, it saves an extra serialization step for a cache put that all application based solutions have to do. It can store the raw wire protocol data in the cache without having to serialize into a PHP variable first and deserializing the PHP variable for storing in the cache again.

7.8.4.2 Setup

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The plugin is implemented as a PHP extension. See also the [installation instructions](#) to install the PECL/mysqlnd_qc extension.

Compile or configure the PHP MySQL extension ([mysqli](#), [PDO_MYSQL](#), [mysql](#)) that you plan to use with support for the [mysqlnd](#) library. PECL/mysqlnd_qc is a plugin for the mysqlnd library. To use the plugin with any of the existing PHP MySQL extensions (APIs), the extension has to use the mysqlnd library.

Then, load the extension into PHP and activate the plugin in the PHP configuration file using the PHP configuration directive named [mysqlnd qc.enable qc](#).

Example 7.309 Enabling the plugin (php.ini)

```
mysqlnd_qc.enable_qc=1
```

7.8.4.3 Caching queries

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There are four ways to trigger caching of a query.

- Use of SQL hints on a per query basis
- User supplied callbacks to decide on a per query basis, for example, using [mysqlnd qc_is_select](#)
- [mysqlnd_set_cache_condition](#) for rule based automatic per query decisions
- [mysqlnd qc.cache_by_default = 1](#) to cache all queries blindly

Use of SQL hints and [mysqlnd qc.cache_by_default = 1](#) are explained below. Please, refer to the function reference on [mysqlnd qc_is_select](#) for a description of using a callback and, [mysqlnd qc_set_cache_condition](#) on how to set rules for automatic caching.

A SQL hint is a SQL standards compliant comment. As a SQL comment it is ignored by the database. A statement is considered eligible for caching if it either begins with the SQL hint enabling caching or it is a [SELECT](#) statement.

An individual query which shall be cached must begin with the SQL hint `/*qc=on*/`. It is recommended to use the PHP constant [MYSQLND_QC_ENABLE_SWITCH](#) instead of using the string value.

- not eligible for caching and not cached: [INSERT INTO test\(id\) VALUES \(1\)](#)
- not eligible for caching and not cached: [SHOW ENGINES](#)
- eligible for caching but uncached: [SELECT id FROM test](#)
- eligible for caching and cached: `/*qc=on*/SELECT id FROM test`

The examples [SELECT](#) statement string is prefixed with the [MYSQLND_QC_ENABLE_SWITCH](#) SQL hint to enable caching of the statement. The SQL hint must be given at the very beginning of the statement string to enable caching.

Example 7.310 Using the [MYSQLND_QC_ENABLE_SWITCH](#) SQL hint

```
mysqlnd_qc.enable_qc=1
```

```
<?php
```

```

/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2)");
/* Will be cached because of the SQL hint */
$start = microtime(true);
$res   = $mysqli->query("/*" . MYSQLND_QC_ENABLE_SWITCH . "*/" . "SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
printf("Total time uncached query: %.6fs\n", microtime(true) - $start);
/* Cache hit */
$start = microtime(true);
$res   = $mysqli->query("/*" . MYSQLND_QC_ENABLE_SWITCH . "*/" . "SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
printf("Total time cached query: %.6fs\n", microtime(true) - $start);
?>

```

The above examples will output something similar to:

```

array(1) {
    ["id"]=>
        string(1) "1"
}
Total time uncached query: 0.000740s
array(1) {
    ["id"]=>
        string(1) "1"
}
Total time cached query: 0.000098s

```

If nothing else is configured, as it is the case in the quickstart example, the plugin will use the built-in `default` storage handler. The `default` storage handler uses process memory to hold a cache entry. Depending on the PHP deployment model, a PHP process may serve one or more web requests. Please, consult the web server manual for details. Details make no difference for the examples given in the quickstart.

The query cache plugin will cache all queries regardless if the query string begins with the SQL hint which enables caching or not, if the PHP configuration directive `mysqlnd_qc.cache_by_default` is set to `1`. The setting `mysqlnd_qc.cache_by_default` is evaluated by the core of the query cache plugins. Neither the built-in nor user-defined storage handler can overrule the setting.

The SQL hint `/*qc=off*/` can be used to disable caching of individual queries if `mysqlnd_qc.cache_by_default = 1`. It is recommended to use the PHP constant `MYSQLND_QC_DISABLE_SWITCH` instead of using the string value.

Example 7.311 Using the `MYSQLND_QC_DISABLE_SWITCH` SQL hint

```

mysqlnd_qc.enable_qc=1
mysqlnd_qc.cache_by_default=1

```

```

<?php
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2)");
/* Will be cached although no SQL hint is present because of mysqlnd_qc.cache_by_default = 1*/
$res = $mysqli->query("SELECT id FROM test WHERE id = 1");

```

```

var_dump($res->fetch_assoc());
$res->free();
$mysqli->query("DELETE FROM test WHERE id = 1");
/* Cache hit - no automatic invalidation and still valid! */
$res = $mysqli->query("SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
/* Cache miss - query must not be cached because of the SQL hint */
$res = $mysqli->query("/*" . MYSQLND_QC_DISABLE_SWITCH . "*/SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
?>

```

The above examples will output:

```

array(1) {
    ["id"]=>
        string(1) "1"
}
array(1) {
    ["id"]=>
        string(1) "1"
}
NULL

```

PECL/mysqlnd_qc forbids caching of statements for which at least one column from the statements result set shows no table name in its meta data by default. This is usually the case for columns originating from SQL functions such as `NOW()` or `LAST_INSERT_ID()`. The policy aims to prevent pitfalls if caching by default is used.

Example 7.312 Example showing which type of statements are not cached

```

mysqlnd_qc.enable_qc=1
mysqlnd_qc.cache_by_default=1

```

```

<?php
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1)");
for ($i = 0; $i < 3; $i++) {
    $start = microtime(true);
    /* Note: statement will not be cached because of NOW() use */
    $res = $mysqli->query("SELECT id, NOW() AS _time FROM test");
    $row = $res->fetch_assoc();
    /* dump results */
    var_dump($row);
    printf("Total time: %.6fs\n", microtime(true) - $start);
    /* pause one second */
    sleep(1);
}
?>

```

The above examples will output something similar to:

```

array(2) {
    ["id"]=>
        string(1) "1"
}

```

```

[ "_time"]=>
  string(19) "2012-01-11 15:43:10"
}
Total time: 0.000540s
array(2) {
  [ "id"]=>
  string(1) "1"
  [ "_time"]=>
  string(19) "2012-01-11 15:43:11"
}
Total time: 0.000555s
array(2) {
  [ "id"]=>
  string(1) "1"
  [ "_time"]=>
  string(19) "2012-01-11 15:43:12"
}
Total time: 0.000549s

```

It is possible to enable caching for all statements including those which has columns in their result set for which MySQL reports no table, such as the statement from the example. Set `mysqlnd_qc.cache_no_table = 1` to enable caching of such statements. Please, note the difference in the measured times for the above and below examples.

Example 7.313 Enabling caching for all statements using the `mysqlnd_qc.cache_no_table` ini setting

```

mysqlnd_qc.enable_qc=1
mysqlnd_qc.cache_by_default=1
mysqlnd_qc.cache_no_table=1

```

```

<?php
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1)");
for ($i = 0; $i < 3; $i++) {
    $start = microtime(true);
    /* Note: statement will not be cached because of NOW() use */
    $res = $mysqli->query("SELECT id, NOW() AS _time FROM test");
    $row = $res->fetch_assoc();
    /* dump results */
    var_dump($row);
    printf("Total time: %.6fs\n", microtime(true) - $start);
    /* pause one second */
    sleep(1);
}
?>

```

The above examples will output something similar to:

```

array(2) {
  [ "id"]=>
  string(1) "1"
  [ "_time"]=>
  string(19) "2012-01-11 15:47:45"
}
Total time: 0.000546s
array(2) {
  [ "id"]=>
  string(1) "1"
}

```

```
[ "_time"]=>
  string(19) "2012-01-11 15:47:45"
}
Total time: 0.000187s
array(2) {
  ["id"]=>
  string(1) "1"
  ["_time"]=>
  string(19) "2012-01-11 15:47:45"
}
Total time: 0.000167s
```

Note

Although `mysqlnd_qc.cache_no_table = 1` has been created for use with `mysqlnd_qc.cache_by_default = 1` it is bound it. The plugin will evaluate the `mysqlnd_qc.cache_no_table` whenever a query is to be cached, no matter whether caching has been enabled using a SQL hint or any other measure.

7.8.4.4 Setting the TTL

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The default invalidation strategy of the query cache plugin is Time to Live ([TTL](#)). The built-in storage handlers will use the default [TTL](#) defined by the PHP configuration value `mysqlnd_qc.ttl` unless the query string contains a hint for setting a different [TTL](#). The [TTL](#) is specified in seconds. By default cache entries expire after [30](#) seconds

The example sets `mysqlnd_qc.ttl=3` to cache statements for three seconds by default. Every second it updates a database table record to hold the current time and executes a [SELECT](#) statement to fetch the record from the database. The [SELECT](#) statement is cached for three seconds because it is prefixed with the SQL hint enabling caching. The output verifies that the query results are taken from the cache for the duration of three seconds before they are refreshed.

Example 7.314 Setting the TTL with the `mysqlnd_qc.ttl` ini setting

```
mysqlnd_qc.enable_qc=1
mysqlnd_qc.ttl=3
```

```
<?php
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id VARCHAR(255))");
for ($i = 0; $i < 7; $i++) {
    /* update DB row */
    if (!$mysqli->query("DELETE FROM test") ||
        !$mysqli->query("INSERT INTO test(id) VALUES (NOW())"))
        /* Of course, a real-life script should do better error handling */
        die(sprintf("[%d] %s\n", $mysqli->errno, $mysqli->error));
    /* select latest row but cache results */
    $query = /*" . MYSQLND_QC_ENABLE_SWITCH . "*/;
    $query .= "SELECT id AS _time FROM test";
    if (!$res = $mysqli->query($query)) ||
        !($row = $res->fetch_assoc()))
    {
        printf("[%d] %s\n", $mysqli->errno, $mysqli->error);
    }
    $res->free();
    printf("Wall time %s - DB row time %s\n", date("H:i:s"), $row['_time']);
    /* pause one second */
```

```

    sleep(1);
}
?>

```

The above examples will output something similar to:

```

Wall time 14:55:59 - DB row time 2012-01-11 14:55:59
Wall time 14:56:00 - DB row time 2012-01-11 14:55:59
Wall time 14:56:01 - DB row time 2012-01-11 14:55:59
Wall time 14:56:02 - DB row time 2012-01-11 14:56:02
Wall time 14:56:03 - DB row time 2012-01-11 14:56:02
Wall time 14:56:04 - DB row time 2012-01-11 14:56:02
Wall time 14:56:05 - DB row time 2012-01-11 14:56:05

```

As can be seen from the example, any [TTL](#) based cache can serve stale data. Cache entries are not automatically invalidated, if underlying data changes. Applications using the default [TTL](#) invalidation strategy must be able to work correctly with stale data.

A user-defined cache storage handler can implement any invalidation strategy to work around this limitation.

The default [TTL](#) can be overruled using the SQL hint `/*qc_tt=seconds*/`. The SQL hint must be appear immediately after the SQL hint which enables caching. It is recommended to use the PHP constant [MYSQLND_QC_TTL_SWITCH](#) instead of using the string value.

Example 7.315 Setting TTL with SQL hints

```

<?php
$start = microtime(true);
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2)");
printf("Default TTL\t: %d seconds\n", ini_get("mysqlnd_qc.ttl"));
/* Will be cached for 2 seconds */
$sql = sprintf("/*%s*//*%s%d*/SELECT id FROM test WHERE id = 1", MYSQLND_QC_ENABLE_SWITCH, MYSQLND_QC_T
$res = $mysqli->query($sql);
var_dump($res->fetch_assoc());
$res->free();
$mysqli->query("DELETE FROM test WHERE id = 1");
sleep(1);
/* Cache hit - no automatic invalidation and still valid! */
$res = $mysqli->query($sql);
var_dump($res->fetch_assoc());
$res->free();
sleep(2);
/* Cache miss - cache entry has expired */
$res = $mysqli->query($sql);
var_dump($res->fetch_assoc());
$res->free();
printf("Script runtime\t: %d seconds\n", microtime(true) - $start);
?>

```

The above examples will output something similar to:

```

Default TTL      : 30 seconds
array(1) {
  ["id"]=>
  string(1) "1"
}

```

```

array(1) {
    ["id"]=>
        string(1) "1"
}
NULL
Script runtime : 3 seconds

```

7.8.4.5 Pattern based caching

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An application has three options for telling PECL/mysqlnd_qc whether a particular statement shall be used. The most basic approach is to cache all statements by setting `mysqlnd_qc.cache_by_default = 1`. This approach is often of little practical value. But it enables users to make a quick estimation about the maximum performance gains from caching. An application designed to use a cache may be able to prefix selected statements with the appropriate SQL hints. However, altering an applications source code may not always be possible or desired, for example, to avoid problems with software updates. Therefore, PECL/mysqlnd_qc allows setting a callback which decides if a query is to be cached.

The callback is installed with the `mysqlnd_qc_set_is_select` function. The callback is given the statement string of every statement inspected by the plugin. Then, the callback can decide whether to cache the function. The callback is supposed to return `FALSE` if the statement shall not be cached. A return value of `TRUE` makes the plugin try to add the statement into the cache. The cache entry will be given the default TTL (`mysqlnd_qc.ttl`). If the callback returns a numerical value it is used as the TTL instead of the global default.

Example 7.316 Setting a callback with `mysqlnd_qc_set_is_select`

```

mysqlnd_qc.enable_qc=1
mysqlnd_qc.collect_statistics=1

```

```

<?php
/* callback which decides if query is cached */
function is_select($query) {
    static $patterns = array(
        /* true - use default from mysqlnd_qc.ttl */
        "@SELECT\s+.*\s+FROM\s+test@ismU" => true,
        /* 3 - use TTL = 3 seconds */
        "@SELECT\s+.*\s+FROM\s+news@ismU" => 3
    );
    /* check if query does match pattern */
    foreach ($patterns as $pattern => $ttl) {
        if (preg_match($pattern, $query)) {
            printf("is_select(%45s): cache\n", $query);
            return $ttl;
        }
    }
    printf("is_select(%45s): do not cache\n", $query);
    return false;
}
/* install callback */
mysqlnd_qc_set_is_select("is_select");
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)");
/* cache put */
$mysqli->query("SELECT id FROM test WHERE id = 1");
/* cache hit */
$mysqli->query("SELECT id FROM test WHERE id = 1");

```

```
/* cache put */
$mysqli->query("SELECT * FROM test");
$stmts = mysqlnd_qc_get_core_stats();
printf("Cache put: %d\n", $stmts['cache_put']);
printf("Cache hit: %d\n", $stmts['cache_hit']);
?>
```

The above examples will output something similar to:

```
is_select(          DROP TABLE IF EXISTS test): do not cache
is_select(          CREATE TABLE test(id INT)): do not cache
is_select(    INSERT INTO test(id) VALUES (1), (2), (3)): do not cache
is_select(          SELECT id FROM test WHERE id = 1): cache
is_select(          SELECT id FROM test WHERE id = 1): cache
is_select(          SELECT * FROM test): cache
Cache put: 2
Cache hit: 1
```

The examples callback tests if a statement string matches a pattern. If this is the case, it either returns [TRUE](#) to cache the statement using the global default TTL or an alternative TTL.

To minimize application changes the callback can put into and registered in an auto prepend file.

7.8.4.6 Slam defense

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A badly designed cache can do more harm than good. In the worst case a cache can increase database server load instead of minimizing it. An overload situation can occur if a highly shared cache entry expires (cache stampeding).

Cache entries are shared and reused to a different degree depending on the storage used. The default storage handler stores cache entries in process memory. Thus, a cache entry can be reused for the life-span of a process. Other PHP processes cannot access it. If Memcache is used, a cache entry can be shared among multiple PHP processes and even among multiple machines, depending on the set up being used.

If a highly shared cache entry stored, for example, in Memcache expires, many clients gets a cache miss. Many client requests can no longer be served from the cache but try to run the underlying query on the database server. Until the cache entry is refreshed, more and more clients contact the database server. In the worst case, a total lost of service is the result.

The overload can be avoided using a storage handler which limits the reuse of cache entries to few clients. Then, at the average, its likely that only a limited number of clients will try to refresh a cache entry concurrently.

Additionally, the built-in slam defense mechanism can and should be used. If slam defense is activated an expired cache entry is given an extended life time. The first client getting a cache miss for the expired cache entry tries to refresh the cache entry within the extended life time. All other clients requesting the cache entry are temporarily served from the cache although the original [TTL](#) of the cache entry has expired. The other clients will not experience a cache miss before the extended life time is over.

Example 7.317 Enabling the slam defense mechanism

```
mysqlnd_qc.slam_defense=1
mysqlnd_qc.slam_defense_ttl=1
```

The slam defense mechanism is enabled with the PHP configuration directive `mysqlnd_qc.slam_defense`. The extended life time of a cache entry is set with `mysqlnd_qc.slam_defense_ttl`.

The function `mysqlnd_qc_get_core_stats` returns an array of statistics. The statistics `slam_stale_refresh` and `slam_stale_hit` are incremented if slam defense takes place.

It is not possible to give a one-fits-all recommendation on the slam defense configuration. Users are advised to monitor and test their setup and derive settings accordingly.

7.8.4.7 Finding cache candidates

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A statement should be considered for caching if it is executed often and has a long run time. Cache candidates are found by creating a list of statements sorted by the product of the number of executions multiplied by the statements run time. The function `mysqlnd_qc_get_query_trace_log` returns a query log which help with the task.

Collecting a query trace is a slow operation. Thus, it is disabled by default. The PHP configuration directive `mysqlnd_qc.collect_query_trace` is used to enable it. The functions trace contains one entry for every query issued before the function is called.

Example 7.318 Collecting a query trace

```
mysqlnd_qc.enable_qc=1
mysqlnd_qc.collect_query_trace=1
```

```
<?php
/* connect to MySQL */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
/* dummy queries to fill the query trace */
for ($i = 0; $i < 2; $i++) {
    $res = $mysqli->query("SELECT 1 AS _one FROM DUAL");
    $res->free();
}
/* dump trace */
var_dump(mysqlnd_qc_get_query_trace_log());
?>
```

The above examples will output:

```
array(2) {
[0]=>
array(8) {
["query"]=>
string(26) "SELECT 1 AS _one FROM DUAL"
["origin"]=>
string(102) "#0 qc.php(7): mysqli->query('SELECT 1 AS _on...')"
#1 {main}"
["run_time"]=>
int(0)
["store_time"]=>
int(25)
["eligible_for_caching"]=>
bool(false)
["no_table"]=>
bool(false)
["was_added"]=>
bool(false)
}
```

```

["was_already_in_cache"]=>
    bool(false)
}
[1]=>
array(8) {
    ["query"]=>
        string(26) "SELECT 1 AS _one FROM DUAL"
    ["origin"]=>
        string(102) "#0 qc.php(7): mysqli->query('SELECT 1 AS _on...')"
#1 {main}
    ["run_time"]=>
        int(0)
    ["store_time"]=>
        int(8)
    ["eligible_for_caching"]=>
        bool(false)
    ["no_table"]=>
        bool(false)
    ["was_added"]=>
        bool(false)
    ["was_already_in_cache"]=>
        bool(false)
}
}

```

Assorted information is given in the trace. Among them timings and the origin of the query call. The origin property holds a code backtrace to identify the source of the query. The depth of the backtrace can be limited with the PHP configuration directive `mysqlnd_qc.query_trace_bt_depth`. The default depth is 3.

Example 7.319 Setting the backtrace depth with the `mysqlnd_qc.query_trace_bt_depth` ini setting

```

mysqlnd_qc.enable_qc=1
mysqlnd_qc.collect_query_trace=1

```

```

<?php
/* connect to MySQL */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)");
/* dummy queries to fill the query trace */
for ($i = 0; $i < 3; $i++) {
    $res = $mysqli->query("SELECT id FROM test WHERE id = " . $mysqli->real_escape_string($i));
    $res->free();
}
$trace = mysqlnd_qc_get_query_trace_log();
$summary = array();
foreach ($trace as $entry) {
    if (!isset($summary[$entry['query']])) {
        $summary[$entry['query']] = array(
            "executions" => 1,
            "time"       => $entry['run_time'] + $entry['store_time'],
        );
    } else {
        $summary[$entry['query']]['executions']++;
        $summary[$entry['query']]['time'] += $entry['run_time'] + $entry['store_time'];
    }
}
foreach ($summary as $query => $details) {
    printf("%45s: %5dms (%dx)\n",
        $query, $details['time'], $details['executions']);
}
?>

```

The above examples will output something similar to:

```
DROP TABLE IF EXISTS test:      0ms (1x)
CREATE TABLE test(id INT):    0ms (1x)
INSERT INTO test(id) VALUES (1), (2), (3): 0ms (1x)
SELECT id FROM test WHERE id = 0: 25ms (1x)
SELECT id FROM test WHERE id = 1: 10ms (1x)
SELECT id FROM test WHERE id = 2: 9ms (1x)
```

7.8.4.8 Measuring cache efficiency

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PECL/mysqlnd_qc offers three ways to measure the cache efficiency. The function `mysqlnd_qc_get_normalized_query_trace_log` returns statistics aggregated by the normalized query string, `mysqlnd_qc_get_cache_info` gives storage handler specific information which includes a list of all cached items, depending on the storage handler. Additionally, the core of PECL/mysqlnd_qc collects high-level summary statistics aggregated per PHP process. The high-level statistics are returned by `mysqlnd_qc_get_core_stats`.

The functions `mysqlnd_qc_get_normalized_query_trace_log` and `mysqlnd_qc_get_core_stats` will not collect data unless data collection has been enabled through their corresponding PHP configuration directives. Data collection is disabled by default for performance considerations. It is configurable with the `mysqlnd_qc.time_statistics` option, which determines if timing information should be collected. Collection of time statistics is enabled by default but only performed if data collection as such has been enabled. Recording time statistics causes extra system calls. In most cases, the benefit of the monitoring outweighs any potential performance penalty of the additional system calls.

Example 7.320 Collecting statistics data with the `mysqlnd_qc.time_statistics` ini setting

```
mysqlnd_qc.enable_qc=1
mysqlnd_qc.collect_statistics=1
```

```
<?php
/* connect to MySQL */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)");
/* dummy queries */
for ($i = 1; $i <= 4; $i++) {
    $query = sprintf("/%s*/SELECT id FROM test WHERE id = %d", MYSQLND_QC_ENABLE_SWITCH, $i % 2);
    $res   = $mysqli->query($query);

    $res->free();
}
var_dump(mysqlnd_qc_get_core_stats());
?>
```

The above examples will output something similar to:

```
array(26) {
  ["cache_hit"]=>
```

```

string(1) "2"
["cache_miss"]=>
string(1) "2"
["cache_put"]=>
string(1) "2"
["query_should_cache"]=>
string(1) "4"
["query_should_not_cache"]=>
string(1) "3"
["query_not_cached"]=>
string(1) "3"
["query_could_cache"]=>
string(1) "4"
["query_found_in_cache"]=>
string(1) "2"
["query_uncached_other"]=>
string(1) "0"
["query_uncached_no_table"]=>
string(1) "0"
["query_uncached_no_result"]=>
string(1) "0"
["query_uncached_use_result"]=>
string(1) "0"
["query_aggr_run_time_cache_hit"]=>
string(2) "28"
["query_aggr_run_time_cache_put"]=>
string(3) "900"
["query_aggr_run_time_total"]=>
string(3) "928"
["query_aggr_store_time_cache_hit"]=>
string(2) "14"
["query_aggr_store_time_cache_put"]=>
string(2) "40"
["query_aggr_store_time_total"]=>
string(2) "54"
["receive_bytes_recorded"]=>
string(3) "136"
["receive_bytes_replayed"]=>
string(3) "136"
["send_bytes_recorded"]=>
string(2) "84"
["send_bytes_replayed"]=>
string(2) "84"
["slam_stale_refresh"]=>
string(1) "0"
["slam_stale_hit"]=>
string(1) "0"
["request_counter"]=>
int(1)
["process_hash"]=>
int(1929695233)
}

```

For a quick overview, call [mysqlnd qc_get_core_stats](#). It delivers cache usage, cache timing and traffic related statistics. Values are aggregated on a per process basis for all queries issued by any PHP MySQL API call.

Some storage handler, such as the default handler, can report cache entries, statistics related to the entries and meta data for the underlying query through the [mysqlnd qc_get_cache_info](#) function. Please note, that the information returned depends on the storage handler. Values are aggregated on a per process basis.

Example 7.321 Example `mysqlnd qc_get_cache_info` usage

```
mysqlnd qc.enable_qc=1
```

```
<?php
/* connect to MySQL */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)");
/* dummy queries to fill the query trace */
for ($i = 1; $i <= 4; $i++) {
    $query = sprintf("/*%s*/SELECT id FROM test WHERE id = %d", MYSQLND_QC_ENABLE_SWITCH, $i % 2);
    $res   = $mysqli->query($query);

    $res->free();
}
var_dump(mysqlnd_qc_get_cache_info());
?>
```

The above examples will output something similar to:

```
array(4) {
  ["num_entries"]=>
  int(2)
  ["handler"]=>
  string(7) "default"
  ["handler_version"]=>
  string(5) "1.0.0"
  ["data"]=>
  array(2) {
    ["localhost via UNIX socket
3306
root
test|/*qc=on*/SELECT id FROM test WHERE id = 1"]=>
    array(2) {
      ["statistics"]=>
      array(11) {
        ["rows"]=>
        int(1)
        ["stored_size"]=>
        int(71)
        ["cache_hits"]=>
        int(1)
        ["run_time"]=>
        int(391)
        ["store_time"]=>
        int(27)
        ["min_run_time"]=>
        int(16)
        ["max_run_time"]=>
        int(16)
        ["min_store_time"]=>
        int(8)
        ["max_store_time"]=>
        int(8)
        ["avg_run_time"]=>
        int(8)
        ["avg_store_time"]=>
        int(4)
      }
      ["metadata"]=>
      array(1) {
        [0]=>
        array(8) {
          ["name"]=>
          string(2) "id"
          ["orig_name"]=>
          string(2) "id"
          ["table"]=>
          string(4) "test"
          ["orig_table"]=>
```

It is possible to further break down the granularity of statistics to the level of the normalized statement string. The normalized statement string is the statements string with all parameters replaced with

question marks. For example, the two statements `SELECT id FROM test WHERE id = 0` and `SELECT id FROM test WHERE id = 1` are normalized into `SELECT id FROM test WHERE id = ?`. Their both statistics are aggregated into one entry for `SELECT id FROM test WHERE id = ?`.

Example 7.322 Example `mysqlnd_qc_get_normalized_query_trace_log` usage

```
mysqlnd_qc.enable_qc=1
mysqlnd_qc.collect_normalized_query_trace=1
```

```
<?php
/* connect to MySQL */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)");
/* dummy queries to fill the query trace */
for ($i = 1; $i <= 4; $i++) {
    $query = sprintf("/%s*/SELECT id FROM test WHERE id = %d", MYSQLND_QC_ENABLE_SWITCH, $i % 2);
    $res   = $mysqli->query($query);

    $res->free();
}
var_dump(mysqlnd_qc_get_normalized_query_trace_log());
?>
```

The above examples will output something similar to:

```
array(4) {
[0]=>
array(9) {
["query"]=>
string(25) "DROP TABLE IF EXISTS test"
["occurrences"]=>
int(0)
["eligible_for_caching"]=>
bool(false)
["avg_run_time"]=>
int(0)
["min_run_time"]=>
int(0)
["max_run_time"]=>
int(0)
["avg_store_time"]=>
int(0)
["min_store_time"]=>
int(0)
["max_store_time"]=>
int(0)
}
[1]=>
array(9) {
["query"]=>
string(27) "CREATE TABLE test (id INT )"
["occurrences"]=>
int(0)
["eligible_for_caching"]=>
bool(false)
["avg_run_time"]=>
int(0)
["min_run_time"]=>
int(0)
["max_run_time"]=>
int(0)
["avg_store_time"]=>
int(0)
}
```

```

["min_store_time"]=>
int(0)
["max_store_time"]=>
int(0)
}
[2]=>
array(9) {
["query"]=>
string(46) "INSERT INTO test (id ) VALUES (? ), (? ), (? )"
["occurences"]=>
int(0)
["eligible_for_caching"]=>
bool(false)
["avg_run_time"]=>
int(0)
["min_run_time"]=>
int(0)
["max_run_time"]=>
int(0)
["avg_store_time"]=>
int(0)
["min_store_time"]=>
int(0)
["max_store_time"]=>
int(0)
}
[3]=>
array(9) {
["query"]=>
string(31) "SELECT id FROM test WHERE id =?"
["occurences"]=>
int(4)
["eligible_for_caching"]=>
bool(true)
["avg_run_time"]=>
int(179)
["min_run_time"]=>
int(11)
["max_run_time"]=>
int(393)
["avg_store_time"]=>
int(12)
["min_store_time"]=>
int(7)
["max_store_time"]=>
int(25)
}
}

```

The source distribution of PECL/mysqlnd_qc contains a directory [web/](#) in which web based monitoring scripts can be found which give an example how to write a cache monitor. Please, follow the instructions given in the source.

Since PECL/mysqlnd_qc 1.1.0 it is possible to write statistics into a log file. Please, see [mysqlnd_qc.collect_statistics_log_file](#).

7.8.4.9 Beyond TTL: user-defined storage

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The query cache plugin supports the use of user-defined storage handler. User-defined storage handler can use arbitrarily complex invalidation algorithms and support arbitrary storage media.

All user-defined storage handlers have to provide a certain interface. The functions of the user-defined storage handler will be called by the core of the cache plugin. The necessary interface consists of seven public functions. Both procedural and object oriented user-defined storage handler must implement the same set of functions.

Example 7.323 Using a user-defined storage handler

```

<?php
/* Enable default caching of all statements */
ini_set("mysqlnd_qc.cache_by_default", 1);
/* Procedural user defined storage handler functions */
$__cache = array();
function get_hash($host_info, $port, $user, $db, $query) {
    global $__cache;
    printf("\t%s(%d)\n", __FUNCTION__, func_num_args());
    return md5(sprintf("%s%s%s%s", $host_info, $port, $user, $db, $query));
}
function find_query_in_cache($key) {
    global $__cache;
    printf("\t%s(%d)\n", __FUNCTION__, func_num_args());
    if (isset($__cache[$key])) {
        $tmp = $__cache[$key];
        if ($tmp["valid_until"] < time()) {
            unset($__cache[$key]);
            $ret = NULL;
        } else {
            $ret = $__cache[$key]["data"];
        }
    } else {
        $ret = NULL;
    }
    return $ret;
}
function return_to_cache($key) {
/*
    Called on cache hit after cached data has been processed,
    may be used for reference counting
*/
    printf("\t%s(%d)\n", __FUNCTION__, func_num_args());
}
function add_query_to_cache_if_not_exists($key, $data, $ttl, $run_time, $store_time, $row_count) {
    global $__cache;
    printf("\t%s(%d)\n", __FUNCTION__, func_num_args());
    $__cache[$key] = array(
        "data"              => $data,
        "row_count"         => $row_count,
        "valid_until"       => time() + $ttl,
        "hits"              => 0,
        "run_time"          => $run_time,
        "store_time"         => $store_time,
        "cached_run_times"  => array(),
        "cached_store_times" => array(),
    );
    return TRUE;
}
function query_is_select($query) {
    printf("\t%s('%s'):", __FUNCTION__, $query);
    $ret = FALSE;
    if (stristr($query, "SELECT") !== FALSE) {
        /* cache for 5 seconds */
        $ret = 5;
    }
    printf("%s\n", (FALSE === $ret) ? "FALSE" : $ret);
    return $ret;
}
function update_query_run_time_stats($key, $run_time, $store_time) {
    global $__cache;
    printf("\t%s(%d)\n", __FUNCTION__, func_num_args());
    if (isset($__cache[$key])) {
        $__cache[$key]['hits']++;
        $__cache[$key]['cached_run_times'][] = $run_time;
        $__cache[$key]['cached_store_times'][] = $store_time;
    }
}
function get_stats($key = NULL) {
    global $__cache;

```

```

printf("\t%s(%d)\n", __FUNCTION__, func_num_args());
if ($key && isset($__cache[$key])) {
    $stats = $__cache[$key];
} else {
    $stats = array();
    foreach ($__cache as $key => $details) {
        $stats[$key] = array(
            'hits'          => $details['hits'],
            'bytes'         => strlen($details['data']),
            'uncached_run_time' => $details['run_time'],
            'cached_run_time'   => (count($details['cached_run_times']))
                ? array_sum($details['cached_run_times']) / count($details['cached_run_times'])
                : 0,
        );
    }
}
return $stats;
}
function clear_cache() {
    global $__cache;
    printf("\t%s(%d)\n", __FUNCTION__, func_num_args());
    $__cache = array();
    return TRUE;
}
/* Install procedural user-defined storage handler */
if (!mysqlnd_qc_set_user_handlers("get_hash", "find_query_in_cache",
    "return_to_cache", "add_query_to_cache_if_not_exists",
    "query_is_select", "update_query_run_time_stats", "get_stats", "clear_cache")) {

    printf("Failed to install user-defined storage handler\n");
}
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2)");
printf("\nCache put/cache miss\n");
$res = $mysqli->query("SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
/* Delete record to verify we get our data from the cache */
$mysqli->query("DELETE FROM test WHERE id = 1");
printf("\nCache hit\n");
$res = $mysqli->query("SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
printf("\nDisplay cache statistics\n");
var_dump(mysqlnd_qc_get_cache_info());
printf("\nFlushing cache, cache put/cache miss");
var_dump(mysqlnd_qc_clear_cache());
$res = $mysqli->query("SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
?>

```

The above examples will output something similar to:

```

query_is_select('DROP TABLE IF EXISTS test'): FALSE
query_is_select('CREATE TABLE test(id INT)': FALSE
query_is_select('INSERT INTO test(id) VALUES (1), (2)': FALSE
Cache put/cache miss
    query_is_select('SELECT id FROM test WHERE id = 1'): 5
    get_hash(5)
    find_query_in_cache(1)
    add_query_to_cache_if_not_exists(6)
array(1) {
    ["id"]=>
        string(1) "1"
}

```

```

        query_is_select('DELETE FROM test WHERE id = 1'): FALSE
Cache hit
        query_is_select('SELECT id FROM test WHERE id = 1'): 5
        get_hash(5)
        find_query_in_cache(1)
        return_to_cache(1)
        update_query_run_time_stats(3)
array(1) {
    ["id"]=>
        string(1) "1"
}
Display cache statistics
        get_stats(0)
array(4) {
    ["num_entries"]=>
        int(1)
    ["handler"]=>
        string(4) "user"
    ["handler_version"]=>
        string(5) "1.0.0"
    ["data"]=>
        array(1) {
            ["18683c177dc89bb352b29965d112fdAA"]=>
                array(4) {
                    ["hits"]=>
                        int(1)
                    ["bytes"]=>
                        int(71)
                    ["uncached_run_time"]=>
                        int(398)
                    ["cached_run_time"]=>
                        int(4)
                }
        }
}
Flushing cache, cache put/cache miss      clear_cache(0)
bool(true)
        query_is_select('SELECT id FROM test WHERE id = 1'): 5
        get_hash(5)
        find_query_in_cache(1)
        add_query_to_cache_if_not_exists(6)
NULL

```

7.8.5 Installing/Configuring

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7.8.5.1 Requirements

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PHP 5.3.3 or a newer version of PHP.

PECL/mysqlnd_qc is a mysqlnd plugin. It plugs into the mysqlnd library. To use you this plugin with a PHP MySQL extension, the extension ([mysqli](#), [mysql](#), or [PDO_MYSQL](#)) must enable the mysqlnd library.

For using the APC storage handler with PECL/mysqlnd_qc 1.0 [APC 3.1.3p1-beta](#) or newer. PECL/mysqlnd_qc 1.2 has been tested with [APC 3.1.13-beta](#). The APC storage handler cannot be used with a shared build. You cannot use the PHP configuration directive [extension](#) to load the APC and PECL/mysqlnd_qc extensions if PECL/mysqlnd_qc will use APC as a storage handler. For using the APC storage handler, you have to statically compile PHP with APC and PECL/mysqlnd_qc support into PHP.

For using MEMCACHE storage handler: Use [libmemcache 0.38](#) or newer. PECL/mysqlnd_qc 1.2 has been tested with [libmemcache 1.4.0](#).

For using `sqlite` storage handler: Use the `sqlite3` extension that bundled with PHP.

7.8.5.2 Installation

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This PECL extension is not bundled with PHP.

Information for installing this PECL extension may be found in the manual chapter titled [Installation of PECL extensions](#). Additional information such as new releases, downloads, source files, maintainer information, and a CHANGELOG, can be located here: http://pecl.php.net/package/mysqlnd_qc

A DLL for this PECL extension is currently unavailable. See also the [building on Windows](#) section.

7.8.5.3 Runtime Configuration

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The behaviour of these functions is affected by settings in `php.ini`.

Table 7.43 mysqlnd_qc Configure Options

Name	Default	Changeable	Changelog
<code>mysqlnd_qc.enable_qc</code>	1	PHP_INI_SYSTEM	
<code>mysqlnd_qc.ttl</code>	30	PHP_INI_ALL	
<code>mysqlnd_qc.cache_by_default</code>	0	PHP_INI_ALL	
<code>mysqlnd_qc.cache_no_table</code>	0	PHP_INI_ALL	
<code>mysqlnd_qc.use_request_time</code>	0	PHP_INI_ALL	
<code>mysqlnd_qc.time_statistics</code>	1	PHP_INI_ALL	
<code>mysqlnd_qc.collect_statistics</code>	0	PHP_INI_ALL	
<code>mysqlnd_qc.collect_statistics_file</code>	<code>/tmp/mysqlnd_qc.stats</code>	PHP_INI_SYSTEM	
<code>mysqlnd_qc.collect_query_trace</code>	0	PHP_INI_SYSTEM	
<code>mysqlnd_qc.query_trace_bit_depth</code>	8	PHP_INI_SYSTEM	
<code>mysqlnd_qc.collect_normalized_query_trace</code>	0	PHP_INI_SYSTEM	
<code>mysqlnd_qc.ignore_sql_comments</code>	1	PHP_INI_ALL	
<code>mysqlnd_qc.slam_defense</code>	0	PHP_INI_SYSTEM	
<code>mysqlnd_qc.slam_defense_ttl</code>	0	PHP_INI_SYSTEM	
<code>mysqlnd_qc.std_data_copy</code>	0	PHP_INI_SYSTEM	
<code>mysqlnd_qc.apc_prefix</code>	<code>qc_</code>	PHP_INI_ALL	
<code>mysqlnd_qc.memc_server</code>	<code>127.0.0.1</code>	PHP_INI_ALL	
<code>mysqlnd_qc.memc_port</code>	11211	PHP_INI_ALL	
<code>mysqlnd_qc.sqlite_data_file</code>	<code>memory:</code>	PHP_INI_ALL	

Here's a short explanation of the configuration directives.

`mysqlnd_qc.enable_qc` integer Enables or disables the plugin. If disabled the extension will not plug into `mysqlnd` to proxy internal `mysqlnd` C API calls.

`mysqlnd_qc.ttl` integer Default Time-to-Live (TTL) for cache entries in seconds.

`mysqlnd_qc.cache_by_default` integer Cache all queries regardless if they begin with the SQL hint that enables caching of a query or not. Storage handler cannot overrule the setting. It is evaluated by the core of the plugin.

<code>mysqlnd_qc.cache_no_table</code>	Whether to cache queries with no table name in any of columns meta data of their result set, for example, <code>SELECT SLEEP(1)</code> , <code>SELECT NOW()</code> , <code>SELECT SUBSTRING()</code> .
<code>mysqlnd_qc.use_request_time</code>	Use PHP global request time to avoid <code>gettimeofday()</code> system calls? If using <code>APC</code> storage handler it should be set to the value of <code>apc.use_request_time</code> , if not warnings will be generated.
<code>mysqlnd_qc.time_statistics</code>	Collect run time and store time statistics using <code>gettimeofday()</code> system call? Data will be collected only if you also set <code>mysqlnd_qc.collect_statistics = 1</code> ,
<code>mysqlnd_qc.collect_statistics</code>	Collect statistics for <code>mysqlnd_qc_get_core_stats</code> ? Does not influence storage handler statistics! Handler statistics can be an integral part of the handler internal storage format. Therefore, collection of some handler statistics cannot be disabled.
<code>mysqlnd_qc.collect_statistics_log_file</code>	If <code>mysqlnd_qc.collect_statistics</code> and <code>log-file</code> integer are set, the plugin will dump statistics into the specified log file at every 10th web request during PHP request shutdown. The log file needs to be writable by the web server user.
	Since 1.1.0.
<code>mysqlnd_qc.collect_query_trace_bt</code>	Collect query back traces?
<code>mysqlnd_qc.query_trace_bt_max</code>	Maximum depth/level of a query code backtrace.
<code>mysqlnd_qc.ignore_sql_comments</code>	Whether to remove SQL comments from a query string before hashing it to generate a cache key. Disable if you do not want two statements such as <code>SELECT /*my_source_ip=123*/ id FROM test</code> and <code>SELECT /*my_source_ip=456*/ id FROM test</code> to refer to the same cache entry.
	Since 1.1.0.
<code>mysqlnd_qc.slam_defense</code>	Activates handler based slam defense (cache stampeding protection) if available. Supported by <code>Default</code> and <code>APC</code> storage handler
<code>mysqlnd_qc.slam_defense_ttl</code>	TTL for stale cache entries which are served while another client updates the entries. Supported by <code>APC</code> storage handler.
<code>mysqlnd_qc.collect_normalized_query_traces</code>	Collect aggregated normalized query traces? The setting has no effect by default. You compile the extension using the define <code>NORM_QUERY_TRACE_LOG</code> to make use of the setting.
<code>mysqlnd_qc.std_data_copy</code>	Default storage handler: copy cached wire data? EXPERIMENTAL – use default setting!
<code>mysqlnd_qc.apc_prefix</code>	The <code>APC</code> storage handler stores data in the <code>APC</code> user cache. The setting sets a prefix to be used for cache entries.
<code>mysqlnd_qc.memc_server</code>	<code>MEMCACHE</code> storage handler: memcache server host.
<code>mysqlnd_qc.memc_port</code>	<code>MEMCACHE</code> storage handler: memcached server port.

`mysqlnd_qc.sqlite_data_file`sqlite storage handler: data file. Any setting but `:memory:` may be of little practical value.

7.8.6 Predefined Constants

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The constants below are defined by this extension, and will only be available when the extension has either been compiled into PHP or dynamically loaded at runtime.

SQL hint related

Example 7.324 Using SQL hint constants

The query cache is controlled by SQL hints. SQL hints are used to enable and disable caching. SQL hints can be used to set the `TTL` of a query.

The SQL hints recognized by the query cache can be manually changed at compile time. This makes it possible to use `mysqlnd_qc` in environments in which the default SQL hints are already taken and interpreted by other systems. Therefore it is recommended to use the SQL hint string constants instead of manually adding the default SQL hints to the query string.

```
<?php
/* Use constants for maximum portability */
$query = "/*" . MYSQLND_QC_ENABLE_SWITCH . "*/SELECT id FROM test";
/* Valid but less portable: default TTL */
$query = /*qc=on*/SELECT id FROM test;
/* Valid but less portable: per statement TTL */
$query = /*qc=on//*qc_ttl=5*/SELECT id FROM test";
printf("MYSQLND_QC_ENABLE_SWITCH: %s\n", MYSQLND_QC_ENABLE_SWITCH);
printf("MYSQLND_QC_DISABLE_SWITCH: %s\n", MYSQLND_QC_DISABLE_SWITCH);
printf("MYSQLND_QC_TTL_SWITCH: %s\n", MYSQLND_QC_TTL_SWITCH);
?>
```

The above examples will output:

```
MYSQLND_QC_ENABLE_SWITCH: qc=on
MYSQLND_QC_DISABLE_SWITCH: qc=off
MYSQLND_QC_TTL_SWITCH: qc_ttl=
```

`MYSQLND_QC_ENABLE_SWITCH` SQL hint used to enable caching of a query.
(string)

`MYSQLND_QC_DISABLE_SWITCH` SQL hint used to disable caching of a query if
(string) `mysqlnd_qc.cache_by_default = 1`.

`MYSQLND_QC_TTL_SWITCH` SQL hint used to set the TTL of a result set.
(string)

`MYSQLND_QC_SERVER_ID_SWITCH` This SQL hint should not be used in general.
(string)

It is needed by PECL/mysqlnd_ms to group cache entries for one statement but originating from different physical connections. If the hint is used connection settings such as user, hostname and charset are not considered for generating a cache key of a query. Instead the given value and the query string are used as input to the hashing function that generates the key.

PECL/mysqlnd_ms may, if instructed, cache results from MySQL Replication slaves. Because it can hold many connections to the

slave the cache key shall not be formed from the user, hostname or other settings that may vary for the various slave connections. Instead, PECL/mysqlnd_ms provides an identifier which refers to the group of slave connections that shall be enabled to share cache entries no matter which physical slave connection was to generate the cache entry.

Use of this feature outside of PECL/mysqlnd_ms is not recommended.

mysqlnd_qc_set_cache_condition related

Example 7.325 Example mysqlnd_qc_set_cache_condition usage

The function `mysqlnd_qc_set_cache_condition` allows setting conditions for automatic caching of statements which don't begin with the SQL hints necessary to manually enable caching.

```
<?php
/* Cache all accesses to tables with the name "new%" in schema/database "db_example" for 1 second */
if (!mysqlnd_qc_set_cache_condition(MYSQLND_QC_CONDITION_META_SCHEMA_PATTERN, "db_example.new%", 1)) {
    die("Failed to set cache condition!");
}
$mysqli = new mysqli("host", "user", "password", "db_example", "port");
/* cached although no SQL hint given */
$mysqli->query("SELECT id, title FROM news");
$pdo_mysql = new PDO("mysql:host=host;dbname=db_example;port=port", "user", "password");
/* not cached: no SQL hint, no pattern match */
$pdo_mysql->query("SELECT id, title FROM latest_news");
/* cached: TTL 1 second, pattern match */
$pdo_mysql->query("SELECT id, title FROM news");
?>
```

`MYSQLND_QC_CONDITION_META_SCHEMA_PATTERN` Used as a parameter of `mysqlnd_qc_set_cache_condition` to (int) set conditions for schema based automatic caching.

Other

The plugin version number can be obtained using either `MYSQLND_QC_VERSION`, which is the string representation of the numerical version number, or `MYSQLND_QC_VERSION_ID`, which is an integer such as 10000. Developers can calculate the version number as follows.

Version (part)	Example
Major*10000	1*10000 = 10000
Minor*100	0*100 = 0
Patch	0 = 0
<code>MYSQLND_QC_VERSION_ID</code>	10000

`MYSQLND_QC_VERSION` (string) Plugin version string, for example, “1.0.0-prototype”.

`MYSQLND_QC_VERSION_ID` (int) Plugin version number, for example, 10000.

7.8.7 mysqlnd_qc Functions

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7.8.7.1 mysqlnd_qc_clear_cache

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- `mysqlnd_qc_clear_cache`

Flush all cache contents

Description

```
bool mysqlnd_qc_clear_cache();
```

Flush all cache contents.

Flushing the cache is a storage handler responsibility. All built-in storage handler but the `memcache` storage handler support flushing the cache. The `memcache` storage handler cannot flush its cache contents.

User-defined storage handler may or may not support the operation.

Parameters

This function has no parameters.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

A return value of `FALSE` indicates that flushing all cache contents has failed or the operation is not supported by the active storage handler. Applications must not expect that calling the function will always flush the cache.

7.8.7.2 `mysqlnd_qc_get_available_handlers`

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- `mysqlnd_qc_get_available_handlers`

Returns a list of available storage handler

Description

```
array mysqlnd_qc_get_available_handlers();
```

Which storage are available depends on the compile time configuration of the query cache plugin. The `default` storage handler is always available. All other storage handler must be enabled explicitly when building the extension.

Parameters

This function has no parameters.

Return Values

Returns an array of available built-in storage handler. For each storage handler the version number and version string is given.

Examples

Example 7.326 `mysqlnd_qc_get_available_handlers` example

```
<?php
var_dump(mysqlnd_qc_get_available_handlers());
?>
```

The above examples will output:

```
array(5) {
    ["default"]=>
    array(2) {
```

```

[ "version"]=>
string(5) "1.0.0"
[ "version_number"]=>
int(100000)
}
[ "user"]=>
array(2) {
[ "version"]=>
string(5) "1.0.0"
[ "version_number"]=>
int(100000)
}
[ "APC"]=>
array(2) {
[ "version"]=>
string(5) "1.0.0"
[ "version_number"]=>
int(100000)
}
[ "MEMCACHE"]=>
array(2) {
[ "version"]=>
string(5) "1.0.0"
[ "version_number"]=>
int(100000)
}
[ "sqlite"]=>
array(2) {
[ "version"]=>
string(5) "1.0.0"
[ "version_number"]=>
int(100000)
}
}

```

See Also

[Installation](#)

[mysqlnd_qc_set_storage_handler](#)

7.8.7.3 [mysqlnd_qc_get_cache_info](#)

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- [mysqlnd_qc_get_cache_info](#)

Returns information on the current handler, the number of cache entries and cache entries, if available

Description

```
array mysqlnd_qc_get_cache_info();
```

Parameters

This function has no parameters.

Return Values

Returns information on the current handler, the number of cache entries and cache entries, if available. If and what data will be returned for the cache entries is subject to the active storage handler. Storage handler are free to return any data. Storage handler are recommended to return at least the data provided by the default handler, if technically possible.

The scope of the information is the PHP process. Depending on the PHP deployment model a process may serve one or more web requests.

Values are aggregated for all cache activities on a per storage handler basis. It is not possible to tell how much queries originating from `mysqli`, `PDO_MySQL` or `mysql`.API calls have contributed to the aggregated data values. Use `mysqlnd_qc_get_core_stats` to get timing data aggregated for all storage handlers.

Array of cache information

<code>handler</code> string	The active storage handler.									
	All storage handler. Since 1.0.0.									
<code>handler_version</code> string	The version of the active storage handler.									
	All storage handler. Since 1.0.0.									
<code>num_entries</code> int	The number of cache entries. The value depends on the storage handler in use. The default, APC and SQLite storage handler provide the actual number of cache entries.									
	The MEMCACHE storage handler always returns 0. MEMCACHE does not support counting the number of cache entries.									
	If a user defined handler is used, the number of entries of the <code>data</code> property is reported.									
	Since 1.0.0.									
<code>data</code> array	The version of the active storage handler. Additional storage handler dependent data on the cache entries. Storage handler are requested to provide similar and comparable information. A user defined storage handler is free to return any data. Since 1.0.0.									
	The following information is provided by the default storage handler for the <code>data</code> property. The <code>data</code> property holds a hash. The hash is indexed by the internal cache entry identifier of the storage handler. The cache entry identifier is human-readable and contains the query string leading to the cache entry. Please, see also the example below. The following data is given for every cache entry.									
<code>statistics</code> array	Statistics of the cache entry. Since 1.0.0.									
	<table border="1"><thead><tr><th>Property</th><th>Description</th><th>Version</th></tr></thead><tbody><tr><td><code>rows</code></td><td>Number of rows of the cached result set.</td><td>Since 1.0.0.</td></tr><tr><td><code>size</code></td><td>The size of the cached result set in bytes. This is the size of the payload. The value is not suited for calculating the total memory consumption</td><td>Since 1.0.0.</td></tr></tbody></table>	Property	Description	Version	<code>rows</code>	Number of rows of the cached result set.	Since 1.0.0.	<code>size</code>	The size of the cached result set in bytes. This is the size of the payload. The value is not suited for calculating the total memory consumption	Since 1.0.0.
Property	Description	Version								
<code>rows</code>	Number of rows of the cached result set.	Since 1.0.0.								
<code>size</code>	The size of the cached result set in bytes. This is the size of the payload. The value is not suited for calculating the total memory consumption	Since 1.0.0.								

Property	Description	Version
	of all cache entries including the administrative overhead of the cache entries.	
<code>cache_hits</code>	How often the cached entry has been returned.	Since 1.0.0.
<code>run_time</code>	Runtime of the statement to which the cache entry belongs. This is the run time of the uncached statement. It is the time between sending the statement to MySQL receiving a reply from MySQL. Run time saved by using the query cache plugin can be calculated like this: <code>cache_hits * ((run_time - avg_run_time) + (store_time - avg_store_time))</code> .	Since 1.0.0.
<code>store_time</code>	Store time of the statements result set to which the cache entry belongs. This is the time it took to fetch and store the results of the uncached statement.	Since 1.0.0.
<code>min_run_time</code>	Minimum run time of the cached statement. How long it took to find the statement in the cache.	Since 1.0.0.
<code>min_store_time</code>	Minimum store time of the cached statement. The time taken for fetching the cached result set from the storage medium and decoding	Since 1.0.0.
<code>avg_run_time</code>	Average run time of the cached statement.	Since 1.0.0.
<code>avg_store_time</code>	Average store time of the cached statement.	Since 1.0.0.
<code>max_run_time</code>	Average run time of the cached statement.	Since 1.0.0.

Property	Description	Version
<code>max_stored_time</code>	Average stored time of the cached statement.	Since 1.0.0.
<code>valid_till</code>	Timestamp when the cache entry expires.	Since 1.1.0.

`metadata` array

Metadata of the cache entry.
This is the metadata provided by MySQL together with the result set of the statement in question. Different versions of the MySQL server may return different metadata. Unlike with some of the PHP MySQL extensions no attempt is made to hide MySQL server version dependencies and version details from the caller. Please, refer to the MySQL C API documentation that belongs to the MySQL server in use for further details.

The metadata list contains one entry for every column.

Since 1.0.0.

Property	Description	Version
<code>name</code>	The field name. Depending on the MySQL version this may be the fields alias name.	Since 1.0.0.
<code>org_name</code>	The field name.	Since 1.0.0.
<code>tab</code>	The table name. If an alias name was used for the table, this usually holds the alias name.	Since 1.0.0.
<code>org_tab</code>	The table name.	Since 1.0.0.
<code>db</code>	The database/schema name.	Since 1.0.0.
<code>max_length</code>	The maximum width of the field. Details may vary by MySQL server version.	Since 1.0.0.
<code>length</code>	The width of the field. Details may vary by MySQL server version.	Since 1.0.0.
<code>type</code>	The data type of the field. Details may vary.	Since 1.0.0.

Property	Description	Version
qc_type	by the MySQL server in use. This is the MySQL C API type constants value. It is recommended to use type constants provided by the mysqli extension to test for its meaning. You should not test for certain type values by comparing with certain numbers.	

The APC storage handler returns the same information for the [data](#) property but no [metadata](#). The [metadata](#) of a cache entry is set to [NULL](#).

The MEMCACHE storage handler does not fill the [data](#) property. Statistics are not available on a per cache entry basis with the MEMCACHE storage handler.

A user defined storage handler is free to provide any data.

Examples

Example 7.327 `mysqlnd_qc_get_cache_info` example

The example shows the output from the built-in default storage handler. Other storage handler may report different data.

```
<?php
/* Populate the cache, e.g. using mysqli */
$mysqli = new mysqli("host", "user", "password", "schema");
$mysqli->query("/*" . MYSQLND_QC_ENABLE_SWITCH . "*/SELECT id FROM test");
/* Display cache information */
var_dump(mysqlnd_qc_get_cache_info());
?>
```

The above examples will output:

```
array(4) {
  ["num_entries"]=>
  int(1)
  ["handler"]=>
  string(7) "default"
  ["handler_version"]=>
  string(5) "1.0.0"
  ["data"]=>
  array(1) {
    ["Localhost via UNIX socket 3306 user schema|/*qc=on*/SELECT id FROM test"]=>
    array(2) {
      ["statistics"]=>
      array(11) {
        ["rows"]=>
        int(6)
        ["stored_size"]=>
        int(101)
        ["cache_hits"]=>
        int(0)
        ["run_time"]=>
```

```
    int(471)
    [ "store_time" ]=>
    int(27)
    [ "min_run_time" ]=>
    int(0)
    [ "max_run_time" ]=>
    int(0)
    [ "min_store_time" ]=>
    int(0)
    [ "max_store_time" ]=>
    int(0)
    [ "avg_run_time" ]=>
    int(0)
    [ "avg_store_time" ]=>
    int(0)
}
[ "metadata" ]=>
array(1) {
    [0]=>
    array(8) {
        [ "name" ]=>
        string(2) "id"
        [ "orig_name" ]=>
        string(2) "id"
        [ "table" ]=>
        string(4) "test"
        [ "orig_table" ]=>
        string(4) "test"
        [ "db" ]=>
        string(4) "schema"
        [ "max_length" ]=>
        int(1)
        [ "length" ]=>
        int(11)
        [ "type" ]=>
        int(3)
    }
}
}
```

See Also

```
mysqlnd qc get core stats
```

7.8.7.4 mysqlnd qc_get_core_stats

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- mysqlnd qc get core stats

Statistics collected by the core of the query cache

Description

```
array mysqlnd_qc_get_core_stats();
```

Returns an array of statistics collected by the core of the cache plugin. The same data fields will be reported for any storage handler because the data is collected by the core.

The PHP configuration setting `mysqlnd_qc.collect_statistics` controls the collection of statistics. The collection of statistics is disabled by default for performance reasons. Disabling the collection of statistics will also disable the collection of time related statistics.

The `PHP` configuration setting `mysqlnd_qc.collect_time_statistics` controls the collection of time related statistics.

The scope of the core statistics is the [PHP](#) process. Depending on your deployment model a [PHP](#) process may handle one or multiple requests.

Statistics are aggregated for all cache entries and all storage handler. It is not possible to tell how much queries originating from [mysqli](#), [PDO_MySQL](#) or [mysql](#) API calls have contributed to the aggregated data values.

Parameters

This function has no parameters.

Return Values

Array of core statistics

Statistic	Description	Version
<code>cache_hit</code>	Statement is considered cacheable and cached data has been reused. Statement is considered cacheable and a cache miss happened but the statement got cached by someone else while we process it and thus we can fetch the result from the refreshed cache.	Since 1.0.0.
<code>cache_miss</code>	Statement is considered cacheable... <ul style="list-style-type: none"> • ... and has been added to the cache • ... but the PHP configuration directive setting of <code>mysqlnd_qc.cache_no_table = 1</code> has prevented caching. • ... but an unbuffered result set is requested. • ... but a buffered result set was empty. 	Since 1.0.0.
<code>cache_put</code>	Statement is considered cacheable and has been added to the cache. Take care when calculating derived statistics. Storage handler with a storage life time beyond process scope may report <code>cache_put = 0</code> together with <code>cache_hit > 0</code> , if another process has filled the cache. You may want to use <code>num_entries</code> from mysqlnd_qc_get_cache_info if the handler supports it (<code>default, APC</code>).	Since 1.0.0.
<code>query_should_cache</code>	Statement is considered cacheable based on query string analysis. The statement may or	Since 1.0.0.

Statistic	Description	Version
	may not be added to the cache. See also cache_put .	
<code>query_should_not_cache</code>	Statement is considered not cacheable based on query string analysis.	Since 1.0.0.
<code>query_not_cached</code>	Statement is considered not cacheable or it is considered cachable but the storage handler has not returned a hash key for it.	Since 1.0.0.
<code>query_could_cache</code>	<p>Statement is considered cacheable...</p> <ul style="list-style-type: none"> • ... and statement has been run without errors • ... and meta data shows at least one column in the result set <p>The statement may or may not be in the cache already. It may or may not be added to the cache later on.</p>	Since 1.0.0.
<code>query_found_in_cache</code>	Statement is considered cacheable and we have found it in the cache but we have not replayed the cached data yet and we have not send the result set to the client yet. This is not considered a cache hit because the client might not fetch the result or the cached data may be faulty.	Since 1.0.0.
<code>query_uncached_other</code>	Statement is considered cacheable and it may or may not be in the cache already but either replaying cached data has failed, no result set is available or some other error has happened.	
<code>query_uncached_no_table</code>	<p>Statement has not been cached because the result set has at least one column which has no table name in its meta data.</p> <p>An example of such a query is <code>SELECT SLEEP(1)</code>. To cache those statements you have to change default value of the PHP configuration directive <code>mysqlnd_qc.cache_no_table</code> and set <code>mysqlnd_qc.cache_no_table = 1</code>. Often, it is not desired to cache such statements.</p>	Since 1.0.0.

Statistic	Description	Version
<code>query_uncached_use_result</code>	Statement would have been cached if a buffered result set had been used. The situation is also considered as a cache miss and <code>cache_miss</code> will be incremented as well.	Since 1.0.0.
<code>query_aggr_run_time_cache</code>	Aggregated run time (ms) of all cached queries. Cached queries are those which have incremented <code>cache_hit</code> .	Since 1.0.0.
<code>query_aggr_run_time_cached</code>	Aggregated run time (ms) of all uncached queries that have been put into the cache. See also <code>cache_put</code> .	Since 1.0.0.
<code>query_aggr_run_time_total</code>	Aggregated run time (ms) of all uncached and cached queries that have been inspected and executed by the query cache.	Since 1.0.0.
<code>query_aggr_store_time_cache</code>	Aggregated store time (ms) of all cached queries. Cached queries are those which have incremented <code>cache_hit</code> .	Since 1.0.0.
<code>query_aggr_store_time_cached</code>	Aggregated store time (ms) of all uncached queries that have been put into the cache. See also <code>cache_put</code> .	Since 1.0.0.
<code>query_aggr_store_time_total</code>	Aggregated store time (ms) of all uncached and cached queries that have been inspected and executed by the query cache.	Since 1.0.0.
<code>receive_bytes_recorded</code>	Recorded incoming network traffic (<code>bytes</code>) send from MySQL to PHP. The traffic may or may not have been added to the cache. The traffic is the total for all queries regardless if cached or not.	Since 1.0.0.
<code>receive_bytes_replayed</code>	Network traffic replayed during cache. This is the total amount of incoming traffic saved because of the usage of the query cache plugin.	Since 1.0.0.
<code>send_bytes_recorded</code>	Recorded outgoing network traffic (<code>bytes</code>) send from MySQL to PHP. The traffic may or may not have been added to the cache. The traffic is the total for all queries regardless if cached or not.	Since 1.0.0.
<code>send_bytes_replayed</code>	Network traffic replayed during cache. This is the total amount of outgoing traffic saved because	Since 1.0.0.

Statistic	Description	Version
	of the usage of the query cache plugin.	
<code>slam_stale_refresh</code>	Number of cache misses which triggered serving stale data until the client causing the cache miss has refreshed the cache entry.	Since 1.0.0.
<code>slam_stale_hit</code>	Number of cache hits while a stale cache entry gets refreshed.	Since 1.0.0.

Examples

Example 7.328 `mysqlnd_qc_get_core_stats` example

```
<?php
/* Enable collection of statistics - default: disabled */
ini_set("mysqlnd_qc.collect_statistics", 1);
/* Enable collection of all timing related statistics -
default: enabled but overruled by mysqlnd_qc.collect_statistics = 0 */
ini_set("mysqlnd_qc.collect_time_statistics", 1);
/* Populate the cache, e.g. using mysqli */
$mysqli = new mysqli('host', 'user', 'password', 'schema');
/* Cache miss and cache put */
$mysqli->query("//*qc=on*/SELECT id FROM test");
/* Cache hit */
$mysqli->query("//*qc=on*/SELECT id FROM test");
/* Display core statistics */
var_dump(mysqlnd_qc_get_core_stats());
?>
```

The above examples will output:

```
array(26) {
    ["cache_hit"]=>
    string(1) "1"
    ["cache_miss"]=>
    string(1) "1"
    ["cache_put"]=>
    string(1) "1"
    ["query_should_cache"]=>
    string(1) "2"
    ["query_should_not_cache"]=>
    string(1) "0"
    ["query_not_cached"]=>
    string(1) "0"
    ["query_could_cache"]=>
    string(1) "2"
    ["query_found_in_cache"]=>
    string(1) "1"
    ["query_uncached_other"]=>
    string(1) "0"
    ["query_uncached_no_table"]=>
    string(1) "0"
    ["query_uncached_no_result"]=>
    string(1) "0"
    ["query_uncached_use_result"]=>
    string(1) "0"
    ["query_aggr_run_time_cache_hit"]=>
    string(1) "4"
    ["query_aggr_run_time_cache_put"]=>
    string(3) "395"
    ["query_aggr_run_time_total"]=>
    string(3) "399"
    ["query_aggr_store_time_cache_hit"]=>
```

```

string(1) "2"
["query_aggr_store_time_cache_put"]=>
string(1) "8"
["query_aggr_store_time_total"]=>
string(2) "10"
["receive_bytes_recorded"]=>
string(2) "65"
["receive_bytes_replayed"]=>
string(2) "65"
["send_bytes_recorded"]=>
string(2) "29"
["send_bytes_replayed"]=>
string(2) "29"
["slam_stale_refresh"]=>
string(1) "0"
["slam_stale_hit"]=>
string(1) "0"
["request_counter"]=>
int(1)
["process_hash"]=>
int(3547549858)
}

```

See Also

[Runtime configuration](#)
[mysqlnd_qc.collect_statistics](#)
[mysqlnd_qc.time_statistics](#)
[mysqlnd_qc_get_cache_info](#)

7.8.7.5 mysqlnd_qc_get_normalized_query_trace_log

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- [mysqlnd_qc_get_normalized_query_trace_log](#)

Returns a normalized query trace log for each query inspected by the query cache

Description

```
array mysqlnd_qc_get_normalized_query_trace_log();
```

Returns a normalized query trace log for each query inspected by the query cache. The collection of the trace log is disabled by default. To collect the trace log you have to set the PHP configuration directive [mysqlnd_qc.collect_normalized_query_trace](#) to 1

Entries in the trace log are grouped by the normalized query statement. The normalized query statement is the query statement with all statement parameter values being replaced with a question mark. For example, the two statements `SELECT id FROM test WHERE id = 1` and `SELECT id FROM test WHERE id = 2` are normalized as `SELECT id FROM test WHERE id = ?`. Whenever a statement is inspected by the query cache which matches the normalized statement pattern, its statistics are grouped by the normalized statement string.

Parameters

This function has no parameters.

Return Values

An array of query log. Every list entry contains the normalized query string and further detail information.

Key	Description
query	Normalized statement string.

Key	Description
occurrences	How many statements have matched the normalized statement string in addition to the one which has created the log entry. The value is zero if a statement has been normalized, its normalized representation has been added to the log but no further queries inspected by PECL/mysqlnd_qc have the same normalized statement string.
eligible	Whether the statement could be cached. An statement eligible for caching has not necessarily been cached. It is not possible to tell for sure if or how many cached statement have contributed to the aggregated normalized statement log entry. However, comparing the minimum and average run time one can make an educated guess.
avg_run	The average run time of all queries contributing to the query log entry. The run time is the time between sending the query statement to MySQL and receiving an answer from MySQL.
avg_store	The average store time of all queries contributing to the query log entry. The store time is the time needed to fetch a statements result set from the server to the client and, storing it on the client.
min_run	The minimum run time of all queries contributing to the query log entry.
min_store	The minimum store time of all queries contributing to the query log entry.
max_run	The maximum run time of all queries contributing to the query log entry.
max_store	The maximum store time of all queries contributing to the query log entry.

Examples

Example 7.329 mysqlnd_qc_get_normalized_query_trace_log example

```
mysqlnd_qc.collect_normalized_query_trace=1
```

```
<?php
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2)");
/* not cached */
$res = $mysqli->query("SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
/* cache put */
$res = $mysqli->query("/*" . MYSQLND_QC_ENABLE_SWITCH . "*/" . "SELECT id FROM test WHERE id = 2");
var_dump($res->fetch_assoc());
$res->free();
/* cache hit */
$res = $mysqli->query("/*" . MYSQLND_QC_ENABLE_SWITCH . "*/" . "SELECT id FROM test WHERE id = 2");
var_dump($res->fetch_assoc());
$res->free();
var_dump(mysqlnd_qc_get_normalized_query_trace_log());
?>
```

The above examples will output:

```
array(1) {
    ["id"]=>
        string(1) "1"
}
array(1) {
    ["id"]=>
        string(1) "2"
}
```

```

array(1) {
    ["id"]=>
        string(1) "2"
}
array(4) {
    [0]=>
        array(9) {
            ["query"]=>
                string(25) "DROP TABLE IF EXISTS test"
            ["occurrences"]=>
                int(0)
            ["eligible_for_caching"]=>
                bool(false)
            ["avg_run_time"]=>
                int(0)
            ["min_run_time"]=>
                int(0)
            ["max_run_time"]=>
                int(0)
            ["avg_store_time"]=>
                int(0)
            ["min_store_time"]=>
                int(0)
            ["max_store_time"]=>
                int(0)
        }
    [1]=>
        array(9) {
            ["query"]=>
                string(27) "CREATE TABLE test (id INT )"
            ["occurrences"]=>
                int(0)
            ["eligible_for_caching"]=>
                bool(false)
            ["avg_run_time"]=>
                int(0)
            ["min_run_time"]=>
                int(0)
            ["max_run_time"]=>
                int(0)
            ["avg_store_time"]=>
                int(0)
            ["min_store_time"]=>
                int(0)
            ["max_store_time"]=>
                int(0)
        }
    [2]=>
        array(9) {
            ["query"]=>
                string(40) "INSERT INTO test (id ) VALUES (?, ?)"
            ["occurrences"]=>
                int(0)
            ["eligible_for_caching"]=>
                bool(false)
            ["avg_run_time"]=>
                int(0)
            ["min_run_time"]=>
                int(0)
            ["max_run_time"]=>
                int(0)
            ["avg_store_time"]=>
                int(0)
            ["min_store_time"]=>
                int(0)
            ["max_store_time"]=>
                int(0)
        }
    [3]=>
        array(9) {
            ["query"]=>
                string(31) "SELECT id FROM test WHERE id =?"
        }
}

```

```

[ "occurences" ]=>
int(2)
[ "eligible_for_caching" ]=>
bool(true)
[ "avg_run_time" ]=>
int(159)
[ "min_run_time" ]=>
int(12)
[ "max_run_time" ]=>
int(307)
[ "avg_store_time" ]=>
int(10)
[ "min_store_time" ]=>
int(8)
[ "max_store_time" ]=>
int(13)
}
}
}

```

See Also

[Runtime configuration](#)
[mysqlnd_qc.collect_normalized_query_trace](#)
[mysqlnd_qc.time_statistics](#)
[mysqlnd_qc_get_query_trace_log](#)

7.8.7.6 mysqlnd_qc_get_query_trace_log

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- [mysqlnd_qc_get_query_trace_log](#)

Returns a backtrace for each query inspected by the query cache

Description

```
array mysqlnd_qc_get_query_trace_log();
```

Returns a backtrace for each query inspected by the query cache. The collection of the backtrace is disabled by default. To collect the backtrace you have to set the PHP configuration directive [mysqlnd_qc.collect_query_trace](#) to 1

The maximum depth of the backtrace is limited to the depth set with the PHP configuration directive [mysqlnd_qc.query_trace_bt_depth](#).

Parameters

This function has no parameters.

Return Values

An array of query backtrace. Every list entry contains the query string, a backtrace and further detail information.

Key	Description
query	Query string.
origin	Code backtrace.
run_time	Query run time in milliseconds. The collection of all times and the necessary gettimeofday system calls can be disabled by setting the PHP configuration directive mysqlnd_qc.time_statistics to 0
store_time	Query result set store time in milliseconds. The collection of all times and the necessary gettimeofday system calls can be disabled by setting the PHP configuration directive mysqlnd_qc.time_statistics to 0

Key	Description
<code>eligible</code>	<code>TRUE</code> if query is cacheable otherwise <code>FALSE</code> .
<code>no_table</code>	<code>TRUE</code> if the query has generated a result set and at least one column from the result set has no table name set in its metadata. This is usually the case with queries which one probably do not want to cache such as <code>SELECT SLEEP(1)</code> . By default any such query will not be added to the cache. See also PHP configuration directive <code>mysqlnd_qc.cache_no_table</code> .
<code>was_added</code>	<code>TRUE</code> if the query result has been put into the cache, otherwise <code>FALSE</code> .
<code>was_already</code>	<code>TRUE</code> if the query result would have been added to the cache if it was not already in the cache (cache hit). Otherwise <code>FALSE</code> .

Examples

Example 7.330 `mysqlnd_qc_get_query_trace_log` example

```
mysqlnd_qc.collect_query_trace=1
```

```
<?php
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema", "port", "socket");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2)");
/* not cached */
$res = $mysqli->query("SELECT id FROM test WHERE id = 1");
var_dump($res->fetch_assoc());
$res->free();
/* cache put */
$res = $mysqli->query("/*" . MYSQLND_QC_ENABLE_SWITCH . "*/" . "SELECT id FROM test WHERE id = 2");
var_dump($res->fetch_assoc());
$res->free();
/* cache hit */
$res = $mysqli->query("/*" . MYSQLND_QC_ENABLE_SWITCH . "*/" . "SELECT id FROM test WHERE id = 2");
var_dump($res->fetch_assoc());
$res->free();
var_dump(mysqlnd_qc_get_query_trace_log());
?>
```

The above examples will output:

```
array(1) {
  ["id"]=>
  string(1) "1"
}
array(1) {
  ["id"]=>
  string(1) "2"
}
array(1) {
  ["id"]=>
  string(1) "2"
}
array(6) {
  [0]=>
  array(8) {
    ["query"]=>
    string(25) "DROP TABLE IF EXISTS test"
    ["origin"]=>
    string(102) "#0 qc.php(4): mysqli->query('DROP TABLE IF E...')"
#1 {main}
    ["run_time"]=>
```

```

int(0)
["store_time"]=>
int(0)
["eligible_for_caching"]=>
bool(false)
["no_table"]=>
bool(false)
["was_added"]=>
bool(false)
["was_already_in_cache"]=>
bool(false)
}
[1]=>
array(8) {
  ["query"]=>
  string(25) "CREATE TABLE test(id INT)"
  ["origin"]=>
  string(102) "#0 qc.php(5): mysqli->query('CREATE TABLE te...')"
#1 {main}"
  ["run_time"]=>
  int(0)
  ["store_time"]=>
  int(0)
  ["eligible_for_caching"]=>
  bool(false)
  ["no_table"]=>
  bool(false)
  ["was_added"]=>
  bool(false)
  ["was_already_in_cache"]=>
  bool(false)
}
[2]=>
array(8) {
  ["query"]=>
  string(36) "INSERT INTO test(id) VALUES (1), (2)"
  ["origin"]=>
  string(102) "#0 qc.php(6): mysqli->query('INSERT INTO tes...')"
#1 {main}"
  ["run_time"]=>
  int(0)
  ["store_time"]=>
  int(0)
  ["eligible_for_caching"]=>
  bool(false)
  ["no_table"]=>
  bool(false)
  ["was_added"]=>
  bool(false)
  ["was_already_in_cache"]=>
  bool(false)
}
[3]=>
array(8) {
  ["query"]=>
  string(32) "SELECT id FROM test WHERE id = 1"
  ["origin"]=>
  string(102) "#0 qc.php(9): mysqli->query('SELECT id FROM ...')"
#1 {main}"
  ["run_time"]=>
  int(0)
  ["store_time"]=>
  int(25)
  ["eligible_for_caching"]=>
  bool(false)
  ["no_table"]=>
  bool(false)
  ["was_added"]=>
  bool(false)
  ["was_already_in_cache"]=>
  bool(false)
}

```

```
[ 4 ]=>
array(8) {
    [ "query" ]=>
    string(41) /*qc=on*/SELECT id FROM test WHERE id = 2"
    [ "origin" ]=>
    string(103) "#0 qc.php(14): mysqli->query('/*qc=on*/SELECT...')"
#1 {main}"
    [ "run_time" ]=>
    int(311)
    [ "store_time" ]=>
    int(13)
    [ "eligible_for_caching" ]=>
    bool(true)
    [ "no_table" ]=>
    bool(false)
    [ "was_added" ]=>
    bool(true)
    [ "was_already_in_cache" ]=>
    bool(false)
}
[ 5 ]=>
array(8) {
    [ "query" ]=>
    string(41) /*qc=on*/SELECT id FROM test WHERE id = 2"
    [ "origin" ]=>
    string(103) "#0 qc.php(19): mysqli->query('/*qc=on*/SELECT...')"
#1 {main}"
    [ "run_time" ]=>
    int(13)
    [ "store_time" ]=>
    int(8)
    [ "eligible_for_caching" ]=>
    bool(true)
    [ "no_table" ]=>
    bool(false)
    [ "was_added" ]=>
    bool(false)
    [ "was_already_in_cache" ]=>
    bool(true)
}
}
```

See Also

[Runtime configuration](#)
[mysqlnd_qc.collect_query_trace](#)
[mysqlnd_qc.query_trace_bt_depth](#)
[mysqlnd_qc.time_statistics](#)
[mysqlnd_qc.cache_no_table](#)
[mysqlnd_qc_get_normalized_query_trace_log](#)

7.8.7.7 mysqlnd_qc_set_cache_condition

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- [mysqlnd_qc_set_cache_condition](#)

Set conditions for automatic caching

Description

```
bool mysqlnd_qc_set_cache_condition(
    int condition_type,
    mixed condition,
    mixed condition_option);
```

Sets a condition for automatic caching of statements which do not contain the necessary SQL hints to enable caching of them.

Parameters

<i>condition_type</i>	Type of the condition. The only allowed value is <code>MYSQLND_QC_CONDITION_META_SCHEMA_PATTERN</code> .
<i>condition</i>	Parameter for the condition set with <code>condition_type</code> . Parameter type and structure depend on <code>condition_type</code> If <code>condition_type</code> equals <code>MYSQLND_QC_CONDITION_META_SCHEMA_PATTERN</code> <code>condition</code> must be a string. The string sets a pattern. Statements are cached if table and database meta data entry of their result sets match the pattern. The pattern is checked for a match with the <code>db</code> and <code>org_table</code> meta data entries provided by the underlying MySQL client server library. Please, check the MySQL Reference manual for details about the two entries. The <code>db</code> and <code>org_table</code> values are concatenated with a dot (.) before matched against <code>condition</code> . Pattern matching supports the wildcards <code>%</code> and <code>_</code> . The wildcard <code>%</code> will match one or many arbitrary characters. <code>_</code> will match one arbitrary character. The escape symbol is backslash.
<i>condition_option</i>	Option for <code>condition</code> . Type and structure depend on <code>condition_type</code> . If <code>condition_type</code> equals <code>MYSQLND_QC_CONDITION_META_SCHEMA_PATTERN</code> <code>condition_options</code> is the TTL to be used.

Examples

Example 7.331 `mysqlnd_qc_set_cache_condition` example

```
<?php
/* Cache all accesses to tables with the name "new%" in schema/database "db_example" for 1 second */
if (!mysqlnd_qc_set_cache_condition(MYSQLND_QC_CONDITION_META_SCHEMA_PATTERN, "db_example.new%", 1)) {
    die("Failed to set cache condition!");
}
$mysqli = new mysqli("host", "user", "password", "db_example", "port");
/* cached although no SQL hint given */
$mysqli->query("SELECT id, title FROM news");
$pdo_mysql = new PDO("mysql:host=host;dbname=db_example;port=port", "user", "password");
/* not cached: no SQL hint, no pattern match */
$pdo_mysql->query("SELECT id, title FROM latest_news");
/* cached: TTL 1 second, pattern match */
$pdo_mysql->query("SELECT id, title FROM news");
?>
```

Return Values

Returns TRUE on success or FALSE on FAILURE.

See Also

[Quickstart: pattern based caching](#)

7.8.7.8 `mysqlnd_qc_set_is_select`

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- `mysqlnd_qc_set_is_select`

Installs a callback which decides whether a statement is cached

Description

```
mixed mysqlnd_qc_set_is_select(
    string callback);
```

Installs a callback which decides whether a statement is cached.

There are several ways of hinting PELC/mysqlnd_qc to cache a query. By default, PECL/mysqlnd_qc attempts to cache a if caching of all statements is enabled or the query string begins with a certain SQL hint. The plugin internally calls a function named `is_select()` to find out. This internal function can be replaced with a user-defined callback. Then, the user-defined callback is responsible to decide whether the plugin attempts to cache a statement. Because the internal function is replaced with the callback, the callback gains full control. The callback is free to ignore the configuration setting `mysqlnd_qc.cache_by_default` and SQL hints.

The callback is invoked for every statement inspected by the plugin. It is given the statements string as a parameter. The callback returns `FALSE` if the statement shall not be cached. It returns `TRUE` to make the plugin attempt to cache the statements result set, if any. A so-created cache entry is given the default TTL set with the PHP configuration directive `mysqlnd_qc.ttl`. If a different TTL shall be used, the callback returns a numeric value to be used as the TTL.

The internal `is_select` function is part of the internal cache storage handler interface. Thus, a user-defined storage handler offers the same capabilities.

Parameters

This function has no parameters.

Return Values

Returns `TRUE` on success or `FALSE` on failure.

Examples

Example 7.332 `mysqlnd_qc_set_is_select` example

```
<?php
/* callback which decides if query is cached */
function is_select($query) {
    static $patterns = array(
        /* true - use default from mysqlnd_qc.ttl */
        "@SELECT\s+.*\s+FROM\s+test@ismU" => true,
        /* 3 - use TTL = 3 seconds */
        "@SELECT\s+.*\s+FROM\s+news@ismU" => 3
    );
    /* check if query does match pattern */
    foreach ($patterns as $pattern => $ttl) {
        if (preg_match($pattern, $query)) {
            printf("is_select(%45s): cache\n", $query);
            return $ttl;
        }
    }
    printf("is_select(%45s): do not cache\n", $query);
    return false;
}
mysqlnd_qc_set_is_select("is_select");
/* Connect, create and populate test table */
$mysqli = new mysqli("host", "user", "password", "schema");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1), (2), (3)");
/* cache put */
$mysqli->query("SELECT id FROM test WHERE id = 1");
/* cache hit */
$mysqli->query("SELECT id FROM test WHERE id = 1");
/* cache put */
$mysqli->query("SELECT * FROM test");
```

```
?>
```

The above examples will output:

```
is_select(          DROP TABLE IF EXISTS test): do not cache
is_select(          CREATE TABLE test(id INT)): do not cache
is_select(  INSERT INTO test(id) VALUES (1), (2), (3)): do not cache
is_select(    SELECT id FROM test WHERE id = 1): cache
is_select(    SELECT id FROM test WHERE id = 1): cache
is_select(          SELECT * FROM test): cache
```

See Also

[Runtime configuration](#)

[mysqlnd_qc_ttl](#)

[mysqlnd_qc.cache_by_default](#)

[mysqlnd_qc_set_user_handlers](#)

7.8.7.9 mysqlnd_qc_set_storage_handler

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- [mysqlnd_qc_set_storage_handler](#)

Change current storage handler

Description

```
bool mysqlnd_qc_set_storage_handler(
    string handler);
```

Sets the storage handler used by the query cache. A list of available storage handler can be obtained from [mysqlnd_qc_get_available_handlers](#). Which storage are available depends on the compile time configuration of the query cache plugin. The [default](#) storage handler is always available. All other storage handler must be enabled explicitly when building the extension.

Parameters

handler

Handler can be of type string representing the name of a built-in storage handler or an object of type [mysqlnd_qc_handler_default](#). The names of the built-in storage handler are [default](#), [APC](#), [MEMCACHE](#), [sqlite](#).

Return Values

Returns [TRUE](#) on success or [FALSE](#) on failure.

If changing the storage handler fails a catchable fatal error will be thrown. The query cache cannot operate if the previous storage handler has been shutdown but no new storage handler has been installed.

Examples

Example 7.333 mysqlnd_qc_set_storage_handler example

The example shows the output from the built-in default storage handler. Other storage handler may report different data.

```
<?php
var_dump(mysqlnd_qc_set_storage_handler("memcache"));
```

```

if (true === mysqlnd_qc_set_storage_handler("default"))
    printf("Default storage handler activated");
/* Catchable fatal error */
var_dump(mysqlnd_qc_set_storage_handler("unknown"));
?>

```

The above examples will output:

```

bool(true)
Default storage handler activated
Catchable fatal error: mysqlnd_qc_set_storage_handler(): Unknown handler 'unknown' in (file) on line (line)

```

See Also

[Installation](#)

[mysqlnd_qc_get_available_handlers](#)

7.8.7.10 [mysqlnd_qc_set_user_handlers](#)

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- [mysqlnd_qc_set_user_handlers](#)

Sets the callback functions for a user-defined procedural storage handler

Description

```

bool mysqlnd_qc_set_user_handlers(
    string get_hash,
    string find_query_in_cache,
    string return_to_cache,
    string add_query_to_cache_if_not_exists,
    string query_is_select,
    string update_query_run_time_stats,
    string get_stats,
    string clear_cache);

```

Sets the callback functions for a user-defined procedural storage handler.

Parameters

<code>get_hash</code>	Name of the user function implementing the storage handler <code>get_hash</code> functionality.
<code>find_query_in_cache</code>	Name of the user function implementing the storage handler <code>find_in_cache</code> functionality.
<code>return_to_cache</code>	Name of the user function implementing the storage handler <code>return_to_cache</code> functionality.
<code>add_query_to_cache_if_not_exists</code>	Name of the user function implementing the storage handler <code>add_query_to_cache_if_not_exists</code> functionality.
<code>query_is_select</code>	Name of the user function implementing the storage handler <code>query_is_select</code> functionality.
<code>update_query_run_time_stats</code>	Name of the user function implementing the storage handler <code>update_query_run_time_stats</code> functionality.
<code>get_stats</code>	Name of the user function implementing the storage handler <code>get_stats</code> functionality.

<code>clear_cache</code>	Name of the user function implementing the storage handler <code>clear_cache</code> functionality.
--------------------------	--

Return Values

Returns TRUE on success or FALSE on FAILURE.

See Also

[Procedural user-defined storage handler example](#)

7.8.8 Change History

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This change history is a high level summary of selected changes that may impact applications and/or break backwards compatibility.

See also the [CHANGES](#) file in the source distribution for a complete list of changes.

7.8.8.1 PECL/mysqlnd_qc 1.2 series

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1.2.0 - alpha

- Release date: 03/2013
- Motto/theme: PHP 5.5 compatibility

Feature changes

- Update build for PHP 5.5 (Credits: Remi Collet)
- APC storage handler update
 - Fix build for APC 3.1.13-beta and trunk
- Introduced `MYSQLND_QC_VERSION` and `MYSQLND_QC_VERSION_ID`.

7.8.8.2 PECL/mysqlnd_qc 1.1 series

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1.1.0 - stable

- Release date: 04/2012
- Motto/theme: PHP 5.4 compatibility, schema pattern based caching and mysqlnd_ms support

1.1.0 - beta

- Release date: 04/2012
- Motto/theme: PHP 5.4 compatibility, schema pattern based caching and mysqlnd_ms support

1.1.0 - alpha

- Release date: 04/2012
- Motto/theme: PHP 5.4 compatibility, schema pattern based caching and mysqlnd_ms support

Feature changes

- APC storage handler update
 - Fix build for APC 3.1.9+
 - Note: Use of the APC storage handler is currently not recommended due to stability issues of APC itself.
- New PHP configuration directives
 - `mysqlnd qc.collect_statistics_log_file`. Aggregated cache statistics log file written after every 10th request served by the PHP process.
 - `mysqlnd qc.ignore_sql_comments`. Control whether SQL comments are ignored for cache key hash generation.
- New constants and SQL hints
 - `MYSQLND_QC_SERVER_ID_SWITCH` allows grouping of cache entries from different physical connections. This is needed by PECL/mysqlnd_ms.
 - `MYSQLND_QC_CONDITION_META_SCHEMA_PATTERN` to be used with `mysqlnd qc_set_cache_condition`.
- New function `mysqlnd qc_set_cache_condition` for built-in schema pattern based caching. Likely to support a wider range of conditions in the future.
- Report `valid_until` timestamp for cache entries of the default handler through `mysqlnd qc_get_cache_info`.
- Include charset number for cache entry hashing. This should prevent serving result sets which have the wrong charset.

API change: `get_hash_key` expects new "charsetnr" (int) parameter after "port".
- API change: changing `is_select()` signature from `bool is_select()` to mixed `is_select()`. Mixed can be either boolean or array(`long ttl, string server_id`). This is needed by PECL/mysqlnd_ms.

Other

- Support acting as a cache backend for [PECL/mysqlnd_ms](#) 1.3.0-beta or later to transparently replace MySQL Replication slave reads with cache accesses, if the user explicitly allows.

Bug fixes

- Fixed Bug #59959 (config.m4, wrong library - 64bit memcached handler builds) (Credits: Remi Collet)

7.8.8.3 PECL/mysqlnd_qc 1.0 series

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1.0.1-stable

- Release date: 12/2010
- Motto/theme: Prepared statement support

Added support for Prepared statements and unbuffered queries.

1.0.0-beta

- Release date: 07/2010

- Motto/theme: TTL-based cache with various storage options (Memcache, APC, SQLite, user-defined)

Initial public release of the transparent TTL-based query result cache. Flexible storage of cached results. Various storage media supported.

7.9 Mysqld user handler plugin

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The mysqld user handler plugin ([mysqld_uh](#)) allows users to set hooks for most internal calls of the MySQL native driver for PHP ([mysqld](#)). Mysqld and its plugins, including PECL/mysqld_uh, operate on a layer beneath the PHP MySQL extensions. A mysqld plugin can be considered as a proxy between the PHP MySQL extensions and the MySQL server as part of the PHP executable on the client-side. Because the plugins operates on their own layer below the PHP MySQL extensions, they can monitor and change application actions without requiring application changes. If the PHP MySQL extensions ([mysqli](#), [mysql](#), [PDO_MYSQL](#)) are compiled to use [mysqld](#) this can be used for:

- Monitoring
 - Queries executed by any of the PHP MySQL extensions
 - Prepared statements executing by any of the PHP MySQL extensions
- Auditing
 - Detection of database usage
 - SQL injection protection using black and white lists
- Assorted
 - Load Balancing connections

The MySQL native driver for PHP ([mysqld](#)) features an internal plugin C API. C plugins, such as the mysqld user handler plugin, can extend the functionality of [mysqld](#). PECL/mysqld_uh makes parts of the internal plugin C API available to the PHP user for plugin development with PHP.

Status

The mysqld user handler plugin is in alpha status. Take appropriate care before using it in production environments.

7.9.1 Security considerations

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PECL/mysqld_uh gives users access to MySQL user names, MySQL password used by any of the PHP MySQL extensions to connect to MySQL. It allows monitoring of all queries and prepared statements exposing the statement string to the user. Therefore, the extension should be installed with care. The [PHP_INI_SYSTEM](#) configuration setting [mysqld_uh.enable](#) can be used to prevent users from hooking mysqld calls.

Code obfuscators and similar technologies are not suitable to prevent monitoring of mysqld library activities if PECL/mysqld_uh is made available and the user can install a proxy, for example, using [auto_prepend_file](#).

7.9.2 Documentation note

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Many of the `mysqlnd_uh` functions are briefly described because the `mysqli` extension is a thin abstraction layer on top of the MySQL C API that the `mysqlnd` library provides. Therefore, the corresponding `mysqli` documentation (along with the MySQL reference manual) can be consulted to receive more information about a particular function.

7.9.3 On the name

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The shortcut `mysqlnd_uh` stands for `mysqlnd user handler`, and has been the name since early development.

7.9.4 Quickstart and Examples

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The `mysqlnd` user handler plugin can be understood as a client-side proxy for all PHP MySQL extensions (`mysqli`, `mysql`, `PDO_MYSQL`), if they are compiled to use the `mysqlnd` library. The extensions use the `mysqlnd` library internally, at the C level, to communicate with the MySQL server. PECL/`mysqlnd_uh` allows it to hook many `mysqlnd` calls. Therefore, most activities of the PHP MySQL extensions can be monitored.

Because monitoring happens at the level of the library, at a layer below the application, it is possible to monitor applications without changing them.

On the C level, the `mysqlnd` library is structured in modules or classes. The extension hooks almost all methods of the `mysqlnd` internal `connection` class and exposes them through the user space class `MysqlndUhConnection`. Some few methods of the `mysqlnd` internal `statement` class are made available to the PHP user with the class `MysqlndUhPreparedStatement`. By subclassing the classes `MysqlndUhConnection` and `MysqlndUhPreparedStatement` users get access to `mysqlnd` internal function calls.

Note

The internal `mysqlnd` function calls are not designed to be exposed to the PHP user. Manipulating their activities may cause PHP to crash or leak memory. Often, this is not considered a bug. Please, keep in mind that you are accessing C library functions through PHP which are expected to take certain actions, which you may not be able to emulate in user space. Therefore, it is strongly recommended to always call the parent method implementation when subclassing `MysqlndUhConnection` or `MysqlndUhPreparedStatement`. To prevent the worst case, the extension performs some sanity checks. Please, see also the [Mysqlnd_uh Configure Options](#).

7.9.4.1 Setup

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The plugin is implemented as a PHP extension. See the [installation instructions](#) to install the PECL/`mysqlnd_uh` extension. Then, load the extension into PHP and activate the plugin in the PHP configuration file using the PHP configuration directive named `mysqlnd_uh.enable`. The below example shows the default settings of the extension.

Example 7.334 Enabling the plugin (php.ini)

```
mysqlnd_uh.enable=1
mysqlnd_uh.report_wrong_types=1
```

7.9.4.2 How it works

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This describes the background and inner workings of the `mysqlnd_uh` extension.

Two classes are provided by the extension: `MysqlndUhConnection` and `MysqlndUhPreparedStatement`. `MysqlndUhConnection` lets you access almost all methods of the `mysqlnd` internal `connection` class. The latter exposes some selected methods of the `mysqlnd` internal `statement` class. For example, `MysqlndUhConnection::connect` maps to the `mysqlnd` library C function `mysqlnd_conn_connect`.

As a `mysqlnd` plugin, the PECL/`mysqlnd_uh` extension replaces `mysqlnd` library C functions with its own functions. Whenever a PHP MySQL extension compiled to use `mysqlnd` calls a `mysqlnd` function, the functions installed by the plugin are executed instead of the original `mysqlnd` ones. For example, `mysqli_connect` invokes `mysqlnd_conn_connect`, so the `connect` function installed by PECL/`mysqlnd_uh` will be called. The functions installed by PECL/`mysqlnd_uh` are the methods of the built-in classes.

The built-in PHP classes and their methods do nothing but call their `mysqlnd` C library counterparts, to behave exactly like the original `mysqlnd` function they replace. The code below illustrates in pseudo-code what the extension does.

Example 7.335 Pseudo-code: what a built-in class does

```
class MysqlndUhConnection {
    public function connect((&$conn, $host, $user, $passwd, $db, $port, $socket, $mysql_flags) {
        MYSQLND* c_mysqlnd_connection = convert_from_php_to_c($conn);
        ...
        return call_c_function(mysqlnd_conn_connect(c_mysqlnd_connection, ...));
    }
}
```

The build-in classes behave like a transparent proxy. It is possible for you to replace the proxy with your own. This is done by subclassing `MysqlndUhConnection` or `MysqlndUhPreparedStatement` to extend the functionality of the proxy, followed by registering a new proxy object. Proxy objects are installed by `mysqlnd_uh_set_connection_proxy` and `mysqlnd_uh_set_statement_proxy`.

Example 7.336 Installing a proxy

```
<?php
class proxy extends MysqlndUhConnection {
    public function connect($res, $host, $user, $passwd, $db, $port, $socket, $mysql_flags) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::__connect($res, $host, $user, $passwd, $db, $port, $socket, $mysql_flags);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
?>
```

The above example will output:

```
proxy::__connect(array (
  0 => NULL,
  1 => 'localhost',
  2 => 'root',
  3 => '',
  4 => null,
  5 => null,
  6 => null,
  7 => null,
```

```

4 => 'test',
5 => 3306,
6 => NULL,
7 => 131072,
))
proxy::connect returns true

```

7.9.4.3 Installing a proxy

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The extension provides two built-in classes: `MysqlndUhConnection` and `MysqlndUhPreparedStatement`. The classes are used for hooking `mysqlnd` library calls. Their methods correspond to `mysqlnd` internal functions. By default they act like a transparent proxy and do nothing but call their `mysqlnd` counterparts. By subclassing the classes you can install your own proxy to monitor `mysqlnd`.

See also the [How it works](#) guide to learn about the inner workings of this extension.

Connection proxies are objects of the type `MysqlndUhConnection`. Connection proxy objects are installed by `mysqlnd_uh_set_connection_proxy`. If you install the built-in class `MysqlndUhConnection` as a proxy, nothing happens. It behaves like a transparent proxy.

Example 7.337 Proxy registration, mysqlnd_uh.enable=1

```

<?php
mysqlnd_uh_set_connection_proxy(new MysqlndUhConnection());
$mysqli = new mysqli("localhost", "root", "", "test");
?>

```

The `PHP_INI_SYSTEM` configuration setting `mysqlnd_uh.enable` controls whether a proxy may be set. If disabled, the extension will throw errors of type `E_WARNING`

Example 7.338 Proxy installation disabled

```
mysqlnd_uh.enable=0
```

```

<?php
mysqlnd_uh_set_connection_proxy(new MysqlndUhConnection());
$mysqli = new mysqli("localhost", "root", "", "test");
?>

```

The above example will output:

```

PHP Warning:  MysqlndUhConnection::__construct(): (Mysqlnd User Handler) The plugin has been disabled by se
PHP Warning:  mysqlnd_uh_set_connection_proxy(): (Mysqlnd User Handler) The plugin has been disabled by se

```

To monitor `mysqlnd`, you have to write your own proxy object subclassing `MysqlndUhConnection`. Please, see the function reference for a the list of methods that can be subclassed. Alternatively, you can use reflection to inspect the built-in `MysqlndUhConnection`.

Create a new class `proxy`. Derive it from the built-in class `MysqlndUhConnection`. Replace the `MysqlndUhConnection::__connect` method. Print out the host parameter value passed to the

method. Make sure that you call the parent implementation of the `connect` method. Failing to do so may give unexpected and undesired results, including memory leaks and crashes.

Register your proxy and open three connections using the PHP MySQL extensions `mysqli`, `mysql`, `PDO_MYSQL`. If the extensions have been compiled to use the `mysqlnd` library, the `proxy::connect` method will be called three times, once for each connection opened.

Example 7.339 Connection proxy

```
<?php
class proxy extends MysqlndUhConnection {
    public function connect($res, $host, $user, $passwd, $db, $port, $socket, $mysql_flags) {
        printf("Connection opened to '%s'\n", $host);
        /* Always call the parent implementation! */
        return parent::connect($res, $host, $user, $passwd, $db, $port, $socket, $mysql_flags);
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysql = mysql_connect("localhost", "root", "");
$pdo = new PDO("mysql:host=localhost;dbname=test", "root", "");
?>
```

The above example will output:

```
Connection opened to 'localhost'
Connection opened to 'localhost'
Connection opened to 'localhost'
```

The use of prepared statement proxies follows the same pattern: create a proxy object of the type `MysqlndUhPreparedStatement` and install the proxy using `mysqlnd_uh_set_statement_proxy`.

Example 7.340 Prepared statement proxy

```
<?php
class stmt_proxy extends MysqlndUhPreparedStatement {
    public function prepare($res, $query) {
        printf("%s(%s)\n", __METHOD__, $query);
        return parent::prepare($res, $query);
    }
}
mysqlnd_uh_set_statement_proxy(new stmt_proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$stmt = $mysqli->prepare("SELECT 'mysqlnd hacking made easy' AS _msg FROM DUAL");
?>
```

The above example will output:

```
stmt_proxy::prepare(SELECT 'mysqlnd hacking made easy' AS _msg FROM DUAL)
```

7.9.4.4 Basic query monitoring

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Basic monitoring of a query statement is easy with PECL/mysqlnd_uh. Combined with `debug_print_backtrace` it can become a powerful tool, for example, to find the origin of certain

statement. This may be desired when searching for slow queries but also after database refactoring to find code still accessing deprecated databases or tables. The latter may be a complicated matter to do otherwise, especially if the application uses auto-generated queries.

Example 7.341 Basic Monitoring

```
<?php
class conn_proxy extends MysqlndUhConnection {
    public function query($res, $query) {
        debug_print_backtrace();
        return parent::query($res, $query);
    }
}
class stmt_proxy extends MysqlndUhPreparedStatement {
    public function prepare($res, $query) {
        debug_print_backtrace();
        return parent::prepare($res, $query);
    }
}
mysqlnd_uh_set_connection_proxy(new conn_proxy());
mysqlnd_uh_set_statement_proxy(new stmt_proxy());
printf("Proxies installed...\n");
$pdo = new PDO("mysql:host=localhost;dbname=test", "root", "");
var_dump($pdo->query("SELECT 1 AS _one FROM DUAL")->fetchAll(PDO::FETCH_ASSOC));
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->prepare("SELECT 1 AS _two FROM DUAL");
?>
```

The above example will output:

```
#0  conn_proxy->query(Resource id #19, SELECT 1 AS _one FROM DUAL)
#1  PDO->query(SELECT 1 AS _one FROM DUAL) called at [example.php:19]
array(1) {
  [0]=>
  array(1) {
    [ "_one" ]=>
    string(1) "1"
  }
}
#0  stmt_proxy->prepare(Resource id #753, SELECT 1 AS _two FROM DUAL)
#1  mysqli->prepare(SELECT 1 AS _two FROM DUAL) called at [example.php:22]
```

For basic query monitoring you should install a connection and a prepared statement proxy. The connection proxy should subclass `MysqlndUhConnection::query`. All database queries not using native prepared statements will call this method. In the example the `query` function is invoked by a PDO call. By default, `PDO_MySQL` is using prepared statement emulation.

All native prepared statements are prepared with the `prepare` method of `mysqlnd` exported through `MysqlndUhPreparedStatement::prepare`. Subclass `MysqlndUhPreparedStatement` and overwrite `prepare` for native prepared statement monitoring.

7.9.5 Installing/Configuring

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7.9.5.1 Requirements

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[PHP 5.3.3](#) or later. It is recommended to use [PHP 5.4.0](#) or later to get access to the latest mysqlnd features.

The `mysqlnd_uh` user handler plugin supports all PHP applications and all available PHP MySQL extensions (`mysqli`, `mysql`, `PDO_MYSQL`). The PHP MySQL extension must be configured to use `mysqlnd` in order to be able to use the `mysqlnd_uh` plugin for `mysqlnd`.

The alpha versions makes use of some `mysqli` features. You must enable `mysqli` to compile the plugin. This requirement may be removed in the future. Note, that this requirement does not restrict you to use the plugin only with `mysqli`. You can use the plugin to monitor `mysql`, `mysqli` and `PDO_MYSQL`.

7.9.5.2 Installation

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Information for installing this PECL extension may be found in the manual chapter titled [Installation of PECL extensions](#). Additional information such as new releases, downloads, source files, maintainer information, and a CHANGELOG, can be located here: <http://pecl.php.net/package/mysqlnd-uh>

PECL/mysqlnd_uh is currently not available on Windows. The source code of the extension makes use of `C99` constructs not allowed with PHP Windows builds.

7.9.5.3 Runtime Configuration

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The behaviour of these functions is affected by settings in `php.ini`.

Table 7.44 Mysqlnd_uh Configure Options

Name	Default	Changeable	Changelog
<code>mysqlnd_uh.enable</code>	1	PHP_INI_SYSTEM	
<code>mysqlnd_uh.report_wrong_types</code>	1	PHP_INI_ALL	

Here's a short explanation of the configuration directives.

`mysqlnd_uh.enable` integer Enables or disables the plugin. If set to disabled, the extension will not allow users to plug into `mysqlnd` to hook `mysqlnd` calls.

`mysqlnd_uh.report_wrong_types` integer Whether to report wrong return value types of user hooks as `E_WARNING` level errors. This is recommended for detecting errors.

7.9.5.4 Resource Types

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This extension has no resource types defined.

7.9.6 Predefined Constants

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The constants below are defined by this extension, and will only be available when the extension has either been compiled into PHP or dynamically loaded at runtime.

Most of the constants refer to details of the MySQL Client Server Protocol. Please, refer to the MySQL reference manual to learn about their meaning. To avoid content duplication, only short descriptions are given.

`MysqlndUhConnection::simpleCommand` related

The following constants can be used to detect what command is to be send through `MysqlndUhConnection::simpleCommand`.

MySQLND_UH_MYSQLND_COM_SLEEP MySQL Client Server protocol command: COM_SLEEP.
(integer)

MySQLND_UH_MYSQLND_COM_QUIT MySQL Client Server protocol command: COM_QUIT.
(integer)

MySQLND_UH_MYSQLND_COM_INIT MySQL Client Server protocol command: COM_INIT_DB.
(integer)

MySQLND_UH_MYSQLND_COM_QUERY MySQL Client Server protocol command: COM_QUERY.
(integer)

MySQLND_UH_MYSQLND_COM_FIELD_LIST MySQL Client Server protocol command: COM_FIELD_LIST.
(integer)

MySQLND_UH_MYSQLND_COM_CREATE_DB MySQL Client Server protocol command: COM_CREATE_DB.
(integer)

MySQLND_UH_MYSQLND_COM_DROP_DB MySQL Client Server protocol command: COM_DROP_DB.
(integer)

MySQLND_UH_MYSQLND_COM_REFRESH MySQL Client Server protocol command: COM_REFRESH.
(integer)

MySQLND_UH_MYSQLND_COM_SHUTDOWN MySQL Client Server protocol command: COM_SHUTDOWN.
(integer)

MySQLND_UH_MYSQLND_COM_STATISTICS MySQL Client Server protocol command: COM_STATISTICS.
(integer)

MySQLND_UH_MYSQLND_COM_PROCESS_INFO MySQL Client Server protocol command: COM_PROCESS_INFO.
(integer)

MySQLND_UH_MYSQLND_COM_CONNECT MySQL Client Server protocol command: COM_CONNECT.
(integer)

MySQLND_UH_MYSQLND_COM_PROCESS_KILL MySQL Client Server protocol command: COM_PROCESS_KILL.
(integer)

MySQLND_UH_MYSQLND_COM_DEBUG MySQL Client Server protocol command: COM_DEBUG.
(integer)

MySQLND_UH_MYSQLND_COM_PING MySQL Client Server protocol command: COM_PING.
(integer)

MySQLND_UH_MYSQLND_COM_TIME MySQL Client Server protocol command: COM_TIME.
(integer)

MySQLND_UH_MYSQLND_COM_DELAYED_INSERT MySQL Client Server protocol command:
COM_DELAYED_INSERT.

MySQLND_UH_MYSQLND_COM_CHANGE_USER MySQL Client Server protocol command: COM_CHANGE_USER.
(integer)

MySQLND_UH_MYSQLND_COM_BINLOG_DUMP MySQL Client Server protocol command: COM_BINLOG_DUMP.
(integer)

MySQLND_UH_MYSQLND_COM_TABLE_DUMP MySQL Client Server protocol command: COM_TABLE_DUMP.
(integer)

MySQLND_UH_MYSQLND_COM_CONNECT_OUT MySQL Client Server protocol command: COM_CONNECT_OUT.
(integer)

MySQLND_UH_MYSQLND_COM_REG	MySQL Client Server protocol command: COM_REGISTER_SLAVE.
MySQLND_UH_MYSQLND_COM_STM	MySQL Client Server protocol command: COM_STMT_PREPARE.
MySQLND_UH_MYSQLND_COM_STM	MySQL Client Server protocol command: COM_STMT_EXECUTE.
MySQLND_UH_MYSQLND_COM_STM	MySQL Client Server protocol command: COM_STMT_SEND_LONG_DATA.
MySQLND_UH_MYSQLND_COM_STM	MySQL Client Server protocol command: COM_STMT_CLOSE.
MySQLND_UH_MYSQLND_COM_STM	MySQL Client Server protocol command: COM_STMT_RESET.
MySQLND_UH_MYSQLND_COM_SET	MySQL Client Server protocol command: COM_SET_OPTION.
MySQLND_UH_MYSQLND_COM_STM	MySQL Client Server protocol command: COM_STMT_FETCH.
MySQLND_UH_MYSQLND_COM_DAEMON	MySQL Client Server protocol command: COM_DAEMON.
MySQLND_UH_MYSQLND_COM_END	MySQL Client Server protocol command: COM_END.
The following constants can be used to analyze the <code>ok_packet</code> argument of <code>MysqlndUhConnection::simpleCommand</code> .	
MySQLND_UH_MYSQLND_PROT_GREET	MySQL Client Server protocol packet: greeting.
MySQLND_UH_MYSQLND_PROT_AUTH	MySQL Client Server protocol packet: authentication.
MySQLND_UH_MYSQLND_PROT_OK	MySQL Client Server protocol packet: OK.
MySQLND_UH_MYSQLND_PROT_EOF	MySQL Client Server protocol packet: EOF.
MySQLND_UH_MYSQLND_PROT_COMMAND	MySQL Client Server protocol packet: command.
MySQLND_UH_MYSQLND_PROT_RESULTS	MySQL Client Server protocol packet: result set header.
MySQLND_UH_MYSQLND_PROT_RESULT	MySQL Client Server protocol packet: resultset field.
MySQLND_UH_MYSQLND_PROT_ROW	MySQL Client Server protocol packet: row.
MySQLND_UH_MYSQLND_PROT_STATS	MySQL Client Server protocol packet: stats.
MySQLND_UH_MYSQLND_PREPARE	MySQL Client Server protocol packet: prepare response.

`MYSQLND_UH_MYSQLND_CHG_USE` MySQL Client Server protocol packet: change user response.
(integer)

`MYSQLND_UH_MYSQLND_PROT_LIST` No practical meaning. Last entry marker of internal C data structure list.
(integer)

MysqlndUhConnection::close related

The following constants can be used to detect why a connection has been closed through `MysqlndUhConnection::close()`.

`MYSQLND_UH_MYSQLND_CLOSE_ECONNRESET` User has called mysqlnd to close the connection.
(integer)

`MYSQLND_UH_MYSQLND_CLOSE_IMPLICITLY` Implicitly closed, for example, during garbage connection.
(integer)

`MYSQLND_UH_MYSQLND_CLOSE_DUE_TO_CONNECTION_ERROR` Connection error.
(integer)

`MYSQLND_UH_MYSQLND_CLOSE_INNOCENT` No practical meaning. Last entry marker of internal C data structure list.
(integer)

MysqlndUhConnection::setServerOption() related

The following constants can be used to detect which option is set through `MysqlndUhConnection::setServerOption()`.

`MYSQLND_UH_SERVER_OPTION_MULTI_STATEMENT` Option: enables multi statement support.
(integer)

`MYSQLND_UH_SERVER_OPTION_MULTI_STATEMENT_DISABLE` Option: disables multi statement support.
(integer)

MysqlndUhConnection::setClientOption related

The following constants can be used to detect which option is set through `MysqlndUhConnection::setClientOption`.

`MYSQLND_UH_MYSQLND_OPTION_CONNECTION_TIMEOUT` Option: connection timeout.
(integer)

`MYSQLND_UH_MYSQLND_OPTION_COMPRESSED` Option: whether the MySQL compressed protocol is to be used.
(integer)

`MYSQLND_UH_MYSQLND_OPTION_NAMED_PIPE` Option: named pipe to use for connection (Windows).
(integer)

`MYSQLND_UH_MYSQLND_OPTION_INIT_COMMAND` Option: init command to execute upon connect.
(integer)

`MYSQLND_UH_MYSQLND_READ_DEFAULT_FILE` Option: MySQL server default file to read upon connect.
(integer)

`MYSQLND_UH_MYSQLND_READ_DEFAULT_GROUP` Option: MySQL server default file group to read upon connect.
(integer)

`MYSQLND_UH_MYSQLND_SET_CHARSET_DIR` Option: charset description files directory.
(integer)

`MYSQLND_UH_MYSQLND_SET_CHARSET_NAME` Option: charset name.
(integer)

`MYSQLND_UH_MYSQLND_OPT_LOCAL_INFILE` Option: Whether to allow `LOAD DATA LOCAL INFILE` use.
(integer)

`MYSQLND_UH_MYSQLND_OPT_PROTOCOL` Option: supported protocol version.
(integer)

`MYSQLND_UH_MYSQLND_SHARED_MEMORY_NAME` Option: shared memory base name for shared memory connections.
(integer)

`MYSQLND_UH_MYSQLND_OPT_READ_TIMEOUT` Option: connection read timeout.
(integer)

`MYSQLND_UH_MYSQLND_OPT_WRITE_TIMEOUT` Option: connection write timeout.
(integer)

`MYSQLND_UH_MYSQLND_OPT_USE_UNBUFFERED_RESULTS` Option: unbuffered result sets.
(integer)

`MYSQLND_UH_MYSQLND_OPT_USE_EMDEDDED_SERVER` Option: Embedded server related.
(integer)

`MYSQLND_UH_MYSQLND_OPT_USE_EMDEDDED_SERVER_DSN` Option: Embedded server related DSN
(integer)

`MYSQLND_UH_MYSQLND_OPT_GUEST_CONNECTION` Option: TODO CONNECTION
(integer)

`MYSQLND_UH_MYSQLND_SET_CLIENT_IP` Option: TODO IP
(integer)

`MYSQLND_UH_MYSQLND_SECURE_TODO` Option: TODO
(integer)

`MYSQLND_UH_MYSQLND_REPORT_OPTION` Option: Whether to report data truncation.
(integer)

`MYSQLND_UH_MYSQLND_OPT_RECONNECT` Option: Whether to reconnect automatically.
(integer)

`MYSQLND_UH_MYSQLND_OPT_SSL` Option: TODO SERVER_CERT
(integer)

`MYSQLND_UH_MYSQLND_OPT_NETWORK` Option: mysqlnd network buffer size for commands.
(integer)

`MYSQLND_UH_MYSQLND_OPT_NET_RECV_BUFFER_SIZE` Option: mysqlnd network buffer size for reading from the server.
(integer)

`MYSQLND_UH_MYSQLND_OPT_SSL_KEY` Option: SSL key.
(integer)

`MYSQLND_UH_MYSQLND_OPT_SSL_CERTIFICATE` Option: SSL certificate.
(integer)

`MYSQLND_UH_MYSQLND_OPT_SSL_CA` Option: SSL CA.
(integer)

`MYSQLND_UH_MYSQLND_OPT_SSL_CA_PATH` Option: Path to SSL CA.
(integer)

`MYSQLND_UH_MYSQLND_OPT_SSL_CIPHER` Option: SSL cipher.
(integer)

`MYSQLND_UH_MYSQLND_OPT_SSL` Option `SSL` passphrase.
(integer)

`MYSQLND_UH_SERVER_OPTION_PLUGIN_DIR` Option `server` plugin directory.
(integer)

`MYSQLND_UH_SERVER_OPTION_DEFAULT_AUTH` Option `default` authentication method.
(integer)

`MYSQLND_UH_SERVER_OPTION_SECURE_CLIENT_IP`
(integer)

`MYSQLND_UH_MYSQLND_OPT_MAX_PACKET_SIZE` Option `max_allowed_packet` maximum allowed packet size. Available as of [PHP 5.4.0](#).
(integer)

`MYSQLND_UH_MYSQLND_OPT_AUTHENTICATION` Option `TODO`. Available as of [PHP 5.4.0](#).
(integer)

`MYSQLND_UH_MYSQLND_OPT_INT_TYPE` Option `make_mysqld` make mysqld return integer and float columns as long even when using the MySQL Client Server text protocol. Only available with a custom build of mysqld.

Other

The plugins version number can be obtained using `MYSQLND_UH_VERSION` or `MYSQLND_UH_VERSION_ID`. `MYSQLND_UH_VERSION` is the string representation of the numerical version number `MYSQLND_UH_VERSION_ID`, which is an integer such as 10000. Developers can calculate the version number as follows.

Version (part)	Example
Major*10000	$1 * 10000 = 10000$
Minor*100	$0 * 100 = 0$
Patch	$0 = 0$
<code>MYSQLND_UH_VERSION_ID</code>	10000

`MYSQLND_UH_VERSION` (string) Plugin version string, for example, “1.0.0-alpha”.

`MYSQLND_UH_VERSION_ID` (integer) Plugin version number, for example, 10000.

7.9.7 The MysqldUhConnection class

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```
MysqldUhConnection {
MysqldUhConnection
    Methods

    public bool MysqldUhConnection::changeUser(
        mysqlnd_connection connection,
        string user,
        string password,
        string database,
        bool silent,
        int passwd_len);

    public string MysqldUhConnection::charsetName(
        mysqlnd_connection connection);

    public bool MysqldUhConnection::close()
```

```
mysqlnd_connection connection,
int close_type);

public bool MysqlndUhConnection::connect(
    mysqlnd_connection connection,
    string host,
    string use",
    string password,
    string database,
    int port,
    string socket,
    int mysql_flags);

public MysqlndUhConnection::__construct();

public bool MysqlndUhConnection::endPSession(
    mysqlnd_connection connection);

public string MysqlndUhConnection::escapeString(
    mysqlnd_connection connection,
    string escape_string);

public int MysqlndUhConnection::getAffectedRows(
    mysqlnd_connection connection);

public int MysqlndUhConnection::getErrorMessage(
    mysqlnd_connection connection);

public string MysqlndUhConnection::getLastError(
    mysqlnd_connection connection);

public int MysqlndUhConnection::getFieldCount(
    mysqlnd_connection connection);

public string MysqlndUhConnection::getHostInformation(
    mysqlnd_connection connection);

public int MysqlndUhConnection::getLastInsertId(
    mysqlnd_connection connection);

public void MysqlndUhConnection::getLastMessage(
    mysqlnd_connection connection);

public string MysqlndUhConnection::getProtocolInformation(
    mysqlnd_connection connection);

public string MysqlndUhConnection::getServerInformation(
    mysqlnd_connection connection);

public string MysqlndUhConnection::getServerStatistics(
    mysqlnd_connection connection);

public int MysqlndUhConnection::getServerVersion(
    mysqlnd_connection connection);

public string MysqlndUhConnection::getSqlstate(
    mysqlnd_connection connection);

public array MysqlndUhConnection::getStatistics(
    mysqlnd_connection connection);

public int MysqlndUhConnection::getThreadId(
    mysqlnd_connection connection);

public int MysqlndUhConnection::getWarningCount(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::init(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::killConnection(
    mysqlnd_connection connection,
    int pid);
```

```
public array MysqlndUhConnection::listFields(
    mysqlnd_connection connection,
    string table,
    string achtung_wild);

public void MysqlndUhConnection::listMethod(
    mysqlnd_connection connection,
    string query,
    string achtung_wild,
    string par1);

public bool MysqlndUhConnection::moreResults(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::nextResult(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::ping(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::query(
    mysqlnd_connection connection,
    string query);

public bool MysqlndUhConnection::queryReadResultSetHeader(
    mysqlnd_connection connection,
    mysqlnd_statement mysqlnd_stmt);

public bool MysqlndUhConnection::reapQuery(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::refreshServer(
    mysqlnd_connection connection,
    int options);

public bool MysqlndUhConnection::restartPSession(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::selectDb(
    mysqlnd_connection connection,
    string database);

public bool MysqlndUhConnection::sendClose(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::sendQuery(
    mysqlnd_connection connection,
    string query);

public bool MysqlndUhConnection::serverDumpDebugInformation(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::setAutocommit(
    mysqlnd_connection connection,
    int mode);

public bool MysqlndUhConnection::setCharset(
    mysqlnd_connection connection,
    string charset);

public bool MysqlndUhConnection::setClientOption(
    mysqlnd_connection connection,
    int option,
    int value);

public void MysqlndUhConnection::setServerOption(
    mysqlnd_connection connection,
    int option);

public void MysqlndUhConnection::shutdownServer(
    string MYSQLND_UH_RES_MYSQLND_NAME,
    string level);
```

```

public bool MysqlndUhConnection::simpleCommand(
    mysqlnd_connection connection,
    int command,
    string arg,
    int ok_packet,
    bool silent,
    bool ignore_upsert_status);

public bool MysqlndUhConnection::simpleCommandHandleResponse(
    mysqlnd_connection connection,
    int ok_packet,
    bool silent,
    int command,
    bool ignore_upsert_status);

public bool MysqlndUhConnection::sslSet(
    mysqlnd_connection connection,
    string key,
    string cert,
    string ca,
    string capath,
    string cipher);

public resource MysqlndUhConnection::stmtInit(
    mysqlnd_connection connection);

public resource MysqlndUhConnection::storeResult(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::txCommit(
    mysqlnd_connection connection);

public bool MysqlndUhConnection::txRollback(
    mysqlnd_connection connection);

public resource MysqlndUhConnection::useResult(
    mysqlnd_connection connection);

}

```

7.9.7.1 MysqlndUhConnection::changeUser

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- [MysqlndUhConnection::changeUser](#)

Changes the user of the specified mysqlnd database connection

Description

```

public bool MysqlndUhConnection::changeUser(
    mysqlnd_connection connection,
    string user,
    string password,
    string database,
    bool silent,
    int passwd_len);

```

Changes the user of the specified mysqlnd database connection

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
<i>user</i>	The MySQL user name.
<i>password</i>	The MySQL password.
<i>database</i>	The MySQL database to change to.

<code>silent</code>	Controls if mysqlnd is allowed to emit errors or not.
<code>passwd_len</code>	Length of the MySQL password.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.342 `MysqlndUhConnection::changeUser` example

```
<?php
class proxy extends MysqlndUhConnection {
    /* Hook mysqlnd's connection::change_user call */
    public function changeUser($res, $user, $passwd, $db, $silent, $passwd_len) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::changeUser($res, $user, $passwd, $db, $silent, $passwd_len);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
/* Install proxy/hooks to be used with all future mysqlnd connection */
mysqlnd_uh_set_connection_proxy(new proxy());
/* Create mysqli connection which is using the mysqlnd library */
$mysqli = new mysqli("localhost", "root", "", "test");
/* Example of a user API call which triggers the hooked mysqlnd call */
var_dump($mysqli->change_user("root", "bar", "test"));
?>
```

The above example will output:

```
proxy::changeUser(array (
  0 => NULL,
  1 => 'root',
  2 => 'bar',
  3 => 'test',
  4 => false,
  5 => 3,
))
proxy::changeUser returns false
bool(false)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_change_user](#)

7.9.7.2 `MysqlndUhConnection::charsetName`

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- `MysqlndUhConnection::charsetName`

Returns the default character set for the database connection

Description

```
public string MysqlndUhConnection::charsetName(
    mysqlnd_connection connection);
```

Returns the default character set for the database connection.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

The default character set.

Examples**Example 7.343 MysqlndUhConnection::charsetName example**

```
<?php
class proxy extends MysqlndUhConnection {
    public function charsetName($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::charsetName($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump(mysqli_character_set_name($mysqli));
?>
```

The above example will output:

```
proxy::charsetName(array (
  0 => NULL,
))
proxy::charsetName returns 'latin1'
string(6) "latin1"
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_character_set_name](#)

7.9.7.3 MysqlndUhConnection::close

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- [MysqlndUhConnection::close](#)

Closes a previously opened database connection

Description

```
public bool MysqlndUhConnection::close(
    mysqlnd_connection connection,
    int close_type);
```

Closes a previously opened database connection.

Note

Failing to call the parent implementation may cause memory leaks or crash PHP. This is not considered a bug. Please, keep in mind that the [mysqlnd](#) library functions have never been designed to be exposed to the user space.

Parameters

connection

The connection to be closed. Do not modify!

close_type

Why the connection is to be closed. The value of *close_type* is one of `MYSQLND_UH_MYSQLND_CLOSE_EXPLICIT`, `MYSQLND_UH_MYSQLND_CLOSE_IMPLICIT`, `MYSQLND_UH_MYSQLND_CLOSE_DISCONNECTED` or `MYSQLND_UH_MYSQLND_CLOSE_LAST`. The latter should never be seen, unless the default behaviour of the `mysqlnd` library has been changed by a plugin.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.344 `MysqlndUhConnection::close` example

```
<?php
function close_type_to_string($close_type) {
    $mapping = array(
        MYSQLND_UH_MYSQLND_CLOSE_DISCONNECTED => "MYSQLND_UH_MYSQLND_CLOSE_DISCONNECTED",
        MYSQLND_UH_MYSQLND_CLOSE_EXPLICIT => "MYSQLND_UH_MYSQLND_CLOSE_EXPLICIT",
        MYSQLND_UH_MYSQLND_CLOSE_IMPLICIT => "MYSQLND_UH_MYSQLND_CLOSE_IMPLICIT",
        MYSQLND_UH_MYSQLND_CLOSE_LAST => "MYSQLND_UH_MYSQLND_CLOSE_IMPLICIT"
    );
    return (isset($mapping[$close_type])) ? $mapping[$close_type] : 'unknown';
}
class proxy extends MysqlndUhConnection {
    public function close($res, $close_type) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        printf("close_type = %s\n", close_type_to_string($close_type));
        /* WARNING: you must call the parent */
        $ret = parent::close($res, $close_type);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->close();
?>
```

The above example will output:

```
proxy::close(array (
  0 => NULL,
  1 => 0,
))
close_type = MYSQLND_UH_MYSQLND_CLOSE_EXPLICIT
proxy::close returns true
```

See Also

`mysqlnd_uh_set_connection_proxy`
`mysqli_close`
`mysql_close`

7.9.7.4 `MysqlndUhConnection::connect`

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- **MysqlndUhConnection::connect**

Open a new connection to the MySQL server

Description

```
public bool MysqlndUhConnection::connect(
    mysqlnd_connection connection,
    string host,
    string user",
    string password,
    string database,
    int port,
    string socket,
    int mysql_flags);
```

Open a new connection to the MySQL server.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
<i>host</i>	Can be either a host name or an IP address. Passing the NULL value or the string "localhost" to this parameter, the local host is assumed. When possible, pipes will be used instead of the TCP/IP protocol.
<i>user</i>	The MySQL user name.
<i>password</i>	If not provided or <code>NULL</code> , the MySQL server will attempt to authenticate the user against those user records which have no password only. This allows one username to be used with different permissions (depending on if a password as provided or not).
<i>database</i>	If provided will specify the default database to be used when performing queries.
<i>port</i>	Specifies the port number to attempt to connect to the MySQL server.
<i>socket</i>	Specifies the socket or named pipe that should be used. If <code>NULL</code> , mysqlnd will default to <code>/tmp/mysql.sock</code> .
<i>mysql_flags</i>	Connection options.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.345 MysqlndUhConnection::connect example

```
<?php
class proxy extends MysqlndUhConnection {
    public function connect($res, $host, $user, $passwd, $db, $port, $socket, $mysql_flags) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::connect($res, $host, $user, $passwd, $db, $port, $socket, $mysql_flags);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
?>
```

The above example will output:

```
proxy::connect(array (
  0 => NULL,
  1 => 'localhost',
  2 => 'root',
  3 => '',
  4 => 'test',
  5 => 3306,
  6 => NULL,
  7 => 131072,
))
proxy::connect returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_connect](#)
[mysql_connect](#)

7.9.7.5 MysqlndUhConnection::__construct

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- [MysqlndUhConnection::__construct](#)

The __construct purpose

Description

```
public MysqlndUhConnection::__construct();
```

Warning

This function is currently not documented; only its argument list is available.

Parameters

This function has no parameters.

Return Values

7.9.7.6 MysqlndUhConnection::endPSession

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- [MysqlndUhConnection::endPSession](#)

End a persistent connection

Description

```
public bool MysqlndUhConnection::endPSession(
  mysqlnd_connection connection);
```

End a persistent connection

Warning

This function is currently not documented; only its argument list is available.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples**Example 7.346 MysqlndUhConnection::endPSession example**

```
<?php
class proxy extends MysqlndUhConnection {
    public function endPSession($conn) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::endPSession($conn);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("p:localhost", "root", "", "test");
$mysqli->close();
?>
```

The above example will output:

```
proxy::endPSession(array (
  0 => NULL,
))
proxy::endPSession returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)

7.9.7.7 MysqlndUhConnection::escapeString

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- [MysqlndUhConnection::escapeString](#)

Escapes special characters in a string for use in an SQL statement, taking into account the current charset of the connection

Description

```
public string MysqlndUhConnection::escapeString(
    mysqlnd_connection connection,
    string escape_string);
```

Escapes special characters in a string for use in an SQL statement, taking into account the current charset of the connection.

Parameters

MYSQLND_UH_RES_MYSQLND_NAME Mysqlnd connection handle. Do not modify!

escape_string The string to be escaped.

Return Values

The escaped string.

Examples

Example 7.347 `MysqlndUhConnection::escapeString` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function escapeString($res, $string) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::escapeString($res, $string);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->set_charset("latin1");
$mysqli->real_escape_string("test0'test");
?>
```

The above example will output:

```
proxy::escapeString(array (
  0 => NULL,
  1 => 'test0\'test',
))
proxy::escapeString returns 'test0\\\\\'test'
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_real_escape_string](#)
[mysql_real_escape_string](#)

7.9.7.8 `MysqlndUhConnection::getAffectedRows`

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- [`MysqlndUhConnection::getAffectedRows`](#)

Gets the number of affected rows in a previous MySQL operation

Description

```
public int MysqlndUhConnection::getAffectedRows(
    mysqlnd_connection connection);
```

Gets the number of affected rows in a previous MySQL operation.

Parameters

connection

Mysqlnd connection handle. Do not modify!

Return Values

Number of affected rows.

Examples

Example 7.348 MysqlndUhConnection::getAffectedRows example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getAffectedRows($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getAffectedRows($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->query("DROP TABLE IF EXISTS test");
$mysqli->query("CREATE TABLE test(id INT)");
$mysqli->query("INSERT INTO test(id) VALUES (1)");
var_dump($mysqli->affected_rows);
?>
```

The above example will output:

```
proxy::getAffectedRows(array (
  0 => NULL,
))
proxy::getAffectedRows returns 1
int(1)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_affected_rows](#)
[mysql_affected_rows](#)

7.9.7.9 MysqlndUhConnection::getErrorCode

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- [MysqlndUhConnection::getErrorCode](#)

Returns the error code for the most recent function call

Description

```
public int MysqlndUhConnection::getErrorCode(
    mysqlnd_connection connection);
```

Returns the error code for the most recent function call.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Error code for the most recent function call.

Examples

[MysqlndUhConnection::getErrorCode](#) is not only executed after the invocation of a user space API call which maps directly to it but also called internally.

Example 7.349 `MysqlndUhConnection::getErrorHandler` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getErrorHandler($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getErrorHandler($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
printf("connect...\n");
$mysqli = new mysqli("localhost", "root", "", "test");
printf("query...\n");
$mysqli->query("PLEASE LET THIS BE INVALID SQL");
printf("errno...\n");
var_dump($mysqli->errno);
printf("close...\n");
$mysqli->close();
?>
```

The above example will output:

```
connect...
proxy::getErrorHandler(array (
    0 => NULL,
))
proxy::getErrorHandler returns 0
query...
errno...
proxy::getErrorHandler(array (
    0 => NULL,
))
proxy::getErrorHandler returns 1064
int(1064)
close...
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[MysqlndUhConnection::getErrorMessage](#)
[mysqli_errno](#)
[mysql_errno](#)

7.9.7.10 `MysqlndUhConnection::getErrorMessage`

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- [MysqlndUhConnection::getErrorMessage](#)

Returns a string description of the last error

Description

```
public string MysqlndUhConnection::getErrorMessage(
    mysqlnd_connection connection);
```

Returns a string description of the last error.

Parameters

connection

Mysqlnd connection handle. Do not modify!

Return Values

Error string for the most recent function call.

Examples

`MysqlndUhConnection::getErrorMessage` is not only executed after the invocation of a user space API call which maps directly to it but also called internally.

Example 7.350 `MysqlndUhConnection::getErrorMessage` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getErrorMessage($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getErrorMessage($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
printf("connect...\n");
$mysqli = new mysqli("localhost", "root", "", "test");
printf("query...\n");
$mysqli->query("WILL_I_EVER_LEARN_SQL?");
printf("errno...\n");
var_dump($mysqli->error);
printf("close...\n");
$mysqli->close();
?>
```

The above example will output:

```
connect...
proxy::getErrorMessage(array (
  0 => NULL,
))
proxy::getErrorMessage returns ''
query...
errno...
proxy::getErrorMessage(array (
  0 => NULL,
))
proxy::getErrorMessage returns 'You have an error in your SQL syntax; check the manual that corresponds
string(168) "You have an error in your SQL syntax; check the manual that corresponds to your MySQL serv
close...
```

See Also

`mysqlnd_uh_set_connection_proxy`
`MysqlndUhConnection::getErrorMessage`
`mysqli_error`
`mysql_error`

7.9.7.11 `MysqlndUhConnection::getRowCount`

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- `MysqlndUhConnection::getRowCount`

Returns the number of columns for the most recent query

Description

```
public int MysqlndUhConnection::getRowCount(
    mysqlnd_connection connection);
```

Returns the number of columns for the most recent query.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Number of columns.

Examples

`MysqlndUhConnection::getRowCount` is not only executed after the invocation of a user space API call which maps directly to it but also called internally.

Example 7.351 `MysqlndUhConnection::getRowCount` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getRowCount($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getRowCount($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->query("WILL_I_EVER_LEARN_SQL?");
var_dump($mysqli->field_count);
$mysqli->query("SELECT 1, 2, 3 FROM DUAL");
var_dump($mysqli->field_count);
?>
```

The above example will output:

```
proxy::getRowCount(array (
    0 => NULL,
))
proxy::getRowCount returns 0
int(0)
proxy::getRowCount(array (
    0 => NULL,
))
proxy::getRowCount returns 3
proxy::getRowCount(array (
    0 => NULL,
))
proxy::getRowCount returns 3
int(3)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_field_count](#)

7.9.7.12 `MysqlndUhConnection::getHostInformation`

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- [MysqlndUhConnection::getHostInformation](#)

Returns a string representing the type of connection used

Description

```
public string MysqlndUhConnection::getHostInformation(  
    mysqlnd_connection connection);
```

Returns a string representing the type of connection used.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Connection description.

Examples

Example 7.352 MysqlndUhConnection::getHostInformation example

```
<?php  
class proxy extends MysqlndUhConnection {  
    public function getHostInformation($res) {  
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));  
        $ret = parent::__getHostInformation($res);  
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));  
        return $ret;  
    }  
}  
mysqlnd_uh_set_connection_proxy(new proxy());  
$mysqli = new mysqli("localhost", "root", "", "test");  
var_dump($mysqli->host_info);  
?>
```

The above example will output:

```
proxy::getHostInformation(array (  
    0 => NULL,  
)  
proxy::getHostInformation returns 'Localhost via UNIX socket'  
string(25) "Localhost via UNIX socket"
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_get_host_info](#)
[mysql_get_host_info](#)

7.9.7.13 MysqlndUhConnection::getLastInsertId

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- [MysqlndUhConnection::getLastInsertId](#)

Returns the auto generated id used in the last query

Description

```
public int MysqlndUhConnection::getLastInsertId(  
    mysqlnd_connection connection);
```

Returns the auto generated id used in the last query.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Last insert id.

Examples

Example 7.353 `MysqlndUhConnection::getLastInsertId` example

```
<?php  
class proxy extends MysqlndUhConnection {  
    public function getLastInsertId($res) {  
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));  
        $ret = parent::__getLastInsertId($res);  
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));  
        return $ret;  
    }  
}  
mysqlnd_uh_set_connection_proxy(new proxy());  
$mysqli = new mysqli("localhost", "root", "", "test");  
$mysqli->query("DROP TABLE IF EXISTS test");  
$mysqli->query("CREATE TABLE test(id INT AUTO_INCREMENT PRIMARY KEY, col VARCHAR(255))");  
$mysqli->query("INSERT INTO test(col) VALUES ('a')");  
var_dump($mysqli->insert_id);  
?>
```

The above example will output:

```
proxy::getLastInsertId(array (  
    0 => NULL,  
)  
proxy::getLastInsertId returns 1  
int(1)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_insert_id](#)
[mysql_insert_id](#)

7.9.7.14 `MysqlndUhConnection::getLastMessage`

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- [`MysqlndUhConnection::getLastMessage`](#)

Retrieves information about the most recently executed query

Description

```
public void MysqlndUhConnection::getLastMessage(  
    mysqlnd_connection connection);
```

Retrieves information about the most recently executed query.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Last message. Trying to return a string longer than 511 bytes will cause an error of the type [E_WARNING](#) and result in the string being truncated.

Examples

Example 7.354 `MysqlndUhConnection::getLastMessage` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getLastMessage($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::__getLastMessage($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump($mysqli->info);
$mysqli->query("DROP TABLE IF EXISTS test");
var_dump($mysqli->info);
?>
```

The above example will output:

```
proxy::getLastMessage(array (
  0 => NULL,
))
proxy::getLastMessage returns ''
string(0) ""
proxy::getLastMessage(array (
  0 => NULL,
))
proxy::getLastMessage returns ''
string(0) ""
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_info](#)
[mysql_info](#)

7.9.7.15 `MysqlndUhConnection::getProtocolInformation`

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- [MysqlndUhConnection::getProtocolInformation](#)

Returns the version of the MySQL protocol used

Description

```
public string MysqlndUhConnection::getProtocolInformation(
    mysqlnd_connection connection);
```

Returns the version of the MySQL protocol used.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

The protocol version.

Examples

Example 7.355 `MysqlndUhConnection::getProtocolInformation` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getProtocolInformation($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::__getProtocolInformation($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump($mysqli->protocol_version);
?>
```

The above example will output:

```
proxy::__getProtocolInformation(array (
    0 => NULL,
))
proxy::__getProtocolInformation returns 10
int(10)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_get_proto_info](#)
[mysql_get_proto_info](#)

7.9.7.16 `MysqlndUhConnection::getServerInformation`

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- `MysqlndUhConnection::getServerInformation`

Returns the version of the MySQL server

Description

```
public string MysqlndUhConnection::__getServerInformation(
    mysqlnd_connection connection);
```

Returns the version of the MySQL server.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

The server version.

Examples

Example 7.356 MysqlndUhConnection::getServerInformation example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getServerInformation($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getServerInformation($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump($mysqli->server_info);
?>
```

The above example will output:

```
proxy::getServerInformation(array (
  0 => NULL,
))
proxy::getServerInformation returns '5.1.45-debug-log'
string(16) "5.1.45-debug-log"
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_get_server_info](#)
[mysql_get_server_info](#)

7.9.7.17 MysqlndUhConnection::getServerStatistics

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- [MysqlndUhConnection::getServerStatistics](#)

Gets the current system status

Description

```
public string MysqlndUhConnection::getServerStatistics(
    mysqlnd_connection connection);
```

Gets the current system status.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

The system status message.

Examples

Example 7.357 MysqlndUhConnection::getServerStatistics example

```
<?php
class proxy extends MysqlndUhConnection {
```

```
public function getServerStatistics($res) {
    printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
    $ret = parent::getServerStatistics($res);
    printf("%s returns %s\n", __METHOD__, var_export($ret, true));
    return $ret;
}
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump(mysqli_stat($mysqli));
?>
```

The above example will output:

```
proxy::getServerStatistics(array (
  0 => NULL,
))
proxy::getServerStatistics returns 'Uptime: 2059995 Threads: 1 Questions: 126157 Slow queries: 0 Opens: string(140) "Uptime: 2059995 Threads: 1 Questions: 126157 Slow queries: 0 Opens: 6377 Flush tables: 1'
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_stat](#)
[mysql_stat](#)

7.9.7.18 MysqlndUhConnection::getServerVersion

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- [MysqlndUhConnection::getServerVersion](#)

Returns the version of the MySQL server as an integer

Description

```
public int MysqlndUhConnection::getServerVersion(
    mysqlnd_connection connection);
```

Returns the version of the MySQL server as an integer.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

The MySQL version.

Examples

Example 7.358 MysqlndUhConnection::getServerVersion example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getServerVersion($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getServerVersion($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
```

```
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump($mysqli->server_version);
?>
```

The above example will output:

```
proxy::getServerVersion(array (
  0 => NULL,
))
proxy::getServerVersion returns 50145
int(50145)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_get_server_version](#)
[mysql_get_server_version](#)

7.9.7.19 MysqlndUhConnection::getSqlstate

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- [MysqlndUhConnection::getSqlstate](#)

Returns the SQLSTATE error from previous MySQL operation

Description

```
public string MysqlndUhConnection::getSqlstate(
    mysqlnd_connection connection);
```

Returns the SQLSTATE error from previous MySQL operation.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

The SQLSTATE code.

Examples

Example 7.359 MysqlndUhConnection::getSqlstate example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getSqlstate($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getSqlstate($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump($mysqli->sqlstate);
$mysqli->query("AN_INVALID_REQUEST_TO_PROVOKE_AN_ERROR");
var_dump($mysqli->sqlstate);
?>
```

The above example will output:

```
proxy::getSqlstate(array (
    0 => NULL,
))
proxy::getSqlstate returns '00000'
string(5) "00000"
proxy::getSqlstate(array (
    0 => NULL,
))
proxy::getSqlstate returns '42000'
string(5) "42000"
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_sql_state](#)

7.9.7.20 MysqlndUhConnection::getStatistics

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- [MysqlndUhConnection::getStatistics](#)

Returns statistics about the client connection

Description

```
public array MysqlndUhConnection::getStatistics(
    mysqlnd_connection connection);
```

Returns statistics about the client connection.

Warning

This function is currently not documented; only its argument list is available.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Connection statistics collected by mysqlnd.

Examples

Example 7.360 MysqlndUhConnection::getStatistics example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getStatistics($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getStatistics($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump($mysqli->get_connection_stats());
?>
```

The above example will output:

```

proxy::getStatistics(array (
  0 => NULL,
))
proxy::getStatistics returns array (
  'bytes_sent' => '73',
  'bytes_received' => '77',
  'packets_sent' => '2',
  'packets_received' => '2',
  'protocol_overhead_in' => '8',
  'protocol_overhead_out' => '8',
  'bytes_received_ok_packet' => '0',
  'bytes_received_eof_packet' => '0',
  'bytes_received_rset_header_packet' => '0',
  'bytes_received_rset_field_meta_packet' => '0',
  'bytes_received_rset_row_packet' => '0',
  'bytes_received_prepare_response_packet' => '0',
  'bytes_received_change_user_packet' => '0',
  'packets_sent_command' => '0',
  'packets_received_ok' => '0',
  'packets_received_eof' => '0',
  'packets_received_rset_header' => '0',
  'packets_received_rset_field_meta' => '0',
  'packets_received_rset_row' => '0',
  'packets_received_prepare_response' => '0',
  'packets_received_change_user' => '0',
  'result_set_queries' => '0',
  'non_result_set_queries' => '0',
  'no_index_used' => '0',
  'bad_index_used' => '0',
  'slow_queries' => '0',
  'buffered_sets' => '0',
  'unbuffered_sets' => '0',
  'ps_buffered_sets' => '0',
  'ps_unbuffered_sets' => '0',
  'flushed_normal_sets' => '0',
  'flushed_ps_sets' => '0',
  'ps_prepared_never_executed' => '0',
  'ps_prepared_once_executed' => '0',
  'rows_fetched_from_server_normal' => '0',
  'rows_fetched_from_server_ps' => '0',
  'rows_buffered_from_client_normal' => '0',
  'rows_buffered_from_client_ps' => '0',
  'rows_fetched_from_client_normal_buffered' => '0',
  'rows_fetched_from_client_normal_unbuffered' => '0',
  'rows_fetched_from_client_ps_buffered' => '0',
  'rows_fetched_from_client_ps_unbuffered' => '0',
  'rows_fetched_from_client_ps_cursor' => '0',
  'rows_affected_normal' => '0',
  'rows_affected_ps' => '0',
  'rows_skipped_normal' => '0',
  'rows_skipped_ps' => '0',
  'copy_on_write_saved' => '0',
  'copy_on_write_performed' => '0',
  'command_buffer_too_small' => '0',
  'connect_success' => '1',
  'connect_failure' => '0',
  'connection_reused' => '0',
  'reconnect' => '0',
  'pconnect_success' => '0',
  'active_connections' => '1',
  'active_persistent_connections' => '0',
  'explicit_close' => '0',
  'implicit_close' => '0',
  'disconnect_close' => '0',
  'in_middle_of_command_close' => '0',
  'explicit_free_result' => '0',
  'implicit_free_result' => '0',
)

```

```
'explicit_stmt_close' => '0',
'implicit_stmt_close' => '0',
'mem_emalloc_count' => '0',
'mem_emalloc_amount' => '0',
'mem_ecalloc_count' => '0',
'mem_ecalloc_amount' => '0',
'mem_erealloc_count' => '0',
'mem_erealloc_amount' => '0',
'mem_efree_count' => '0',
'mem_efree_amount' => '0',
'mem_malloc_count' => '0',
'mem_malloc_amount' => '0',
'mem_calloc_count' => '0',
'mem_calloc_amount' => '0',
'mem_realloc_count' => '0',
'mem_realloc_amount' => '0',
'mem_free_count' => '0',
'mem_free_amount' => '0',
'mem_estrndup_count' => '0',
'mem_strndup_count' => '0',
'mem_estndup_count' => '0',
'mem_strdup_count' => '0',
'proto_text_fetched_null' => '0',
'proto_text_fetched_bit' => '0',
'proto_text_fetched_tinyint' => '0',
'proto_text_fetched_short' => '0',
'proto_text_fetched_int24' => '0',
'proto_text_fetched_int' => '0',
'proto_text_fetched_bigint' => '0',
'proto_text_fetched_decimal' => '0',
'proto_text_fetched_float' => '0',
'proto_text_fetched_double' => '0',
'proto_text_fetched_date' => '0',
'proto_text_fetched_year' => '0',
'proto_text_fetched_time' => '0',
'proto_text_fetched_datetime' => '0',
'proto_text_fetched_timestamp' => '0',
'proto_text_fetched_string' => '0',
'proto_text_fetched_blob' => '0',
'proto_text_fetched_enum' => '0',
'proto_text_fetched_set' => '0',
'proto_text_fetched_geometry' => '0',
'proto_text_fetched_other' => '0',
'proto_binary_fetched_null' => '0',
'proto_binary_fetched_bit' => '0',
'proto_binary_fetched_tinyint' => '0',
'proto_binary_fetched_short' => '0',
'proto_binary_fetched_int24' => '0',
'proto_binary_fetched_int' => '0',
'proto_binary_fetched_bigint' => '0',
'proto_binary_fetched_decimal' => '0',
'proto_binary_fetched_float' => '0',
'proto_binary_fetched_double' => '0',
'proto_binary_fetched_date' => '0',
'proto_binary_fetched_year' => '0',
'proto_binary_fetched_time' => '0',
'proto_binary_fetched_datetime' => '0',
'proto_binary_fetched_timestamp' => '0',
'proto_binary_fetched_string' => '0',
'proto_binary_fetched_blob' => '0',
'proto_binary_fetched_enum' => '0',
'proto_binary_fetched_set' => '0',
'proto_binary_fetched_geometry' => '0',
'proto_binary_fetched_other' => '0',
'init_command_executed_count' => '0',
'init_command_failed_count' => '0',
'com_quit' => '0',
'com_init_db' => '0',
'com_query' => '0',
'com_field_list' => '0',
'com_create_db' => '0',
'com_drop_db' => '0',
```

```

'com_refresh' => '0',
'com_shutdown' => '0',
'com_statistics' => '0',
'com_process_info' => '0',
'com_connect' => '0',
'com_process_kill' => '0',
'com_debug' => '0',
'com_ping' => '0',
'com_time' => '0',
'com_delayed_insert' => '0',
'com_change_user' => '0',
'com_binlog_dump' => '0',
'com_table_dump' => '0',
'com_connect_out' => '0',
'com_register_slave' => '0',
'com_stmt_prepare' => '0',
'com_stmt_execute' => '0',
'com_stmt_send_long_data' => '0',
'com_stmt_close' => '0',
'com_stmt_reset' => '0',
'com_stmt_set_option' => '0',
'com_stmt_fetch' => '0',
'com_deamon' => '0',
'bytes_received_real_data_normal' => '0',
'bytes_received_real_data_ps' => '0',
)
array(160) {
["bytes_sent"]=>
string(2) "73"
["bytes_received"]=>
string(2) "77"
["packets_sent"]=>
string(1) "2"
["packets_received"]=>
string(1) "2"
["protocol_overhead_in"]=>
string(1) "8"
["protocol_overhead_out"]=>
string(1) "8"
["bytes_received_ok_packet"]=>
string(1) "0"
["bytes_received_eof_packet"]=>
string(1) "0"
["bytes_received_rset_header_packet"]=>
string(1) "0"
["bytes_received_rset_field_meta_packet"]=>
string(1) "0"
["bytes_received_rset_row_packet"]=>
string(1) "0"
["bytes_received_prepare_response_packet"]=>
string(1) "0"
["bytes_received_change_user_packet"]=>
string(1) "0"
["packets_sent_command"]=>
string(1) "0"
["packets_received_ok"]=>
string(1) "0"
["packets_received_eof"]=>
string(1) "0"
["packets_received_rset_header"]=>
string(1) "0"
["packets_received_rset_field_meta"]=>
string(1) "0"
["packets_received_rset_row"]=>
string(1) "0"
["packets_received_prepare_response"]=>
string(1) "0"
["packets_received_change_user"]=>
string(1) "0"
["result_set_queries"]=>
string(1) "0"
["non_result_set_queries"]=>

```

```
string(1) "0"
["no_index_used"]=>
string(1) "0"
["bad_index_used"]=>
string(1) "0"
["slow_queries"]=>
string(1) "0"
["buffered_sets"]=>
string(1) "0"
["unbuffered_sets"]=>
string(1) "0"
["ps_buffered_sets"]=>
string(1) "0"
["ps_unbuffered_sets"]=>
string(1) "0"
["flushed_normal_sets"]=>
string(1) "0"
["flushed_ps_sets"]=>
string(1) "0"
["ps_prepared_never_executed"]=>
string(1) "0"
["ps_prepared_once_executed"]=>
string(1) "0"
["rows_fetched_from_server_normal"]=>
string(1) "0"
["rows_fetched_from_server_ps"]=>
string(1) "0"
["rows_buffered_from_client_normal"]=>
string(1) "0"
["rows_buffered_from_client_ps"]=>
string(1) "0"
["rows_fetched_from_client_normal_buffered"]=>
string(1) "0"
["rows_fetched_from_client_normal_unbuffered"]=>
string(1) "0"
["rows_fetched_from_client_ps_buffered"]=>
string(1) "0"
["rows_fetched_from_client_ps_unbuffered"]=>
string(1) "0"
["rows_fetched_from_client_ps_cursor"]=>
string(1) "0"
["rows_affected_normal"]=>
string(1) "0"
["rows_affected_ps"]=>
string(1) "0"
["rows_skipped_normal"]=>
string(1) "0"
["rows_skipped_ps"]=>
string(1) "0"
["copy_on_write_saved"]=>
string(1) "0"
["copy_on_write_performed"]=>
string(1) "0"
["command_buffer_too_small"]=>
string(1) "0"
["connect_success"]=>
string(1) "1"
["connect_failure"]=>
string(1) "0"
["connection_reused"]=>
string(1) "0"
["reconnect"]=>
string(1) "0"
["pconnect_success"]=>
string(1) "0"
["active_connections"]=>
string(1) "1"
["active_persistent_connections"]=>
string(1) "0"
["explicit_close"]=>
string(1) "0"
["implicit_close"]=>
```

```
string(1) "0"
[ "disconnect_close" ]=>
string(1) "0"
[ "in_middle_of_command_close" ]=>
string(1) "0"
[ "explicit_free_result" ]=>
string(1) "0"
[ "implicit_free_result" ]=>
string(1) "0"
[ "explicit_stmt_close" ]=>
string(1) "0"
[ "implicit_stmt_close" ]=>
string(1) "0"
[ "mem_emalloc_count" ]=>
string(1) "0"
[ "mem_emalloc_amount" ]=>
string(1) "0"
[ "mem_ecalloc_count" ]=>
string(1) "0"
[ "mem_ecalloc_amount" ]=>
string(1) "0"
[ "mem_erealloc_count" ]=>
string(1) "0"
[ "mem_erealloc_amount" ]=>
string(1) "0"
[ "mem_efree_count" ]=>
string(1) "0"
[ "mem_efree_amount" ]=>
string(1) "0"
[ "mem_malloc_count" ]=>
string(1) "0"
[ "mem_malloc_amount" ]=>
string(1) "0"
[ "mem_calloc_count" ]=>
string(1) "0"
[ "mem_calloc_amount" ]=>
string(1) "0"
[ "mem_realloc_count" ]=>
string(1) "0"
[ "mem_realloc_amount" ]=>
string(1) "0"
[ "mem_free_count" ]=>
string(1) "0"
[ "mem_free_amount" ]=>
string(1) "0"
[ "mem_estrndup_count" ]=>
string(1) "0"
[ "mem_strdup_count" ]=>
string(1) "0"
[ "mem_estndup_count" ]=>
string(1) "0"
[ "mem_strdup_count" ]=>
string(1) "0"
[ "proto_text_fetched_null" ]=>
string(1) "0"
[ "proto_text_fetched_bit" ]=>
string(1) "0"
[ "proto_text_fetched_tinyint" ]=>
string(1) "0"
[ "proto_text_fetched_short" ]=>
string(1) "0"
[ "proto_text_fetched_int24" ]=>
string(1) "0"
[ "proto_text_fetched_int" ]=>
string(1) "0"
[ "proto_text_fetched_bigint" ]=>
string(1) "0"
[ "proto_text_fetched_decimal" ]=>
string(1) "0"
[ "proto_text_fetched_float" ]=>
string(1) "0"
[ "proto_text_fetched_double" ]=>
```

```
string(1) "0"
["proto_text_fetched_date"]=>
string(1) "0"
["proto_text_fetched_year"]=>
string(1) "0"
["proto_text_fetched_time"]=>
string(1) "0"
["proto_text_fetched_datetime"]=>
string(1) "0"
["proto_text_fetched_timestamp"]=>
string(1) "0"
["proto_text_fetched_string"]=>
string(1) "0"
["proto_text_fetched_blob"]=>
string(1) "0"
["proto_text_fetched_enum"]=>
string(1) "0"
["proto_text_fetched_set"]=>
string(1) "0"
["proto_text_fetched_geometry"]=>
string(1) "0"
["proto_text_fetched_other"]=>
string(1) "0"
["proto_binary_fetched_null"]=>
string(1) "0"
["proto_binary_fetched_bit"]=>
string(1) "0"
["proto_binary_fetched_tinyint"]=>
string(1) "0"
["proto_binary_fetched_short"]=>
string(1) "0"
["proto_binary_fetched_int24"]=>
string(1) "0"
["proto_binary_fetched_int"]=>
string(1) "0"
["proto_binary_fetched_bigint"]=>
string(1) "0"
["proto_binary_fetched_decimal"]=>
string(1) "0"
["proto_binary_fetched_float"]=>
string(1) "0"
["proto_binary_fetched_double"]=>
string(1) "0"
["proto_binary_fetched_date"]=>
string(1) "0"
["proto_binary_fetched_year"]=>
string(1) "0"
["proto_binary_fetched_time"]=>
string(1) "0"
["proto_binary_fetched_datetime"]=>
string(1) "0"
["proto_binary_fetched_timestamp"]=>
string(1) "0"
["proto_binary_fetched_string"]=>
string(1) "0"
["proto_binary_fetched_blob"]=>
string(1) "0"
["proto_binary_fetched_enum"]=>
string(1) "0"
["proto_binary_fetched_set"]=>
string(1) "0"
["proto_binary_fetched_geometry"]=>
string(1) "0"
["proto_binary_fetched_other"]=>
string(1) "0"
["init_command_executed_count"]=>
string(1) "0"
["init_command_failed_count"]=>
string(1) "0"
["com_quit"]=>
string(1) "0"
["com_init_db"]=>
```

```
string(1) "0"
["com_query"]=>
string(1) "0"
["com_field_list"]=>
string(1) "0"
["com_create_db"]=>
string(1) "0"
["com_drop_db"]=>
string(1) "0"
["com_refresh"]=>
string(1) "0"
["com_shutdown"]=>
string(1) "0"
["com_statistics"]=>
string(1) "0"
["com_process_info"]=>
string(1) "0"
["com_connect"]=>
string(1) "0"
["com_process_kill"]=>
string(1) "0"
["com_debug"]=>
string(1) "0"
["com_ping"]=>
string(1) "0"
["com_time"]=>
string(1) "0"
["com_delayed_insert"]=>
string(1) "0"
["com_change_user"]=>
string(1) "0"
["com_binlog_dump"]=>
string(1) "0"
["com_table_dump"]=>
string(1) "0"
["com_connect_out"]=>
string(1) "0"
["com_register_slave"]=>
string(1) "0"
["com_stmt_prepare"]=>
string(1) "0"
["com_stmt_execute"]=>
string(1) "0"
["com_stmt_send_long_data"]=>
string(1) "0"
["com_stmt_close"]=>
string(1) "0"
["com_stmt_reset"]=>
string(1) "0"
["com_stmt_set_option"]=>
string(1) "0"
["com_stmt_fetch"]=>
string(1) "0"
["com_deamon"]=>
string(1) "0"
["bytes_received_real_data_normal"]=>
string(1) "0"
["bytes_received_real_data_ps"]=>
string(1) "0"
}
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_get_connection_stats](#)

7.9.7.21 **MysqlndUhConnection::getThreadId**

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- [MysqlndUhConnection::getThreadId](#)

Returns the thread ID for the current connection

Description

```
public int MysqlndUhConnection::getThreadId(  
    mysqlnd_connection connection);
```

Returns the thread ID for the current connection.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Connection thread id.

Examples

Example 7.361 [MysqlndUhConnection::getThreadId](#) example

```
<?php  
class proxy extends MysqlndUhConnection {  
    public function getThreadId($res) {  
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));  
        $ret = parent::getThreadId($res);  
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));  
        return $ret;  
    }  
}  
mysqlnd_uh_set_connection_proxy(new proxy());  
$mysqli = new mysqli("localhost", "root", "", "test");  
var_dump($mysqli->thread_id);  
?>
```

The above example will output:

```
proxy::getThreadId(array (  
    0 => NULL,  
)  
proxy::getThreadId returns 27646  
int(27646)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_thread_id](#)
[mysql_thread_id](#)

7.9.7.22 [MysqlndUhConnection::getWarningCount](#)

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- [MysqlndUhConnection::getWarningCount](#)

Returns the number of warnings from the last query for the given link

Description

```
public int MysqlndUhConnection::getWarningCount(  
    mysqlnd_connection connection);
```

Returns the number of warnings from the last query for the given link.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Number of warnings.

Examples

Example 7.362 `MysqlndUhConnection::getWarningCount` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function getWarningCount($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::getWarningCount($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
var_dump($mysqli->warning_count);
?>
```

The above example will output:

```
proxy::getWarningCount(array (
  0 => NULL,
))
proxy::getWarningCount returns 0
int(0)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_warning_count](#)

7.9.7.23 `MysqlndUhConnection::init`

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- [MysqlndUhConnection::init](#)

Initialize mysqlnd connection

Description

```
public bool MysqlndUhConnection::init(
    mysqlnd_connection connection);
```

Initialize mysqlnd connection. This is an mysqlnd internal call to initialize the connection object.

Note

Failing to call the parent implementation may cause memory leaks or crash PHP. This is not considered a bug. Please, keep in mind that the `mysqlnd` library functions have never been designed to be exposed to the user space.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples**Example 7.363 MysqlndUhConnection::init example**

```
<?php
class proxy extends MysqlndUhConnection {
    public function init($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::init($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
?>
```

The above example will output:

```
proxy::init(array (
    0 => NULL,
))
proxy::init returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)

7.9.7.24 MysqlndUhConnection::killConnection

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- [MysqlndUhConnection::killConnection](#)

Asks the server to kill a MySQL thread

Description

```
public bool MysqlndUhConnection::killConnection(
    mysqlnd_connection connection,
    int pid);
```

Asks the server to kill a MySQL thread.

Parameters

connection Mysqlnd connection handle. Do not modify!

pid Thread Id of the connection to be killed.

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.364 MysqlndUhConnection::kill example

```
<?php
class proxy extends MysqlndUhConnection {
    public function killConnection($res, $pid) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::killConnection($res, $pid);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->kill($mysqli->thread_id);
?>
```

The above example will output:

```
proxy::killConnection(array (
  0 => NULL,
  1 => 27650,
))
proxy::killConnection returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_kill](#)

7.9.7.25 MysqlndUhConnection::listFields

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- [MysqlndUhConnection::listFields](#)

List MySQL table fields

Description

```
public array MysqlndUhConnection::listFields(
    mysqlnd_connection connection,
    string table,
    string achtung_wild);
```

List MySQL table fields.

Warning

This function is currently not documented; only its argument list is available.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
<i>table</i>	The name of the table that's being queried.
<i>pattern</i>	Name pattern.

Return Values**Examples**

Example 7.365 MysqlndUhConnection::listFields example

```
<?php
class proxy extends MysqlndUhConnection {
    public function listFields($res, $table, $pattern) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::listFields($res, $table, $pattern);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysql = mysql_connect("localhost", "root", "");
mysql_select_db("test", $mysql);
mysql_query("DROP TABLE IF EXISTS test_a", $mysql);
mysql_query("CREATE TABLE test_a(id INT, coll VARCHAR(255))", $mysql);
$res = mysql_list_fields("test", "test_a", $mysql);
printf("num_rows = %d\n", mysql_num_rows($res));
while ($row = mysql_fetch_assoc($res))
    var_dump($row);
?>
```

The above example will output:

```
proxy::listFields(array (
    0 => NULL,
    1 => 'test_a',
    2 => '',
))
proxy::listFields returns NULL
num_rows = 0
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysql_list_fields](#)

7.9.7.26 MysqlndUhConnection::listMethod

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- [MysqlndUhConnection::listMethod](#)

Wrapper for assorted list commands

Description

```
public void MysqlndUhConnection::listMethod(
    mysqlnd_connection connection,
    string query,
    string achtung_wild,
    string par1);
```

Wrapper for assorted list commands.

Warning

This function is currently not documented; only its argument list is available.

Parameters

connection

Mysqlnd connection handle. Do not modify!

query SHOW command to be executed.

achtung_wild

par1

Return Values

Return Values

TODO

Examples

Example 7.366 MysqlIndUhConnection::listMethod example

```
<?php
class proxy extends MysqlIndUhConnection {
    public function listMethod($res, $query, $pattern, $par1) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::listMethod($res, $query, $pattern, $par1);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysql = mysql_connect("localhost", "root", "");
$res = mysql_list_dbs($mysql);
printf("num_rows = %d\n", mysql_num_rows($res));
while ($row = mysql_fetch_assoc($res))
    var_dump($row);
?>
```

The above example will output:

```
proxy::listMethod(array (
    0 => NULL,
    1 => 'SHOW DATABASES',
    2 => '',
    3 => '',
))
proxy::listMethod returns NULL
num_rows = 6
array(1) {
    ["Database"]=>
    string(18) "information_schema"
}
array(1) {
    ["Database"]=>
    string(5) "mysql"
}
array(1) {
    ["Database"]=>
    string(8) "oxid_new"
}
array(1) {
    ["Database"]=>
    string(7) "phptest"
}
array(1) {
    ["Database"]=>
    string(7) "pushphp"
}
array(1) {
    ["Database"]=>
    string(4) "test"
```

```
}
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysql_list_dbs](#)

7.9.7.27 `MysqlndUhConnection::moreResults`

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- [MysqlndUhConnection::moreResults](#)

Check if there are any more query results from a multi query

Description

```
public bool MysqlndUhConnection::moreResults(  
    mysqlnd_connection connection);
```

Check if there are any more query results from a multi query.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.367 `MysqlndUhConnection::moreResults` example

```
<?php  
class proxy extends MysqlndUhConnection {  
    public function moreResults($res) {  
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));  
        $ret = parent::__moreResults($res);  
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));  
        return $ret;  
    }  
}  
mysqlnd_uh_set_connection_proxy(new proxy());  
$mysqli = new mysqli("localhost", "root", "", "test");  
$mysqli->multi_query("SELECT 1 AS _one; SELECT 2 AS _two");  
do {  
    $res = $mysqli->store_result();  
    var_dump($res->fetch_assoc());  
    printf("%s\n", str_repeat("-", 40));  
} while ($mysqli->more_results() && $mysqli->next_result());  
?>
```

The above example will output:

```
array(1) {  
    ["_one"]=>  
    string(1) "1"  
}  
-----  
proxy::moreResults(array (  
    0 => NULL,  
))
```

```

proxy::moreResults returns true
proxy::moreResults(array (
  0 => NULL,
))
proxy::moreResults returns true
array(1) {
  ["_two"]=>
  string(1) "2"
}
-----
proxy::moreResults(array (
  0 => NULL,
))
proxy::moreResults returns false

```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_more_results](#)

7.9.7.28 MysqlndUhConnection::nextResult

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- [MysqlndUhConnection::nextResult](#)

Prepare next result from multi_query

Description

```
public bool MysqlndUhConnection::nextResult(
    mysqlnd_connection connection);
```

Prepare next result from multi_query.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples**Example 7.368 MysqlndUhConnection::nextResult example**

```

<?php
class proxy extends MysqlndUhConnection {
    public function nextResult($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::nextResult($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->multi_query("SELECT 1 AS _one; SELECT 2 AS _two");
do {
    $res = $mysqli->store_result();
    var_dump($res->fetch_assoc());
    printf("%s\n", str_repeat("-", 40));
} while ($mysqli->more_results() && $mysqli->next_result());
?>
```

The above example will output:

```
array(1) {
    ["_one"]=>
    string(1) "1"
}

-----
proxy::nextResult(array (
    0 => NULL,
))
proxy::nextResult returns true
array(1) {
    ["_two"]=>
    string(1) "2"
}
```

See Also

```
mysqlnd_uh_set_connection_proxy  
mysqli_next_result
```

7.9.7.29 MysqlndUhConnection::ping

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- `MysqlndUhConnection::ping`

Pings a server connection, or tries to reconnect if the connection has gone down

Description

```
public bool MysqlndUhConnection::ping(  
    mysqlnd_connection connection);
```

Pings a server connection, or tries to reconnect if the connection has gone down.

Parameters

connection Mysqld connection handle. Do not modify!

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.369 `MysqlndUhConnection::ping` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function ping($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::__ping($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->ping();
?>
```

The above example will output:

```
proxy::ping(array (
  0 => NULL,
))
proxy::ping returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_ping](#)
[mysql_ping](#)

7.9.7.30 MysqlndUhConnection::query

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- [MysqlndUhConnection::query](#)

Performs a query on the database

Description

```
public bool MysqlndUhConnection::query(
    mysqlnd_connection connection,
    string query);
```

Performs a query on the database (COM_QUERY).

Parameters

connection Mysqlnd connection handle. Do not modify!

query The query string.

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.370 MysqlndUhConnection::query example

```
<?php
class proxy extends MysqlndUhConnection {
    public function query($res, $query) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $query = "SELECT 'How about query rewriting?'";
        $ret = parent::query($res, $query);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$res = $mysqli->query("SELECT 'Welcome mysqlnd_uh!' FROM DUAL");
var_dump($res->fetch_assoc());
?>
```

The above example will output:

```
proxy::query(array (
  0 => NULL,
  1 => 'SELECT \'Welcome mysqlnd_uh!\' FROM DUAL',
))
proxy::query returns true
array(1) {
  [ "How about query rewriting?"]=>
  string(26) "How about query rewriting?"
}
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_query](#)
[mysql_query](#)

7.9.7.31 MysqlndUhConnection::queryReadResultsetHeader

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- [MysqlndUhConnection::queryReadResultsetHeader](#)

Read a result set header

Description

```
public bool MysqlndUhConnection::queryReadResultsetHeader(
    mysqlnd_connection connection,
    mysqlnd_statement mysqlnd_stmt);
```

Read a result set header.

Parameters

connection

Mysqlnd connection handle. Do not modify!

mysqlnd_stmt

Mysqlnd statement handle. Do not modify! Set to [NULL](#), if function is not used in the context of a prepared statement.

Return Values

Returns [TRUE](#) on success. Otherwise, returns [FALSE](#)

Examples

Example 7.371 MysqlndUhConnection::queryReadResultsetHeader example

```
<?php
class proxy extends MysqlndUhConnection {
    public function queryReadResultsetHeader($res, $stmt) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::queryReadResultsetHeader($res, $stmt);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$res = $mysqli->query("SELECT 'Welcome mysqlnd_uh!' FROM DUAL");
var_dump($res->fetch_assoc());
?>
```

The above example will output:

```
proxy::queryReadResultSetHeader(array (
  0 => NULL,
  1 => NULL,
))
proxy::queryReadResultSetHeader returns true
array(1) {
  [ "Welcome mysqlnd_uh!" ]=>
  string(19) "Welcome mysqlnd_uh!"
}
```

See Also

[mysqlnd_uh_set_connection_proxy](#)

7.9.7.32 MysqlndUhConnection::reapQuery

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- [MysqlndUhConnection::reapQuery](#)

Get result from async query

Description

```
public bool MysqlndUhConnection::reapQuery(
    mysqlnd_connection connection);
```

Get result from async query.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
-------------------	---

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.372 MysqlndUhConnection::reapQuery example

```
<?php
class proxy extends MysqlndUhConnection {
    public function reapQuery($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::reapQuery($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$conn1 = new mysqli("localhost", "root", "", "test");
$conn2 = new mysqli("localhost", "root", "", "test");
$conn1->query("SELECT 1 as 'one', SLEEP(1) AS _sleep FROM DUAL", MYSQLI_ASYNC | MYSQLI_USE_RESULT);
$conn2->query("SELECT 1.1 as 'one dot one' FROM DUAL", MYSQLI_ASYNC | MYSQLI_USE_RESULT);
$links = array(
    $conn1->thread_id => array('link' => $conn1, 'processed' => false),
    $conn2->thread_id => array('link' => $conn2, 'processed' => false)
);
$saved_errors = array();
do {
    $poll_links = $poll_errors = $poll_reject = array();
    foreach ($links as $thread_id => $link) {
```

```
if (!$link['processed']) {
    $poll_links[] = $link['link'];
    $poll_errors[] = $link['link'];
    $poll_reject[] = $link['link'];
}
}
if (0 == count($poll_links))
    break;
if (0 == ($num_ready = mysqli_poll($poll_links, $poll_errors, $poll_reject, 0, 200000)))
    continue;
if (!empty($poll_errors)) {
    die(var_dump($poll_errors));
}
foreach ($poll_links as $link) {
    $thread_id = mysqli_thread_id($link);
    $links[$thread_id]['processed'] = true;
    if (is_object($res = mysqli_reap_async_query($link))) {
        // result set object
        while ($row = mysqli_fetch_assoc($res)) {
            // eat up all results
            var_dump($row);
        }
        mysqli_free_result($res);
    } else {
        // either there is no result (no SELECT) or there is an error
        if (mysqli_errno($link) > 0) {
            $saved_errors[$thread_id] = mysqli_errno($link);
            printf("'" . $link['query'] . "' caused %d\n", $links[$thread_id]['query'], mysqli_errno($link));
        }
    }
}
} while (true);
?>
```

The above example will output:

```
proxy::reapQuery(array (
  0 => NULL,
))
proxy::reapQuery returns true
array(1) {
  ["one dot one"]=>
  string(3) "1.1"
}
proxy::reapQuery(array (
  0 => NULL,
))
proxy::reapQuery returns true
array(2) {
  ["one"]=>
  string(1) "1"
  ["_sleep"]=>
  string(1) "0"
}
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_real_async_query](#)

7.9.7.33 MysqlndUhConnection::refreshServer

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- [MysqlndUhConnection::refreshServer](#)

Flush or reset tables and caches

Description

```
public bool MysqlndUhConnection::refreshServer(
    mysqlnd_connection connection,
    int options);
```

Flush or reset tables and caches.

Warning

This function is currently not documented; only its argument list is available.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
<i>options</i>	What to refresh.

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.373 `MysqlndUhConnection::refreshServer` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function refreshServer($res, $option) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::refreshServer($res, $option);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
mysqli_refresh($mysqli, 1);
?>
```

The above example will output:

```
proxy::refreshServer(array (
  0 => NULL,
  1 => 1,
))
proxy::refreshServer returns false
```

See Also

[mysqlnd_uh_set_connection_proxy](#)

7.9.7.34 `MysqlndUhConnection::restartPSession`

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- [MysqlndUhConnection::restartPSession](#)

Restart a persistent mysqlnd connection

Description

```
public bool MysqlndUhConnection::restartPSession(  
    mysqlnd_connection connection);
```

Restart a persistent mysqlnd connection.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.374 **MysqlndUhConnection::restartPSession** example

```
<?php  
class proxy extends MysqlndUhConnection {  
    public function ping($res) {  
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));  
        $ret = parent::__ping($res);  
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));  
        return $ret;  
    }  
}  
mysqlnd_uh_set_connection_proxy(new proxy());  
$mysqli = new mysqli("localhost", "root", "", "test");  
$mysqli->ping();  
?>
```

The above example will output:

```
proxy::restartPSession(array (  
    0 => NULL,  
)  
proxy::restartPSession returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)

7.9.7.35 **MysqlndUhConnection::selectDb**

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- [MysqlndUhConnection::selectDb](#)

Selects the default database for database queries

Description

```
public bool MysqlndUhConnection::selectDb(  
    mysqlnd_connection connection,  
    string database);
```

Selects the default database for database queries.

Parameters

connection Mysqlnd connection handle. Do not modify!

database The database name.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.375 `MysqlndUhConnection::selectDb` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function selectDb($res, $database) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::__selectDb($res, $database);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->select_db("mysql");
?>
```

The above example will output:

```
proxy::selectDb(array (
  0 => NULL,
  1 => 'mysql',
))
proxy::selectDb returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_select_db](#)
[mysql_select_db](#)

7.9.7.36 `MysqlndUhConnection::sendClose`

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- `MysqlndUhConnection::sendClose`

Sends a close command to MySQL

Description

```
public bool MysqlndUhConnection::sendClose(
    mysqlnd_connection connection);
```

Sends a close command to MySQL.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.376 MysqlndUhConnection::sendClose example

```
<?php
class proxy extends MysqlndUhConnection {
    public function sendClose($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::sendClose($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->close();
?>
```

The above example will output:

```
proxy::sendClose(array (
    0 => NULL,
))
proxy::sendClose returns true
proxy::sendClose(array (
    0 => NULL,
))
proxy::sendClose returns true
```

See Also

mysqlnd_uh_set_connection_proxy

7.9.7.37 MysqlndUhConnection::sendQuery

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- `MysqlndUhConnection::sendQuery`

Sends a query to MySQL

Description

```
public bool MysqlndUhConnection::sendQuery(  
    mysqlnd_connection connection,  
    string query);
```

Sends a query to MySQL.

Parameters

connection Mysqlnd connection handle. Do not modify!

query The query string.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.377 MysqlndUhConnection::sendQuery example

```
<?php
class proxy extends MysqlndUhConnection {
    public function sendQuery($res, $query) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::sendQuery($res, $query);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->query("SELECT 1");
?>
```

The above example will output:

```
proxy::sendQuery(array (
  0 => NULL,
  1 => 'SELECT 1',
))
proxy::sendQuery returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)

7.9.7.38 MysqlndUhConnection::serverDumpDebugInformation

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- [MysqlndUhConnection::serverDumpDebugInformation](#)

Dump debugging information into the log for the MySQL server

Description

```
public bool MysqlndUhConnection::serverDumpDebugInformation(
    mysqlnd_connection connection);
```

Dump debugging information into the log for the MySQL server.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
-------------------	---

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.378 MysqlndUhConnection::serverDumpDebugInformation example

```
<?php
class proxy extends MysqlndUhConnection {
    public function serverDumpDebugInformation($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::serverDumpDebugInformation($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
```

```
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->dump_debug_info();
?>
```

The above example will output:

```
proxy::serverDumpDebugInformation(array (
    0 => NULL,
))
proxy::serverDumpDebugInformation returns true
```

See Also

```
mysqlnd_uh_set_connection_proxy  
mysqli_dump_debug_info
```

7.9.7.39 MysqlndUhConnection::setAutocommit

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- `MysqlndUhConnection::setAutocommit`

Turns on or off auto-committing database modifications

Description

```
public bool MysqldUhConnection::setAutocommit(  
    mysqlnd_connection connection,  
    int mode);
```

Turns on or off auto-committing database modifications

Parameters

connection Mysqlind connection handle. Do not modify!

mode Whether to turn on auto-commit or not.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.379 `MysqlndUhConnection::setAutocommit` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function setAutocommit($res, $mode) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::setAutocommit($res, $mode);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->autocommit(false);
$mysqli->autocommit(true);
?>
```

The above example will output:

```
proxy::setAutocommit(array (
    0 => NULL,
    1 => 0,
))
proxy::setAutocommit returns true
proxy::setAutocommit(array (
    0 => NULL,
    1 => 1,
))
proxy::setAutocommit returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_autocommit](#)

7.9.7.40 MysqlndUhConnection::setCharset

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- [MysqlndUhConnection::setCharset](#)

Sets the default client character set

Description

```
public bool MysqlndUhConnection::setCharset(
    mysqlnd_connection connection,
    string charset);
```

Sets the default client character set.

Parameters

connection Mysqlnd connection handle. Do not modify!

charset The charset to be set as default.

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.380 MysqlndUhConnection::setCharset example

```
<?php
class proxy extends MysqlndUhConnection {
    public function setCharset($res, $charset) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::setCharset($res, $charset);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->set_charset("latin1");
?>
```

The above example will output:

```
proxy::setCharset(array (
  0 => NULL,
  1 => 'latin1',
))
proxy::setCharset returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_set_charset](#)

7.9.7.41 MysqlndUhConnection::setClientOption

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- [MysqlndUhConnection::setClientOption](#)

Sets a client option

Description

```
public bool MysqlndUhConnection::setClientOption(
    mysqlnd_connection connection,
    int option,
    int value);
```

Sets a client option.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
<i>option</i>	The option to be set.
<i>value</i>	Optional option value, if required.

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.381 MysqlndUhConnection::setClientOption example

```
<?php
function client_option_to_string($option) {
    static $mapping = array(
        MYSQLND_UH_MYSQLND_OPTION_OPT_CONNECT_TIMEOUT => "MYSQLND_UH_MYSQLND_OPTION_OPT_CONNECT_TIMEOUT",
        MYSQLND_UH_MYSQLND_OPTION_OPT_COMPRESS => "MYSQLND_UH_MYSQLND_OPTION_OPT_COMPRESS",
        MYSQLND_UH_MYSQLND_OPTION_OPT_NAMED_PIPE => "MYSQLND_UH_MYSQLND_OPTION_OPT_NAMED_PIPE",
        MYSQLND_UH_MYSQLND_OPTION_INIT_COMMAND => "MYSQLND_UH_MYSQLND_OPTION_INIT_COMMAND",
        MYSQLND_UH_MYSQLND_READ_DEFAULT_FILE => "MYSQLND_UH_MYSQLND_READ_DEFAULT_FILE",
        MYSQLND_UH_MYSQLND_READ_DEFAULT_GROUP => "MYSQLND_UH_MYSQLND_READ_DEFAULT_GROUP",
        MYSQLND_UH_MYSQLND_SET_CHARSET_DIR => "MYSQLND_UH_MYSQLND_SET_CHARSET_DIR",
        MYSQLND_UH_MYSQLND_SET_CHARSET_NAME => "MYSQLND_UH_MYSQLND_SET_CHARSET_NAME",
        MYSQLND_UH_MYSQLND_OPT_LOCAL_INFILE => "MYSQLND_UH_MYSQLND_OPT_LOCAL_INFILE",
        MYSQLND_UH_MYSQLND_OPT_PROTOCOL => "MYSQLND_UH_MYSQLND_OPT_PROTOCOL",
        MYSQLND_UH_MYSQLND_SHARED_MEMORY_BASE_NAME => "MYSQLND_UH_MYSQLND_SHARED_MEMORY_BASE_NAME",
        MYSQLND_UH_MYSQLND_OPT_READ_TIMEOUT => "MYSQLND_UH_MYSQLND_OPT_READ_TIMEOUT",
        MYSQLND_UH_MYSQLND_OPT_WRITE_TIMEOUT => "MYSQLND_UH_MYSQLND_OPT_WRITE_TIMEOUT",
        MYSQLND_UH_MYSQLND_OPT_USE_RESULT => "MYSQLND_UH_MYSQLND_OPT_USE_RESULT",
        MYSQLND_UH_MYSQLND_OPT_USE_REMOTE_CONNECTION => "MYSQLND_UH_MYSQLND_OPT_USE_REMOTE_CONNECTION",
```

```

MYSQLND_UH_MYSQLND_OPT_USE_EMBEDDED_CONNECTION => "MYSQLND_UH_MYSQLND_OPT_USE_EMBEDDED_CONNECTION",
MYSQLND_UH_MYSQLND_OPT_GUESS_CONNECTION => "MYSQLND_UH_MYSQLND_OPT_GUESS_CONNECTION",
MYSQLND_UH_MYSQLND_SET_CLIENT_IP => "MYSQLND_UH_MYSQLND_SET_CLIENT_IP",
MYSQLND_UH_MYSQLND_SECURE_AUTH => "MYSQLND_UH_MYSQLND_SECURE_AUTH",
MYSQLND_UH_MYSQLND_REPORT_DATA_TRUNCATION => "MYSQLND_UH_MYSQLND_REPORT_DATA_TRUNCATION",
MYSQLND_UH_MYSQLND_OPT_RECONNECT => "MYSQLND_UH_MYSQLND_OPT_RECONNECT",
MYSQLND_UH_MYSQLND_OPT_SSL_VERIFY_SERVER_CERT => "MYSQLND_UH_MYSQLND_OPT_SSL_VERIFY_SERVER_CERT",
MYSQLND_UH_MYSQLND_OPT_NET_CMD_BUFFER_SIZE => "MYSQLND_UH_MYSQLND_OPT_NET_CMD_BUFFER_SIZE",
MYSQLND_UH_MYSQLND_OPT_NET_READ_BUFFER_SIZE => "MYSQLND_UH_MYSQLND_OPT_NET_READ_BUFFER_SIZE",
MYSQLND_UH_MYSQLND_OPT_SSL_KEY => "MYSQLND_UH_MYSQLND_OPT_SSL_KEY",
MYSQLND_UH_MYSQLND_OPT_SSL_CERT => "MYSQLND_UH_MYSQLND_OPT_SSL_CERT",
MYSQLND_UH_MYSQLND_OPT_SSL_CA => "MYSQLND_UH_MYSQLND_OPT_SSL_CA",
MYSQLND_UH_MYSQLND_OPT_SSL_CAPATH => "MYSQLND_UH_MYSQLND_OPT_SSL_CAPATH",
MYSQLND_UH_MYSQLND_OPT_SSL_CIPHER => "MYSQLND_UH_MYSQLND_OPT_SSL_CIPHER",
MYSQLND_UH_MYSQLND_OPT_SSL_PASSPHRASE => "MYSQLND_UH_MYSQLND_OPT_SSL_PASSPHRASE",
MYSQLND_UH_SERVER_OPTION_PLUGIN_DIR => "MYSQLND_UH_SERVER_OPTION_PLUGIN_DIR",
MYSQLND_UH_SERVER_OPTION_DEFAULT_AUTH => "MYSQLND_UH_SERVER_OPTION_DEFAULT_AUTH",
MYSQLND_UH_SERVER_OPTION_SET_CLIENT_IP => "MYSQLND_UH_SERVER_OPTION_SET_CLIENT_IP"
);
if (version_compare(PHP_VERSION, '5.3.99-dev', '>')) {
    $mapping[MYSQLND_UH_MYSQLND_OPT_MAX_ALLOWED_PACKET] = "MYSQLND_UH_MYSQLND_OPT_MAX_ALLOWED_PACKET";
    $mapping[MYSQLND_UH_MYSQLND_OPT_AUTH_PROTOCOL] = "MYSQLND_UH_MYSQLND_OPT_AUTH_PROTOCOL";
}
if (defined("MYSQLND_UH_MYSQLND_OPT_INT_AND_FLOAT_NATIVE")) {
    /* special mysqlnd build */
    $mapping["MYSQLND_UH_MYSQLND_OPT_INT_AND_FLOAT_NATIVE"] = "MYSQLND_UH_MYSQLND_OPT_INT_AND_FLOAT_NATIVE";
}
return (isset($mapping[$option])) ? $mapping[$option] : 'unknown';
}
class proxy extends MysqldUhConnection {
    public function setClientOption($res, $option, $value) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        printf("Option '%s' set to %s\n", client_option_to_string($option), var_export($value, true));
        $ret = parent::setClientOption($res, $option, $value);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
?>

```

The above example will output:

```

proxy::setClientOption(array (
  0 => NULL,
  1 => 210,
  2 => 3221225472,
))
Option 'MYSQLND_UH_MYSQLND_OPT_MAX_ALLOWED_PACKET' set to 3221225472
proxy::setClientOption returns true
proxy::setClientOption(array (
  0 => NULL,
  1 => 211,
  2 => 'mysql_native_password',
))
Option 'MYSQLND_UH_MYSQLND_OPT_AUTH_PROTOCOL' set to 'mysql_native_password'
proxy::setClientOption returns true
proxy::setClientOption(array (
  0 => NULL,
  1 => 8,
  2 => 1,
))
Option 'MYSQLND_UH_MYSQLND_OPT_LOCAL_INFILE' set to 1
proxy::setClientOption returns true

```

See Also

```
mysqlnd_uh_set_connection_proxy  
mysqli_real_connect  
mysqli_options
```

7.9.7.42 MysqlndUhConnection::setServerOption

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- **MysqlndUhConnection::setServerOption**

Sets a server option

Description

```
public void MysqlndUhConnection::setServerOption(  
    mysqlnd_connection connection,  
    int option);
```

Sets a server option.

Parameters

connection Mysqlnd connection handle. Do not modify!

option The option to be set.

Return Values

Returns **TRUE** on success. Otherwise, returns **FALSE**

Examples

Example 7.382 MysqlndUhConnection::setServerOption example

```
<?php  
function server_option_to_string($option) {  
    $ret = 'unknown';  
    switch ($option) {  
        case MYSQLND_UH_SERVER_OPTION_MULTI_STATEMENTS_ON:  
            $ret = 'MYSQLND_UH_SERVER_OPTION_MULTI_STATEMENTS_ON';  
            break;  
        case MYSQLND_UH_SERVER_OPTION_MULTI_STATEMENTS_OFF:  
            $ret = 'MYSQLND_UH_SERVER_OPTION_MULTI_STATEMENTS_ON';  
            break;  
    }  
    return $ret;  
}  
class proxy extends MysqlndUhConnection {  
    public function setServerOption($res, $option) {  
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));  
        printf("Option '%s' set\n", server_option_to_string($option));  
        $ret = parent::__setServerOption($res, $option);  
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));  
        return $ret;  
    }  
}  
mysqlnd_uh_set_connection_proxy(new proxy());  
$mysqli = new mysqli("localhost", "root", "", "test");  
$mysqli->multi_query("SELECT 1; SELECT 2");  
?>
```

The above example will output:

```
proxy::__setServerOption(array (
```

```

    0 => NULL,
    1 => 0,
))
Option 'MYSQLND_UH_SERVER_OPTION_MULTI_STATEMENTS_ON' set
proxy::setServerOption returns true

```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_real_connect](#)
[mysqli_options](#)
[mysqli_multi_query](#)

7.9.7.43 MysqlndUhConnection::shutdownServer

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- [MysqlndUhConnection::shutdownServer](#)

The shutdownServer purpose

Description

```

public void MysqlndUhConnection::shutdownServer(
    string MYSQLND_UH_RES_MYSQLND_NAME,
    string level);

```

Warning

This function is currently not documented; only its argument list is available.

Parameters

MYSQLND_UH_RES_MYSQLND_NAME
level

Return Values**7.9.7.44 MysqlndUhConnection::simpleCommand**

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- [MysqlndUhConnection::simpleCommand](#)

Sends a basic COM_* command

Description

```

public bool MysqlndUhConnection::simpleCommand(
    mysqlnd_connection connection,
    int command,
    string arg,
    int ok_packet,
    bool silent,
    bool ignore_upsert_status);

```

Sends a basic COM_* command to MySQL.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
-------------------	---

<i>command</i>	The COM command to be send.
<i>arg</i>	Optional COM command arguments.
<i>ok_packet</i>	The OK packet type.
<i>silent</i>	Whether mysqlnd may emit errors.
<i>ignore_upsert_status</i>	Whether to ignore <code>UPDATE/INSERT</code> status.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.383 `MysqlndUhConnection::simpleCommand` example

```
<?php
function server_cmd_2_string($command) {
    $mapping = array(
        MYSQLND_UH_MYSQLND_COM_SLEEP => "MYSQLND_UH_MYSQLND_COM_SLEEP",
        MYSQLND_UH_MYSQLND_COM_QUIT => "MYSQLND_UH_MYSQLND_COM_QUIT",
        MYSQLND_UH_MYSQLND_COM_INIT_DB => "MYSQLND_UH_MYSQLND_COM_INIT_DB",
        MYSQLND_UH_MYSQLND_COM_QUERY => "MYSQLND_UH_MYSQLND_COM_QUERY",
        MYSQLND_UH_MYSQLND_COM_FIELD_LIST => "MYSQLND_UH_MYSQLND_COM_FIELD_LIST",
        MYSQLND_UH_MYSQLND_COM_CREATE_DB => "MYSQLND_UH_MYSQLND_COM_CREATE_DB",
        MYSQLND_UH_MYSQLND_COM_DROP_DB => "MYSQLND_UH_MYSQLND_COM_DROP_DB",
        MYSQLND_UH_MYSQLND_COM_REFRESH => "MYSQLND_UH_MYSQLND_COM_REFRESH",
        MYSQLND_UH_MYSQLND_COM_SHUTDOWN => "MYSQLND_UH_MYSQLND_COM_SHUTDOWN",
        MYSQLND_UH_MYSQLND_COM_STATISTICS => "MYSQLND_UH_MYSQLND_COM_STATISTICS",
        MYSQLND_UH_MYSQLND_COM_PROCESS_INFO => "MYSQLND_UH_MYSQLND_COM_PROCESS_INFO",
        MYSQLND_UH_MYSQLND_COM_CONNECT => "MYSQLND_UH_MYSQLND_COM_CONNECT",
        MYSQLND_UH_MYSQLND_COM_PROCESS_KILL => "MYSQLND_UH_MYSQLND_COM_PROCESS_KILL",
        MYSQLND_UH_MYSQLND_COM_DEBUG => "MYSQLND_UH_MYSQLND_COM_DEBUG",
        MYSQLND_UH_MYSQLND_COM_PING => "MYSQLND_UH_MYSQLND_COM_PING",
        MYSQLND_UH_MYSQLND_COM_TIME => "MYSQLND_UH_MYSQLND_COM_TIME",
        MYSQLND_UH_MYSQLND_COM_DELAYED_INSERT => "MYSQLND_UH_MYSQLND_COM_DELAYED_INSERT",
        MYSQLND_UH_MYSQLND_COM_CHANGE_USER => "MYSQLND_UH_MYSQLND_COM_CHANGE_USER",
        MYSQLND_UH_MYSQLND_COM_BINLOG_DUMP => "MYSQLND_UH_MYSQLND_COM_BINLOG_DUMP",
        MYSQLND_UH_MYSQLND_COM_TABLE_DUMP => "MYSQLND_UH_MYSQLND_COM_TABLE_DUMP",
        MYSQLND_UH_MYSQLND_COM_CONNECT_OUT => "MYSQLND_UH_MYSQLND_COM_CONNECT_OUT",
        MYSQLND_UH_MYSQLND_COM_REGISTER_SLAVE => "MYSQLND_UH_MYSQLND_COM_REGISTER_SLAVE",
        MYSQLND_UH_MYSQLND_COM_STMT_PREPARE => "MYSQLND_UH_MYSQLND_COM_STMT_PREPARE",
        MYSQLND_UH_MYSQLND_COM_STMT_EXECUTE => "MYSQLND_UH_MYSQLND_COM_STMT_EXECUTE",
        MYSQLND_UH_MYSQLND_COM_STMT_SEND_LONG_DATA => "MYSQLND_UH_MYSQLND_COM_STMT_SEND_LONG_DATA",
        MYSQLND_UH_MYSQLND_COM_STMT_CLOSE => "MYSQLND_UH_MYSQLND_COM_STMT_CLOSE",
        MYSQLND_UH_MYSQLND_COM_STMT_RESET => "MYSQLND_UH_MYSQLND_COM_STMT_RESET",
        MYSQLND_UH_MYSQLND_COM_SET_OPTION => "MYSQLND_UH_MYSQLND_COM_SET_OPTION",
        MYSQLND_UH_MYSQLND_COM_STMT_FETCH => "MYSQLND_UH_MYSQLND_COM_STMT_FETCH",
        MYSQLND_UH_MYSQLND_COM_DAEMON => "MYSQLND_UH_MYSQLND_COM_DAEMON",
        MYSQLND_UH_MYSQLND_COM_END => "MYSQLND_UH_MYSQLND_COM_END",
    );
    return (isset($mapping[$command])) ? $mapping[$command] : 'unknown';
}
function ok_packet_2_string($ok_packet) {
    $mapping = array(
        MYSQLND_UH_MYSQLND_PROT_GREET_PACKET => "MYSQLND_UH_MYSQLND_PROT_GREET_PACKET",
        MYSQLND_UH_MYSQLND_PROT_AUTH_PACKET => "MYSQLND_UH_MYSQLND_PROT_AUTH_PACKET",
        MYSQLND_UH_MYSQLND_PROT_OK_PACKET => "MYSQLND_UH_MYSQLND_PROT_OK_PACKET",
        MYSQLND_UH_MYSQLND_PROT_EOF_PACKET => "MYSQLND_UH_MYSQLND_PROT_EOF_PACKET",
        MYSQLND_UH_MYSQLND_PROT_CMD_PACKET => "MYSQLND_UH_MYSQLND_PROT_CMD_PACKET",
        MYSQLND_UH_MYSQLND_PROT_RSET_HEADER_PACKET => "MYSQLND_UH_MYSQLND_PROT_RSET_HEADER_PACKET",
        MYSQLND_UH_MYSQLND_PROT_RSET_FLD_PACKET => "MYSQLND_UH_MYSQLND_PROT_RSET_FLD_PACKET",
        MYSQLND_UH_MYSQLND_PROT_ROW_PACKET => "MYSQLND_UH_MYSQLND_PROT_ROW_PACKET",
        MYSQLND_UH_MYSQLND_PROT_STATS_PACKET => "MYSQLND_UH_MYSQLND_PROT_STATS_PACKET",
        MYSQLND_UH_MYSQLND_PREPARE_RESP_PACKET => "MYSQLND_UH_MYSQLND_PREPARE_RESP_PACKET",
        MYSQLND_UH_MYSQLND_CHG_USER_RESP_PACKET => "MYSQLND_UH_MYSQLND_CHG_USER_RESP_PACKET",
        MYSQLND_UH_MYSQLND_PROT_LAST => "MYSQLND_UH_MYSQLND_PROT_LAST",
    );
}
```

```
);
return (isset($mapping[$ok_packet])) ? $mapping[$ok_packet] : 'unknown';
}
class proxy extends MysqlndUhConnection {
public function simpleCommand($conn, $command, $arg, $ok_packet, $silent, $ignore_upsert_status) {
printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
printf("Command '%s'\n", server_cmd_2_string($command));
printf("OK packet '%s'\n", ok_packet_2_string($ok_packet));
$ret = parent::simpleCommand($conn, $command, $arg, $ok_packet, $silent, $ignore_upsert_status);
printf("%s returns %s\n", __METHOD__, var_export($ret, true));
return $ret;
}
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->query("SELECT 1");
?>
```

The above example will output:

```
proxy::simpleCommand(array (
  0 => NULL,
  1 => 3,
  2 => 'SELECT 1',
  3 => 13,
  4 => false,
  5 => false,
))
Command 'MYSQLND_UH_MYSQLND_COM_QUERY'
OK packet 'MYSQLND_UH_MYSQLND_PROT_LAST'
proxy::simpleCommand returns true
:)proxy::simpleCommand(array (
  0 => NULL,
  1 => 1,
  2 => '',
  3 => 13,
  4 => true,
  5 => true,
))
Command 'MYSQLND_UH_MYSQLND_COM_QUIT'
OK packet 'MYSQLND_UH_MYSQLND_PROT_LAST'
proxy::simpleCommand returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)

7.9.7.45 MysqlndUhConnection::simpleCommandHandleResponse

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- [MysqlndUhConnection::simpleCommandHandleResponse](#)

Process a response for a basic COM_* command send to the client

Description

```
public bool MysqlndUhConnection::simpleCommandHandleResponse(
    mysqlnd_connection connection,
    int ok_packet,
    bool silent,
    int command,
    bool ignore_upsert_status);
```

Process a response for a basic COM_* command send to the client.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
<i>ok_packet</i>	The OK packet type.
<i>silent</i>	Whether mysqlnd may emit errors.
<i>command</i>	The COM command to process results from.
<i>ignore_upsert_status</i>	Whether to ignore UPDATE/INSERT status.

Return Values

Returns TRUE on success. Otherwise, returns FALSE

Examples

Example 7.384 MysqlndUhConnection::simpleCommandHandleResponse example

```
<?php
function server_cmd_2_string($command) {
    $mapping = array(
        MYSQLND_UH_MYSQLND_COM_SLEEP => "MYSQLND_UH_MYSQLND_COM_SLEEP",
        MYSQLND_UH_MYSQLND_COM_QUIT => "MYSQLND_UH_MYSQLND_COM_QUIT",
        MYSQLND_UH_MYSQLND_COM_INIT_DB => "MYSQLND_UH_MYSQLND_COM_INIT_DB",
        MYSQLND_UH_MYSQLND_COM_QUERY => "MYSQLND_UH_MYSQLND_COM_QUERY",
        MYSQLND_UH_MYSQLND_COM_FIELD_LIST => "MYSQLND_UH_MYSQLND_COM_FIELD_LIST",
        MYSQLND_UH_MYSQLND_COM_CREATE_DB => "MYSQLND_UH_MYSQLND_COM_CREATE_DB",
        MYSQLND_UH_MYSQLND_COM_DROP_DB => "MYSQLND_UH_MYSQLND_COM_DROP_DB",
        MYSQLND_UH_MYSQLND_COM_REFRESH => "MYSQLND_UH_MYSQLND_COM_REFRESH",
        MYSQLND_UH_MYSQLND_COM_SHUTDOWN => "MYSQLND_UH_MYSQLND_COM_SHUTDOWN",
        MYSQLND_UH_MYSQLND_COM_STATISTICS => "MYSQLND_UH_MYSQLND_COM_STATISTICS",
        MYSQLND_UH_MYSQLND_COM_PROCESS_INFO => "MYSQLND_UH_MYSQLND_COM_PROCESS_INFO",
        MYSQLND_UH_MYSQLND_COM_CONNECT => "MYSQLND_UH_MYSQLND_COM_CONNECT",
        MYSQLND_UH_MYSQLND_COM_PROCESS_KILL => "MYSQLND_UH_MYSQLND_COM_PROCESS_KILL",
        MYSQLND_UH_MYSQLND_COM_DEBUG => "MYSQLND_UH_MYSQLND_COM_DEBUG",
        MYSQLND_UH_MYSQLND_COM_PING => "MYSQLND_UH_MYSQLND_COM_PING",
        MYSQLND_UH_MYSQLND_COM_TIME => "MYSQLND_UH_MYSQLND_COM_TIME",
        MYSQLND_UH_MYSQLND_COM_DELAYED_INSERT => "MYSQLND_UH_MYSQLND_COM_DELAYED_INSERT",
        MYSQLND_UH_MYSQLND_COM_CHANGE_USER => "MYSQLND_UH_MYSQLND_COM_CHANGE_USER",
        MYSQLND_UH_MYSQLND_COM_BINLOG_DUMP => "MYSQLND_UH_MYSQLND_COM_BINLOG_DUMP",
        MYSQLND_UH_MYSQLND_COM_TABLE_DUMP => "MYSQLND_UH_MYSQLND_COM_TABLE_DUMP",
        MYSQLND_UH_MYSQLND_COM_CONNECT_OUT => "MYSQLND_UH_MYSQLND_COM_CONNECT_OUT",
        MYSQLND_UH_MYSQLND_COM_REGISTER_SLAVE => "MYSQLND_UH_MYSQLND_COM_REGISTER_SLAVE",
        MYSQLND_UH_MYSQLND_COM_STMT_PREPARE => "MYSQLND_UH_MYSQLND_COM_STMT_PREPARE",
        MYSQLND_UH_MYSQLND_COM_STMT_EXECUTE => "MYSQLND_UH_MYSQLND_COM_STMT_EXECUTE",
        MYSQLND_UH_MYSQLND_COM_STMT_SEND_LONG_DATA => "MYSQLND_UH_MYSQLND_COM_STMT_SEND_LONG_DATA",
        MYSQLND_UH_MYSQLND_COM_STMT_CLOSE => "MYSQLND_UH_MYSQLND_COM_STMT_CLOSE",
        MYSQLND_UH_MYSQLND_COM_STMT_RESET => "MYSQLND_UH_MYSQLND_COM_STMT_RESET",
        MYSQLND_UH_MYSQLND_COM_SET_OPTION => "MYSQLND_UH_MYSQLND_COM_SET_OPTION",
        MYSQLND_UH_MYSQLND_COM_STMT_FETCH => "MYSQLND_UH_MYSQLND_COM_STMT_FETCH",
        MYSQLND_UH_MYSQLND_COM_DAEMON => "MYSQLND_UH_MYSQLND_COM_DAEMON",
        MYSQLND_UH_MYSQLND_COM_END => "MYSQLND_UH_MYSQLND_COM_END",
    );
    return (isset($mapping[$command])) ? $mapping[$command] : 'unknown';
}
function ok_packet_2_string($ok_packet) {
    $mapping = array(
        MYSQLND_UH_MYSQLND_PROT_GREET_PACKET => "MYSQLND_UH_MYSQLND_PROT_GREET_PACKET",
        MYSQLND_UH_MYSQLND_PROT_AUTH_PACKET => "MYSQLND_UH_MYSQLND_PROT_AUTH_PACKET",
        MYSQLND_UH_MYSQLND_PROT_OK_PACKET => "MYSQLND_UH_MYSQLND_PROT_OK_PACKET",
        MYSQLND_UH_MYSQLND_PROT_EOF_PACKET => "MYSQLND_UH_MYSQLND_PROT_EOF_PACKET",
        MYSQLND_UH_MYSQLND_PROT_CMD_PACKET => "MYSQLND_UH_MYSQLND_PROT_CMD_PACKET",
        MYSQLND_UH_MYSQLND_PROT_RSET_HEADER_PACKET => "MYSQLND_UH_MYSQLND_PROT_RSET_HEADER_PACKET",
        MYSQLND_UH_MYSQLND_PROT_RSET_FLD_PACKET => "MYSQLND_UH_MYSQLND_PROT_RSET_FLD_PACKET",
        MYSQLND_UH_MYSQLND_PROT_ROW_PACKET => "MYSQLND_UH_MYSQLND_PROT_ROW_PACKET",
        MYSQLND_UH_MYSQLND_PROT_STATS_PACKET => "MYSQLND_UH_MYSQLND_PROT_STATS_PACKET",
        MYSQLND_UH_MYSQLND_PREPARE_RESP_PACKET => "MYSQLND_UH_MYSQLND_PREPARE_RESP_PACKET",
    );
}
```

```

MYSQLND_UH_MYSQLND_CHG_USER_RESP_PACKET => "MYSQLND_UH_MYSQLND_CHG_USER_RESP_PACKET",
MYSQLND_UH_MYSQLND_PROT_LAST => "MYSQLND_UH_MYSQLND_PROT_LAST",
);
return (isset($mapping[$ok_packet])) ? $mapping[$ok_packet] : 'unknown';
}
class proxy extends MysqlndUhConnection {
public function simpleCommandHandleResponse($conn, $ok_packet, $silent, $command, $ignore_upsert_status) {
printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
printf("Command '%s'\n", server_cmd_2_string($command));
printf("OK packet '%s'\n", ok_packet_2_string($ok_packet));
$ret = parent::simpleCommandHandleResponse($conn, $ok_packet, $silent, $command, $ignore_upsert_status);
printf("%s returns %s\n", __METHOD__, var_export($ret, true));
return $ret;
}
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysql = mysql_connect("localhost", "root", "");
mysql_query("SELECT 1 FROM DUAL", $mysql);
?>

```

The above example will output:

```

proxy::simpleCommandHandleResponse(array (
  0 => NULL,
  1 => 5,
  2 => false,
  3 => 27,
  4 => true,
))
Command 'MYSQLND_UH_MYSQLND_COM_SET_OPTION'
OK packet 'MYSQLND_UH_MYSQLND_PROT_EOF_PACKET'
proxy::simpleCommandHandleResponse returns true

```

See Also

[mysqlnd_uh_set_connection_proxy](#)

7.9.7.46 MysqlndUhConnection::sslSet

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- [MysqlndUhConnection::sslSet](#)

Used for establishing secure connections using SSL

Description

```

public bool MysqlndUhConnection::sslSet(
    mysqlnd_connection connection,
    string key,
    string cert,
    string ca,
    string capath,
    string cipher);

```

Used for establishing secure connections using SSL.

Parameters

<i>connection</i>	Mysqlnd connection handle. Do not modify!
<i>key</i>	The path name to the key file.
<i>cert</i>	The path name to the certificate file.

ca

The path name to the certificate authority file.

capath

The pathname to a directory that contains trusted SSL CA certificates in PEM format.

cipher

A list of allowable ciphers to use for SSL encryption.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.385 `MysqlndUhConnection::sslSet` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function sslSet($conn, $key, $cert, $ca, $capath, $cipher) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::__METHOD__($conn, $key, $cert, $ca, $capath, $cipher);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->ssl_set("key", "cert", "ca", "capath", "cipher");
?>
```

The above example will output:

```
proxy::sslSet(array (
  0 => NULL,
  1 => 'key',
  2 => 'cert',
  3 => 'ca',
  4 => 'capath',
  5 => 'cipher',
))
proxy::sslSet returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_ssl_set](#)

7.9.7.47 `MysqlndUhConnection::stmtInit`

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- [`MysqlndUhConnection::stmtInit`](#)

Initializes a statement and returns a resource for use with `mysqli_statement::prepare`

Description

```
public resource MysqlndUhConnection::stmtInit(
    mysqlnd_connection connection);
```

Initializes a statement and returns a resource for use with `mysqli_statement::prepare`.

Parameters

connection

Mysqlnd connection handle. Do not modify!

Return Values

Resource of type `Mysqlnd Prepared Statement (internal only - you must not modify it!)`. The documentation may also refer to such resources using the alias name `mysqlnd_prepared_statement`.

Examples

Example 7.386 `MysqlndUhConnection::stmtInit` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function stmtInit($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        var_dump($res);
        $ret = parent::stmtInit($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        var_dump($ret);
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$stmt = $mysqli->prepare("SELECT 1 AS _one FROM DUAL");
$stmt->execute();
$one = NULL;
$stmt->bind_result($one);
$stmt->fetch();
var_dump($one);
?>
```

The above example will output:

```
proxy::stmtInit(array (
  0 => NULL,
))
resource(19) of type (Mysqlnd Connection)
proxy::stmtInit returns NULL
resource(246) of type (Mysqlnd Prepared Statement (internal only - you must not modify it!))
int(1)
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_stmt_init](#)

7.9.7.48 `MysqlndUhConnection::storeResult`

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- [MysqlndUhConnection::storeResult](#)

Transfers a result set from the last query

Description

```
public resource MysqlndUhConnection::storeResult(
    mysqlnd_connection connection);
```

Transfers a result set from the last query.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Resource of type `Mysqlnd Resultset (internal only - you must not modify it!)`. The documentation may also refer to such resources using the alias name `mysqlnd_resultset`.

Examples

Example 7.387 `MysqlndUhConnection::storeResult` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function storeResult($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::__storeResult($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        var_dump($ret);
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$res = $mysqli->query("SELECT 'Also called buffered result' AS _msg FROM DUAL");
var_dump($res->fetch_assoc());
$mysqli->real_query("SELECT 'Good morning!' AS _msg FROM DUAL");
$res = $mysqli->store_result();
var_dump($res->fetch_assoc());
?>
```

The above example will output:

```
proxy::storeResult(array (
  0 => NULL,
))
proxy::storeResult returns NULL
resource(475) of type (Mysqlnd Resultset (internal only - you must not modify it!))
array(1) {
  ["_msg"]=>
  string(27) "Also called buffered result"
}
proxy::storeResult(array (
  0 => NULL,
))
proxy::storeResult returns NULL
resource(730) of type (Mysqlnd Resultset (internal only - you must not modify it!))
array(1) {
  ["_msg"]=>
  string(13) "Good morning!"
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_store_result](#)
[mysqli_real_query](#)

7.9.7.49 `MysqlndUhConnection::txCommit`

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- [MysqlndUhConnection::txCommit](#)

Commits the current transaction

Description

```
public bool MysqlndUhConnection::txCommit(
    mysqlnd_connection connection);
```

Commits the current transaction.

Parameters

connection Mysqlnd connection handle. Do not modify!

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.388 `MysqlndUhConnection::txCommit` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function txCommit($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::txCommit($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->commit();
?>
```

The above example will output:

```
proxy::txCommit(array (
  0 => NULL,
))
proxy::txCommit returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_commit](#)

7.9.7.50 `MysqlndUhConnection::txRollback`

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- [MysqlndUhConnection::txRollback](#)

Rolls back current transaction

Description

```
public bool MysqlndUhConnection::txRollback(
```

```
mysqlnd_connection connection);
```

Rolls back current transaction.

Parameters

connection

Mysqlnd connection handle. Do not modify!

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.389 `MysqlndUhConnection::txRollback` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function txRollback($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::__txRollback($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->rollback();
?>
```

The above example will output:

```
proxy::txRollback(array (
  0 => NULL,
))
proxy::txRollback returns true
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_commit](#)

7.9.7.51 `MysqlndUhConnection::useResult`

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- [`MysqlndUhConnection::useResult`](#)

Initiate a result set retrieval

Description

```
public resource MysqlndUhConnection::useResult(
    mysqlnd_connection connection);
```

Initiate a result set retrieval.

Parameters

connection

Mysqlnd connection handle. Do not modify!

Return Values

Resource of type `Mysqlnd Resultset (internal only - you must not modify it!)`. The documentation may also refer to such resources using the alias name `mysqlnd_resultset`.

Examples

Example 7.390 `MysqlndUhConnection::useResult` example

```
<?php
class proxy extends MysqlndUhConnection {
    public function useResult($res) {
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
        $ret = parent::useResult($res);
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));
        var_dump($ret);
        return $ret;
    }
}
mysqlnd_uh_set_connection_proxy(new proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$mysqli->real_query("SELECT 'Good morning!' AS _msg FROM DUAL");
$res = $mysqli->use_result();
var_dump($res->fetch_assoc());
?>
```

The above example will output:

```
proxy::useResult(array (
  0 => NULL,
))
proxy::useResult returns NULL
resource(425) of type (Mysqlnd Resultset (internal only - you must not modify it!))
array(1) {
  ["_msg"]=>
  string(13) "Good morning!"
```

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqli_use_result](#)
[mysqli_real_query](#)

7.9.8 The MysqlndUhPreparedStatement class

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```
MysqlndUhPreparedStatement {
MysqlndUhPreparedStatement
    Methods

    public MysqlndUhPreparedStatement::__construct();

    public bool MysqlndUhPreparedStatement::execute(
        mysqlnd_prepared_statement statement);

    public bool MysqlndUhPreparedStatement::prepare(
        mysqlnd_prepared_statement statement,
        string query);
```

```
}
```

7.9.8.1 MysqlndUhPreparedStatement::__construct

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- `MysqlndUhPreparedStatement::__construct`

The __construct purpose

Description

```
public MysqlndUhPreparedStatement::__construct();
```

Warning

This function is currently not documented; only its argument list is available.

Parameters

This function has no parameters.

Return Values

7.9.8.2 MysqlndUhPreparedStatement::execute

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- `MysqlndUhPreparedStatement::execute`

Executes a prepared Query

Description

```
public bool MysqlndUhPreparedStatement::execute(  
    mysqlnd_prepared_statement statement);
```

Executes a prepared Query.

Parameters

`statement`

Mysqlnd prepared statement handle. Do not modify! Resource of type `Mysqlnd Prepared Statement (internal only - you must not modify it!)`.

Return Values

Returns `TRUE` on success. Otherwise, returns `FALSE`

Examples

Example 7.391 MysqlndUhPreparedStatement::execute example

```
<?php  
class stmt_proxy extends MysqlndUhPreparedStatement {  
    public function execute($res) {  
        printf("%s(%s)", __METHOD__);  
        var_dump($res);  
        printf("\n");  
        $ret = parent::__execute($res);  
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));  
        var_dump($ret);
```

```
        return $ret;
    }
}
mysqlnd_uh_set_statement_proxy(new stmt_proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$stmt = $mysqli->prepare("SELECT 'Labskaus' AS _msg FROM DUAL");
$stmt->execute();
$msg = NULL;
$stmt->bind_result($msg);
$stmt->fetch();
var_dump($msg);
?>
```

The above example will output:

```
stmt_proxy::execute(resource(256) of type (Mysqlnd Prepared Statement (internal only - you must not modify it))
stmt_proxy::execute returns true
bool(true)
string(8) "Labskaus"
```

See Also

[mysqlnd_uh_set_statement_proxy](#)
[mysqli_stmt_execute](#)

7.9.8.3 MysqlndUhPreparedStatement::prepare

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- [MysqlndUhPreparedStatement::prepare](#)

Prepare an SQL statement for execution

Description

```
public bool MysqlndUhPreparedStatement::prepare(
    mysqlnd_prepared_statement statement,
    string query);
```

Prepare an SQL statement for execution.

Parameters

statement Mysqlnd prepared statement handle. Do not modify! Resource of type [Mysqlnd Prepared Statement \(internal only - you must not modify it!\)](#).

query The query to be prepared.

Return Values

Returns [TRUE](#) on success. Otherwise, returns [FALSE](#)

Examples

Example 7.392 MysqlndUhPreparedStatement::prepare example

```
<?php
class stmt_proxy extends MysqlndUhPreparedStatement {
    public function prepare($res, $query) {
```

```
printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));
$query = "SELECT 'No more you-know-what-I-mean for lunch, please' AS _msg FROM DUAL";
$ret = parent::prepare($res, $query);
printf("%s returns %s\n", __METHOD__, var_export($ret, true));
var_dump($ret);
return $ret;
}
}
mysqlnd_uh_set_statement_proxy(new stmt_proxy());
$mysqli = new mysqli("localhost", "root", "", "test");
$stmt = $mysqli->prepare("SELECT 'Labskaus' AS _msg FROM DUAL");
$stmt->execute();
$msg = NULL;
$stmt->bind_result($msg);
$stmt->fetch();
var_dump($msg);
?>
```

The above example will output:

```
stmt_proxy::prepare(array (
  0 => NULL,
  1 => 'SELECT \'Labskaus\' AS _msg FROM DUAL',
))
stmt_proxy::prepare returns true
bool(true)
string(46) "No more you-know-what-I-mean for lunch, please"
```

See Also

[mysqlnd_uh_set_statement_proxy](#)
[mysqli_stmt_prepare](#)
[mysqli_prepare](#)

7.9.9 Mysqlnd_uh Functions

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7.9.9.1 mysqlnd_uh_convert_to_mysqlnd

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- [mysqlnd_uh_convert_to_mysqlnd](#)

Converts a MySQL connection handle into a mysqlnd connection handle

Description

```
resource mysqlnd_uh_convert_to_mysqlnd(
    mysqli mysql_connection);
```

Converts a MySQL connection handle into a mysqlnd connection handle. After conversion you can execute mysqlnd library calls on the connection handle. This can be used to access mysqlnd functionality not made available through user space API calls.

The function can be disabled with [mysqlnd_uh.enable](#). If [mysqlnd_uh.enable](#) is set to [FALSE](#) the function will not install the proxy and always return [TRUE](#). Additionally, an error of the type [E_WARNING](#) may be emitted. The error message may read like [PHP Warning: mysqlnd_uh_convert_to_mysqlnd\(\): \(Mysqlnd User Handler\) The plugin has been disabled by setting the configuration parameter mysqlnd_uh.enable = false. You are not allowed to call this function \[...\]](#).

Parameters

MySQL connection handle A MySQL connection handle of type mysql, mysqli or PDO_MySQL.

Return Values

A mysqlnd connection handle.

Changelog

Version	Description
5.4.0	The <i>mysql_connection</i> parameter can now be of type mysql, PDO_MySQL, or mysqli. Before, only the mysqli type was allowed.

Examples

Example 7.393 mysqlnd_uh_convert_to_mysqlnd example

```
<?php
/* PDO user API gives no access to connection thread id */
$mysql_connection = new PDO("mysql:host=localhost;dbname=test", "root", "");
/* Convert PDO MySQL handle to mysqlnd handle */
$mysqlnd = mysqlnd_uh_convert_to_mysqlnd($mysql_connection);
/* Create Proxy to call mysqlnd connection class methods */
$obj = new MySQLndUHConnection();
/* Call mysqlnd_conn::get_thread_id */
var_dump($obj->getThreadId($mysqlnd));
/* Use SQL to fetch connection thread id */
var_dump($mysql_connection->query("SELECT CONNECTION_ID()")->fetchAll());
?>
```

The above example will output:

```
int(27054)
array(1) {
  [0]=>
  array(2) {
    ["CONNECTION_ID()"]=>
    string(5) "27054"
    [0]=>
    string(5) "27054"
  }
}
```

See Also

[mysqlnd_uh.enable](#)

7.9.9.2 mysqlnd_uh_set_connection_proxy

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- [mysqlnd_uh_set_connection_proxy](#)

Installs a proxy for mysqlnd connections

Description

```
bool mysqlnd_uh_set_connection_proxy(
```

```
MysqlndUhConnection connection_proxy,  
mysqli mysqli_connection);
```

Installs a proxy object to hook mysqlnd's connection objects methods. Once installed, the proxy will be used for all MySQL connections opened with [mysqli](#), [mysql](#) or [PDO_MYSQL](#), assuming that the listed extensions are compiled to use the [mysqlnd](#) library.

The function can be disabled with [mysqlnd_uh.enable](#). If [mysqlnd_uh.enable](#) is set to [FALSE](#) the function will not install the proxy and always return [TRUE](#). Additionally, an error of the type [E_WARNING](#) may be emitted. The error message may read like [PHP Warning: mysqlnd_uh_set_connection_proxy\(\): \(Mysqlnd User Handler\) The plugin has been disabled by setting the configuration parameter mysqlnd_uh.enable = false. The proxy has not been installed \[...\]](#).

Parameters

[connection_proxy](#) A proxy object of type [MysqlndUhConnection](#).

[mysqli_connection](#) Object of type [mysqli](#). If given, the proxy will be set for this particular connection only.

Return Values

Returns [TRUE](#) on success. Otherwise, returns [FALSE](#)

Examples

Example 7.394 [mysqlnd_uh_set_connection_proxy](#) example

```
<?php  
$mysqli = new mysqli("localhost", "root", "", "test");  
$mysqli->query("SELECT 'No proxy installed, yet'");  
class proxy extends MysqlndUhConnection {  
    public function query($res, $query) {  
        printf("%s(%s)\n", __METHOD__, var_export(func_get_args(), true));  
        $ret = parent::query($res, $query);  
        printf("%s returns %s\n", __METHOD__, var_export($ret, true));  
        return $ret;  
    }  
}  
mysqlnd_uh_set_connection_proxy(new proxy());  
$mysqli->query("SELECT 'mysqlnd rocks!'");  
$mysql = mysql_connect("localhost", "root", "", "test");  
mysql_query("SELECT 'Ahoy Andrey!' ", $mysql);  
$pdo = new PDO("mysql:host=localhost;dbname=test", "root", "");  
$pdo->query("SELECT 'Moin Johannes!'");  
?>
```

The above example will output:

```
proxy::query(array (  
    0 => NULL,  
    1 => 'SELECT \'mysqlnd rocks!\'',  
))  
proxy::query returns true  
proxy::query(array (  
    0 => NULL,  
    1 => 'SELECT \'Ahoy Andrey!\'',  
))  
proxy::query returns true  
proxy::query(array (  
    0 => NULL,  
    1 => 'SELECT \'Moin Johannes!\'',  
))
```

```
proxy::query returns true
```

See Also

[mysqlnd_uh_set_statement_proxy](#)
[mysqlnd_uh.enable](#)

7.9.9.3 mysqlnd_uh_set_statement_proxy

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- [mysqlnd_uh_set_statement_proxy](#)

Installs a proxy for mysqlnd statements

Description

```
bool mysqlnd_uh_set_statement_proxy(  
    MysqlndUhStatement statement_proxy);
```

Installs a proxy for mysqlnd statements. The proxy object will be used for all mysqlnd prepared statement objects, regardless which PHP MySQL extension ([mysqli](#), [mysql](#), [PDO_MYSQL](#)) has created them as long as the extension is compiled to use the [mysqlnd](#) library.

The function can be disabled with [mysqlnd_uh.enable](#). If [mysqlnd_uh.enable](#) is set to [FALSE](#) the function will not install the proxy and always return [TRUE](#). Additionally, an error of the type [E_WARNING](#) may be emitted. The error message may read like [PHP Warning: mysqlnd_uh_set_statement_proxy\(\): \(Mysqlnd User Handler\) The plugin has been disabled by setting the configuration parameter mysqlnd_uh.enable = false. The proxy has not been installed \[...\]](#).

Parameters

statement_proxy The mysqlnd statement proxy object of type [MysqlndUhStatement](#)

Return Values

Returns [TRUE](#) on success. Otherwise, returns [FALSE](#)

See Also

[mysqlnd_uh_set_connection_proxy](#)
[mysqlnd_uh.enable](#)

7.9.10 Change History

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The Change History lists major changes users need to be aware of if upgrading from one version to another. It is a high level summary of selected changes that may impact applications or might even break backwards compatibility. See also the [CHANGES](#) file contained in the source for additional changelog information. The commit history is also available.

7.9.10.1 PECL/mysqlnd_uh 1.0 series

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1.0.1-alpha

- Release date: TBD

- Motto/theme: bug fix release

Feature changes

- Support of PHP 5.4.0 or later.
- BC break: `MysqldUhConnection::changeUser` requires additional `passwd_len` parameter.
- BC break: `MYSQLND_UH_VERSION_STR` renamed to `MYSQLND_UH_VERSION`.
`MYSQLND_UH_VERSION` renamed to `MYSQLND_UH_VERSION_ID`.
- BC break: `mysqld_uh.enabled` configuration setting renamed to `mysqld_uh.enable`.

1.0.0-alpha

- Release date: 08/2010
- Motto/theme: Initial release

7.10 Mysqld connection multiplexing plugin

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The mysqld multiplexing plugin (`mysqld_mux`) multiplexes MySQL connections established by all PHP MySQL extensions that use the MySQL native driver (`mysqld`) for PHP.

The MySQL native driver for PHP features an internal C API for plugins, such as the connection multiplexing plugin, which can extend the functionality of mysqld. See the [mysqld](#) for additional details about its benefits over the MySQL Client Library `libmysqlclient`.

Mysqld plugins like `mysqld_mux` operate, for the most part, transparently from a user perspective. The connection multiplexing plugin supports all PHP applications, and all MySQL PHP extensions. It does not change existing APIs. Therefore, it can easily be used with existing PHP applications.

Note

This is a proof-of-concept. All features are at an early stage. Not all kinds of queries are handled by the plugin yet. Thus, it cannot be used in a drop-in fashion at the moment.

Please, do not use this version in production environments.

7.10.1 Key Features

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The key features of `mysqld_mux` are as follows:

- Transparent and therefore easy to use:
 - Supports all of the PHP MySQL extensions.
 - Little to no application changes are required, dependent on the required usage scenario.
- Reduces server load and connection establishment latency:
 - Opens less connections to the MySQL server.
 - Less connections to MySQL mean less work for the MySQL server. In a client-server environment scaling the server is often more difficult than scaling the client. Multiplexing helps with horizontal scale-out (scale-by-client).

- Pooling saves connection time.
- Multiplexed connection: multiple user handles share the same network connection. Once opened, a network connection is cached and shared among multiple user handles. There is a 1:n relationship between internal network connection and user connection handles.
- Persistent connection: a network connection is kept open at the end of the web request, if the PHP deployment model allows. Thus, subsequently web requests can reuse a previously opened connection. Like other resources, network connections are bound to the scope of a process. Thus, they can be reused for all web requests served by a process.

7.10.2 Limitations

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The proof-of-concept does not support unbuffered queries, prepared statements, and asynchronous queries.

The connection pool is using a combination of the transport method and hostname as keys. As a consequence, two connections to the same host using the same transport method (TCP/IP, Unix socket, Windows named pipe) will be linked to the same pooled connection even if username and password differ. Be aware of the possible security implications.

The proof-of-concept is transaction agnostic. It does not know about SQL transactions.

Note

Applications must be aware of the consequences of connection sharing connections.

7.10.3 About the name mysqlnd_mux

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The shortcut `mysqlnd_mux` stands for `mysqlnd connection multiplexing plugin`.

7.10.4 Concepts

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This explains the architecture and related concepts for this plugin. Reading and understanding these concepts is required to successfully use this plugin.

7.10.4.1 Architecture

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The mysqlnd connection multiplexing plugin is implemented as a PHP extension. It is written in C and operates under the hood of PHP. During the startup of the PHP interpreter, in the module initialization phase of the PHP engine, it gets registered as a `mysqlnd` plugin to replace specific mysqlnd C methods.

The mysqlnd library uses PHP streams to communicate with the MySQL server. PHP streams are accessed by the mysqlnd library through its net module. The mysqlnd connection multiplexing plugin proxies methods of the mysqlnd library net module to control opening and closing of network streams.

Upon opening a user connection to MySQL using the appropriate connection functions of either `mysqli`, `PDO_MYSQL` or `ext/mysql`, the plugin will search its connection pool for an open network connection. If the pool contains a network connection to the host specified by the connect function using the transport

method requested (TCP/IP, Unix domain socket, Windows named pipe), the pooled connection is linked to the user handle. Otherwise, a new network connection is opened, put into the pool and associated with the user connection handle. This way, multiple user handles can be linked to the same network connection.

7.10.4.2 Connection pool

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The plugins connection pool is created when PHP initializes its modules ([MINIT](#)) and free'd when PHP shuts down the modules ([MSHUTDOWN](#)). This is the same as for persistent MySQL connections.

Depending on the deployment model, the pool is used for the duration of one or multiple web requests. Network connections are bound to the lifespan of an operating system level process. If the PHP process serves multiple web requests as it is the case for Fast-CGI or threaded web server deployments, then the pooled connections can be reused over multiple connections. Because multiplexing means sharing connections, it can even happen with a threaded deployment that two threads or two distinct web requests are linked to one pooled network connections.

A pooled connection is explicitly closed once the last reference to it is released. An implicit close happens when PHP shuts down its modules.

7.10.4.3 Sharing connections

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The PHP mysqlnd connection multiplexing plugin changes the relationship between a users connection handle and the underlying MySQL connection. Without the plugin, every MySQL connection belongs to exactly one user connection at a time. The multiplexing plugin changes. A MySQL connection is shared among multiple user handles. There no one-to-one relation if using the plugin.

Sharing pooled connections has an impact on the connection state. State changing operations from multiple user handles pointing to one MySQL connection are not isolated from each other. If, for example, a session variable is set through one user connection handle, the session variable becomes visible to all other user handles that reference the same underlying MySQL connection.

This is similar in concept to connection state related phenomena described for the PHP mysqlnd replication and load balancing plugin. Please, check the [PECL/mysqlnd_ms documentation](#) for more details on the state of a connection.

The proof-of-concept takes no measures to isolate multiplexed connections from each other.

7.10.5 Installing/Configuring

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7.10.5.1 Requirements

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[PHP 5.5.0](#) or newer. Some advanced functionality requires [PHP 5.5.0](#) or newer.

The [mysqlnd_mux](#) replication and load balancing plugin supports all PHP applications and all available PHP MySQL extensions ([mysqli](#), [mysql](#), [PDO_MYSQL](#)). The PHP MySQL extension must be configured to use [mysqlnd](#) in order to be able to use the [mysqlnd_mux](#) plugin for [mysqlnd](#).

7.10.5.2 Installation

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Information for installing this PECL extension may be found in the manual chapter titled [Installation of PECL extensions](#). Additional information such as new releases, downloads, source files, maintainer information, and a CHANGELOG, can be located here: http://pecl.php.net/package/mysqlnd_mux

7.10.5.3 Runtime Configuration

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The behaviour of these functions is affected by settings in [php.ini](#).

Table 7.45 Mysqlnd_mux Configure Options

Name	Default	Changeable	Changelog
mysqlnd_mux.enable	0	PHP_INI_SYSTEM	

Here's a short explanation of the configuration directives.

`mysqlnd_mux.enable` integer Enables or disables the plugin. If disabled, the extension will not plug into mysqlnd to proxy internal mysqlnd C API calls.

7.10.6 Predefined Constants

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The constants below are defined by this extension, and will only be available when the extension has either been compiled into PHP or dynamically loaded at runtime.

Other

The plugins version number can be obtained using [MYSQLND_MUX_VERSION](#) or [MYSQLND_MUX_VERSION_ID](#). [MYSQLND_MUX_VERSION](#) is the string representation of the numerical version number [MYSQLND_MUX_VERSION_ID](#), which is an integer such as 10000. Developers can calculate the version number as follows.

Version (part)	Example
Major*10000	$1 * 10000 = 10000$
Minor*100	$0 * 100 = 0$
Patch	$0 = 0$
MYSQLND_MUX_VERSION_ID	10000

[MYSQLND_MUX_VERSION](#)
(string) Plugin version string, for example, "1.0.0-prototype".

[MYSQLND_MUX_VERSION_ID](#)
(integer) Plugin version number, for example, 10000.

7.10.7 Change History

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This change history is a high level summary of selected changes that may impact applications and/or break backwards compatibility.

See also the [CHANGES](#) file in the source distribution for a complete list of changes.

7.10.7.1 PECL/mysqlnd_mux 1.0 series

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1.0.0-pre-alpha

- Release date: no package released, initial check-in 09/2012
- Motto/theme: Proof of concept

Initial check-in. Essentially a demo of the [mysqld](#) plugin API.

Note

This is the current development series. All features are at an early stage. Changes may happen at any time without prior notice. Please, do not use this version in production environments.

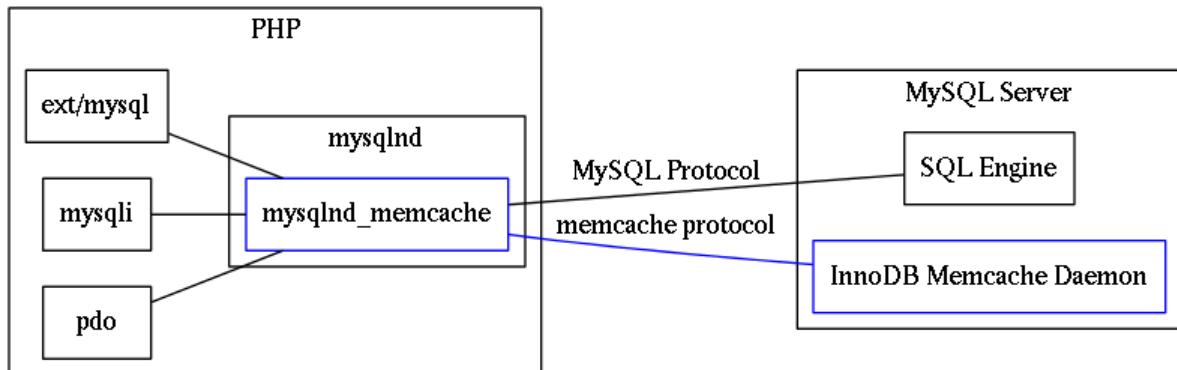
The documentation may not reflect all changes yet.

7.11 Mysqld Memcache plugin

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The mysqld memcache plugin ([mysqld_memcache](#)) is an PHP extension for transparently translating SQL into requests for the MySQL InnoDB Memcached Daemon Plugin (server plugin). It includes experimental support for the MySQL Cluster Memcached Daemon. The server plugin provides access to data stored inside MySQL InnoDB (respectively MySQL Cluster NDB) tables using the Memcache protocol. This PHP extension, which supports all PHP MySQL extensions that use [mysqld](#), will identify tables exported in this way and will translate specific SELECT queries into Memcache requests.

Figure 7.1 mysqld_memcache data flow



Note

This plugin depends on the MySQL InnoDB Memcached Daemon Plugin. It is not provided to be used with a stand-alone Memcached. For a generic query cache using Memcached look at the [mysqld query cache plugin](#). For direct Memcache access look at the [memcache](#) and [memcached](#) extensions.

The MySQL native driver for PHP is a C library that ships together with PHP as of PHP 5.3.0. It serves as a drop-in replacement for the MySQL Client Library (`libmysqlclient`). Using mysqld has several advantages: no extra downloads are required because it's bundled with PHP, it's under the PHP license, there is lower memory consumption in certain cases, and it contains new functionality such as asynchronous queries.

The [mysqld_mmemcache](#) operates, for the most part, transparently from a user perspective. The mysqld memcache plugin supports all PHP applications, and all MySQL PHP extensions. It does not change existing APIs. Therefore, it can easily be used with existing PHP applications.

The MySQL Memcache plugins add key-value style access method for data stored in InnoDB resp. NDB (MySQL Cluster) SQL tables through the Memcache protocol. This type of key-value access is often faster than using SQL.

7.11.1 Key Features

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The key features of PECL/mysqlnd_memcache are as follows.

- Possible performance benefits
 - Client-side: light-weight protocol.
 - Server-side: no SQL parsing, direct access to the storage.
- Please, run your own benchmarks! Actual performance results are highly dependent on setup and hardware used.

7.11.2 Limitations

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The initial version is not binary safe. Due to the way the MySQL Memcache plugin works there are restrictions related to separators.

Prepared statements and asynchronous queries are not supported. Result set meta data support is limited.

The mapping information for tables accessible via Memcache is not cached in the plugin between requests but fetched from the MySQL server each time a MySQL connection is associated with a Memcache connection. See [mysqlnd_memcache_set](#) for details.

7.11.3 On the name

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The shortcut `mysqlnd_memcache` stands for `mysqlnd memcache plugin`. Memcache refers to support of the MySQL Memcache plugins for InnoDB and NDB (MySQL Cluster). The plugin is not related to the Memcached cache server.

7.11.4 Quickstart and Examples

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The mysqlnd memcache plugin is easy to use. This quickstart will demo typical use-cases, and provide practical advice on getting started.

It is strongly recommended to read the reference sections in addition to the quickstart. The quickstart tries to avoid discussing theoretical concepts and limitations. Instead, it will link to the reference sections. It is safe to begin with the quickstart. However, before using the plugin in mission critical environments we urge you to read additionally the background information from the reference sections.

7.11.4.1 Setup

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The plugin is implemented as a PHP extension. See also the [installation instructions](#) to install this extension.

Compile or configure the PHP MySQL extension (API) ([mysqli](#), [PDO_MYSQL](#), [mysql](#)). That extension must use the [mysqlnd](#) library as because `mysqlnd_memcache` is a plugin for the `mysqlnd` library. For additional information, refer to the [mysqlnd_memcache installation instructions](#).

Then, load this extension into PHP and activate the plugin in the PHP configuration file using the PHP configuration directive named [mysqlnd_memcache.enable](#).

Example 7.395 Enabling the plugin (php.ini)

```
; On Windows the filename is php_mysqlnd_memcache.dll
; Load the extension
extension=mysqlnd_memcache.so
; Enable it
mysqlnd_memcache.enable=1
```

Follow the instructions given in the [MySQL Reference Manual on installing the Memcache plugins](#) for the MySQL server. Activate the plugins and configure Memcache access for SQL tables.

The examples in this quickguide assume that the following table exists, and that Memcache is configured with access to it.

Example 7.396 SQL table used for the Quickstart

```
CREATE TABLE test(
    id CHAR(16),
    f1 VARCHAR(255),
    f2 VARCHAR(255),
    f3 VARCHAR(255),
    flags INT NOT NULL,
    cas_column INT,
    expire_time_column INT,
    PRIMARY KEY(id)
) ENGINE=InnoDB;
INSERT INTO test (id, f1, f2, f3) VALUES (1, 'Hello', 'World', '!');
INSERT INTO test (id, f1, f2, f3) VALUES (2, 'Lady', 'and', 'the tramp');
INSERT INTO innodb_memcache.containers(
    name, db_schema, db_table, key_columns, value_columns,
    flags, cas_column, expire_time_column, unique_idx_name_on_key)
VALUES (
    'plugin_test', 'test', 'test', 'id', 'f1,f2,f3',
    'flags', 'cas_column', 'expire_time_column', 'PRIMARY KEY');
```

7.11.4.2 Usage

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After associating a MySQL connection with a Memcache connection using `mysqlnd_memcache_set` the plugin attempts to transparently replace SQL `SELECT` statements by a memcache access. For that purpose the plugin monitors all SQL statements executed and tries to match the statement string against `MYSQLND_MEMCACHE_DEFAULT_REGEXP`. In case of a match, the `mysqlnd` memcache plugin checks whether the `SELECT` is accessing only columns of a mapped table and the `WHERE` clause is limited to a single key lookup.

In case of the example SQL table, the plugin will use the Memcache interface of the MySQL server to fetch results for a SQL query like `SELECT f1, f2, f3 WHERE id = n`.

Example 7.397 Basic example.

```
<?php
```

```
$mysqli = new mysqli("host", "user", "passwd", "database");
$memc = new Memcached();
$memc->addServer("host", 11211);
mysqlnd_memcache_set($mysqli, $memc);
/*
    This is a query which queries table test using id as key in the WHERE part
    and is accessing fields f1, f2 and f3. Therefore, mysqlnd_memcache
    will intercept it and route it via memcache.
*/
$result = $mysqli->query("SELECT f1, f2, f3 FROM test WHERE id = 1");
while ($row = $result->fetch_row()) {
    print_r($row);
}
/*
    This is a query which queries table test but using f1 in the WHERE clause.
    Therefore, mysqlnd_memcache can't intercept it. This will be executed
    using the MySQL protocol
*/
$result = $mysqli->query("SELECT id FROM test WHERE f1 = 'Lady'");
while ($row = $result->fetch_row()) {
    print_r($row);
}
?>
```

The above example will output:

```
array(
    [f1] => Hello
    [f2] => World
    [f3] => !
)
array(
    [id] => 2
)
```

7.11.5 Installing/Configuring

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7.11.5.1 Requirements

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PHP: this extension requires PHP 5.4+, version PHP 5.4.4 or newer. The required PHP extensions are [PCRE](#) (enabled by default), and the [memcached](#) extension version 2.0.x.

The [mysqlnd_memcache](#) Memcache plugin supports all PHP applications and all available PHP MySQL extensions ([mysqli](#), [mysql](#), [PDO_MYSQL](#)). The PHP MySQL extension must be configured with [mysqlnd](#) support.

For accessing [InnoDB](#) tables, this PHP extension requires [MySQL Server 5.6.6](#) or newer with the InnoDB Memcache Daemon Plugin enabled.

For accessing [MySQL Cluster NDB](#) tables, this PHP extension requires [MySQL Cluster 7.2](#) or newer with the NDB Memcache API nodes enabled.

7.11.5.2 Installation

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This [PECL](#) extension is not bundled with PHP.

Information for installing this PECL extension may be found in the manual chapter titled [Installation of PECL extensions](#). Additional information such as new releases, downloads, source files, maintainer information, and a CHANGELOG, can be located here: http://pecl.php.net/package/mysqlnd_memcache

A DLL for this PECL extension is currently unavailable. See also the [building on Windows](#) section.

7.11.5.3 Runtime Configuration

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The behaviour of these functions is affected by settings in [php.ini](#).

Table 7.46 Mysqlnd_memcache Configure Options

Name	Default	Changeable	Changelog
<code>mysqlnd_memcache.enable</code>		<code>PHP_INI_SYSTEM</code>	Available since 1.0.0

Here's a short explanation of the configuration directives.

`mysqlnd_memcache.enable` integer Enables or disables the plugin. If disabled, the extension will not plug into [mysqlnd](#) to proxy internal [mysqlnd](#) C API calls.

Note

This option is mainly used by developers to build this extension statically into PHP. General users are encouraged to build this extension as a shared object, and to unload it completely when it is not needed.

7.11.6 Predefined Constants

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The constants below are defined by this extension, and will only be available when the extension has either been compiled into PHP or dynamically loaded at runtime.

MySQL Memcache Plugin related

`MYSQLND_MEMCACHE_DEFAULT_REGEXP` Default regular expression (PCRE style) used for matching `SELECT` statements that will be mapped into a MySQL Memcache Plugin access point, if possible.

It is also possible to use `mysqlnd_memcache_set`, but the default approach is using this regular expression for pattern matching.

Assorted

The version number of this plugin can be obtained by using `MYSQLND_MEMCACHE_VERSION` or `MYSQLND_MEMCACHE_VERSION_ID`. `MYSQLND_MEMCACHE_VERSION` is the string representation of the numerical version number `MYSQLND_MEMCACHE_VERSION_ID`, which is an integer such as 10000. Developers can calculate the version number as follows.

Version (part)	Example
Major*10000	$1*10000 = 10000$
Minor*100	$0*100 = 0$
Patch	$0 = 0$

Version (part)	Example
MYSQLND_MEMCACHE_VERSION_ID	10000

`MYSQLND_MEMCACHE_VERSION` Plugin version string, for example, “1.0.0-alpha”.
(string)

`MYSQLND_MEMCACHE_VERSION_ID` Plugin version number, for example, 10000.
(integer)

7.11.7 Mysqld_memcache Functions

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7.11.7.1 `mysqld_memcache_get_config`

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- `mysqld_memcache_get_config`

Returns information about the plugin configuration

Description

```
array mysqld_memcache_get_config(
    mixed connection);
```

This function returns an array of all mysqld_memcache related configuration information that is attached to the MySQL connection. This includes MySQL, the Memcache object provided via [mysqld_memcache_set](#), and the table mapping configuration that was automatically collected from the MySQL Server.

Parameters

<code>connection</code>	A handle to a MySQL Server using one of the MySQL API extensions for PHP, which are PDO_MYSQL , mysqli or ext/mysql .
-------------------------	---

Return Values

An array of mysqld_memcache configuration information on success, otherwise `FALSE`.

The returned array has these elements:

Table 7.47 `mysqld_memcache_get_config` array structure

Array Key	Description
<code>memcached</code>	Instance of Memcached associated to this MySQL connection by mysqld_memcache_set . You can use this to change settings of the memcache connection, or directly by querying the server on this connection.
<code>pattern</code>	The PCRE regular expression used to match the SQL query sent to the server. Queries matching this pattern will be further analyzed to decide whether the query can be intercepted and sent via the memcache interface or whether the query is sent using the general MySQL protocol to the server. The pattern is either the default pattern (MYSQLND_MEMCACHE_DEFAULT_REGEX) or it is set via mysqld_memcache_set .

Array Key	Description
mappings	An associative array with a list of all configured containers as they were discovered by this plugin. The key for these elements is the name of the container in the MySQL configuration. The value is described below. The contents of this field is created by querying the MySQL Server during association to MySQL and a memcache connection using mysqlnd_memcache_set .
mapping_query	An SQL query used during mysqlnd_memcache_set to identify the available containers and mappings. The result of that query is provided in the mappings element.

Table 7.48 Mapping entry structure

Array Key	Description
prefix	A prefix used while accessing data via memcache. With the MySQL InnoDB Memcache Deamon plugin, this usually begins with @@ and ends with a configurable separator. This prefix is placed in front of the key value while using the memcache protocol.
schema_name	Name of the schema (database) which contains the table being accessed.
table_name	Name of the table which contains the data accessible via memcache protocol.
id_field_name	Name of the database field (column) with the id used as key when accessing the table via memcache. Often this is the database field having a primary key.
separator	The separator used to split the different field values. This is needed as memcache only provides access to a single value while MySQL can map multiple columns to this value. <div style="border-left: 2px solid black; padding-left: 10px; margin-top: 10px;"> Note The separator, which can be set in the MySQL Server configuration, should not be part of any value retrieved via memcache because proper mapping can't be guaranteed. </div>
fields	An array with the name of all fields available for this mapping.

Examples

Example 7.398 [mysqlnd_memcache_get_config](#) example

```
<?php
$mysqli = new mysqli("host", "user", "passwd", "database");
$memc = new Memcached();
```

```
$memc->addServer("host", 11211);
mysqlnd_memcache_set($mysqli, $memc);
var_dump(mysqlnd_memcache_get_config($mysqli));
?>
```

The above example will output:

```
array(4) {
    [ "memcached" ]=>
    object(Memcached)#2 (0) {
        }
    [ "pattern" ]=>
    string(125) "/^\\s*SELECT\\s*(.+?)\\s*FROM\\s*`?( [a-z0-9_]+)`?\\s*WHERE\\s*`?( [a-z0-9_]+)`?\\s*=\\s*(? (?:[ "
    [ "mappings" ]=>
    array(1) {
        [ "mymem_test" ]=>
        array(6) {
            [ "prefix" ]=>
            string(13) "@@mymem_test."
            [ "schema_name" ]=>
            string(4) "test"
            [ "table_name" ]=>
            string(10) "mymem_test"
            [ "id_field_name" ]=>
            string(2) "id"
            [ "separator" ]=>
            string(1) "|"
            [ "fields" ]=>
            array(3) {
                [0]=>
                string(2) "f1"
                [1]=>
                string(2) "f2"
                [2]=>
                string(2) "f3"
            }
        }
    }
    [ "mapping_query" ]=>
    string(209) "      SELECT c.name,
                           CONCAT('@@', c.name, (SELECT value FROM innodb_memcache.config_options WHERE
                           c.db_schema,
                           c.db_table,
                           c.key_columns,
                           c.value_columns,
                           (SELECT value FROM innodb_memcache.config_options WHERE name = 'separator') A
                           FROM innodb_memcache.containers c"
}
}
```

See Also

[mysqlnd_memcache_set](#)

7.11.7.2 [mysqlnd_memcache_set](#)

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- [mysqlnd_memcache_set](#)

Associate a MySQL connection with a Memcache connection

Description

```
bool mysqlnd_memcache_set(
    mixed mysql_connection,
```

```
Memcached memcache_connection,
string pattern,
callback callback);
```

Associate `mysql_connection` with `memcache_connection` using `pattern` as a PCRE regular expression, and `callback` as a notification callback or to unset the association of `mysql_connection`.

While associating a MySQL connection with a Memcache connection, this function will query the MySQL Server for its configuration. It will automatically detect whether the server is configured to use the InnoDB Memcache Daemon Plugin or MySQL Cluster NDB Memcache support. It will also query the server to automatically identify exported tables and other configuration options. The results of this automatic configuration can be retrieved using `mysqld_memcache_get_config`.

Parameters

<code>mysql_connection</code>	A handle to a MySQL Server using one of the MySQL API extensions for PHP, which are <code>PDO_MYSQL</code> , <code>mysqli</code> or <code>ext/mysql</code> .
<code>memcache_connection</code>	A <code>Memcached</code> instance with a connection to the MySQL Memcache Daemon plugin. If this parameter is omitted, then <code>mysql_connection</code> will be unassociated from any memcache connection. And if a previous association exists, then it will be replaced.
<code>pattern</code>	A regular expression in Perl Compatible Regular Expression syntax used to identify potential Memcache-queries. The query should have three sub patterns. The first subpattern contains the requested field list, the second the name of the ID column from the query and the third the requested value. If this parameter is omitted or os set to <code>NULL</code> , then a default pattern will be used.
<code>callback</code>	A callback which will be used whenever a query is being sent to MySQL. The callback will receive a single boolean parameter telling if a query was sent via Memcache.

Return Values

`TRUE` if the association or disassociation is successful, otherwise `FALSE` if there is an error.

Examples

Example 7.399 `mysqld_memcache_set` example with `var_dump` as a simple debugging callback.

```
<?php
$mysqli = new mysqli("host", "user", "passwd", "database");
$memc = new Memcached();
$memc->addServer("host", 11211);
mysqld_memcache_set($mysqli, $memc, NULL, 'var_dump');
/* This query will be intercepted and executed via Memcache protocol */
echo "Sending query for id via Memcache: ";
$mysqli->query("SELECT f1, f2, f3 FROM test WHERE id = 1");
/* f1 is not configured as valid key field, this won't be sent via Memcache */
echo "Sending query for f1 via Memcache: ";
$mysqli->query("SELECT id FROM test WHERE f1 = 1");
mysqld_memcache_set($mysqli);
/* Now the regular MySQL protocol will be used */
echo "var_dump won't be invoked: ";
$mysqli->query("SELECT f1, f2, f3 WHERE id = 1");
?>
```

The above example will output:

```
Sending query for id via Memcache: bool(true)
Sending query for f1 via Memcache: bool(false)
var_dump won't be invoked:
```

See Also

[mysqlnd_memcache_get_config](#)

7.11.8 Change History

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This change history is a high level summary of selected changes that may impact applications and/or break backwards compatibility.

See also the [CHANGES](#) file in the source distribution for a complete list of changes.

7.11.8.1 PECL/mysqlnd_memcache 1.0 series

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1.0.0-alpha

- Release date: TBD
- Motto/theme: Basic mapping of SQL SELECT to a MySQL Memcache plugin access.

The initial release does map basic SQL SELECT statements to a MySQL Memcache plugin access. This bares potential performance benefits as the direct key-value access to MySQL storage using the Memcache protocol is usually faster than using SQL access.

7.12 Common Problems with MySQL and PHP

- [Error: Maximum Execution Time Exceeded](#): This is a PHP limit; go into the [php.ini](#) file and set the maximum execution time up from 30 seconds to something higher, as needed. It is also not a bad idea to double the RAM allowed per script to 16MB instead of 8MB.
- [Fatal error: Call to unsupported or undefined function mysql_connect\(\) in ...](#): This means that your PHP version isn't compiled with MySQL support. You can either compile a dynamic MySQL module and load it into PHP or recompile PHP with built-in MySQL support. This process is described in detail in the PHP manual.
- [Error: Undefined reference to 'uncompress'](#): This means that the client library is compiled with support for a compressed client/server protocol. The fix is to add [-lz](#) last when linking with [-lmysqlclient](#).

