
Data Lifecycle Management Series —

Migrating to MySQL

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August 2004

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Introduction

It's recently become very hard to be involved in the database industry and not be acquainted with MySQL. Boasting an install base of some five million systems and 35,000 downloads a day, MySQL has come on the database scene in a very dramatic way. The "M" in the open source LAMP (Linux, Apache, MySQL, Perl) stack, the MySQL database server runs on over 18 platforms and is powering more than just web-based businesses these days. Companies like Sabre Holdings, the New York Stock Exchange, AOL, and more are running key components of their business on MySQL with great success. In fact, the meteoric rise of MySQL has caused Charlie Gerry of the Meta Group to declare, "The future of the database market will be the standardization on MySQL¹."

With the popularity of MySQL rising, more corporations are beginning to explore how best to migrate existing systems to the MySQL platform. Database conversion efforts can be challenging, so IT organizations are naturally looking to make the switch to MySQL as easy as possible. This paper explores the reasons for migrating to MySQL and demonstrates how such migrations, whether large or small, can successfully be performed with the aid of data lifecycle solutions offered by Embarcadero Technologies.

Why Migrate to MySQL?

A few years ago, IT professionals seemed to migrate *from* MySQL rather than *to* MySQL. The attitude was that MySQL would be used until the application or system outgrew the database, and then a migration would be performed to a larger database vendor. That mindset has rapidly changed as of late, and now countless organizations are moving from the database heavyweights (Oracle, Microsoft, IBM, and Sybase) to MySQL. Why has this happened and what factors are being considered by those making the move to MySQL?

The three broad areas being reviewed by those switching to MySQL are:

1. The Business Case
2. The Technical Case
3. The Ease-of-Migration Case

Let's examine each of these areas in detail to learn why migrating to MySQL makes sense in many situations.

Business Reasons for Migrating to MySQL

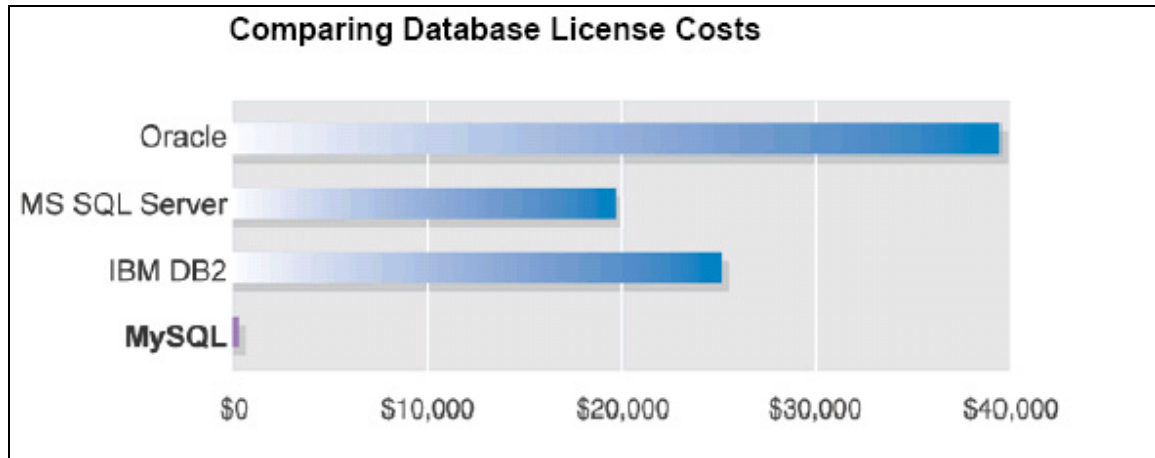
When making the business case for migrating to MySQL, two things are generally examined:

1. What are the cost benefits of migrating to MySQL?
2. Can I trust MySQL as a vendor, and one that will be around for a long time?

¹"MySQL breaks into the Data Center", ComputerWorld, October 13, 2003

Does Migrating to MySQL Make Financial Sense?

Nearly all of those that have switched to MySQL respond to this question with a resounding “Yes!” The dual licensing model of MySQL allows corporations great flexibility and cost savings in nearly every case over other database vendor licensing models². This is well depicted by a ComputerWorld article³ that showed a dramatic representation of how MySQL can save companies a lot of money in the areas of database license costs.



And it's especially nice when the database works every bit as well and sometimes better than something that costs a lot of money. Of course, you can also purchase support agreements and services from MySQL, but even those pale in comparison to costs charged by other software vendors. As one example, when NASA switched over to MySQL from Oracle, they found that they reduced their total cost of ownership by ninety percent.⁴

Can I Trust MySQL Open Source Software?

As an O'Reilly article⁵ recently pointed out, “MySQL succeeds at maintaining two faces. To paying customers, it's a traditional, responsible vendor. To programmers and database administrators, it's a flexible, responsive network of independently-minded developers in free-software style.” When many people hear the words “open source” they tend to think of a chaotic development environment with hundreds or thousands of developers each contributing to the code base and virtually no trusted support options. That concept scares a lot of traditional DBAs and IT managers away from even looking at an open source database, but as the O'Reilly snippet points out, MySQL AB does things a bit differently. MySQL is a privately held company and not just some open source project. They have been around since the mid-90's, and have been financed by venture capital since July 2001.

Being a full-fledge company instead of an open source project provides a number of benefits to those shy of committing their data assets to an open source database. For one, MySQL offers a full 24 x 7 support staff, which has already garnered much respect and applause from those in the industry who pay for it. MySQL has also started MySQL Press, which has introduced a number

² www.mysql.com/products/licensing/

³ “MySQL breaks into the Data Center”, ComputerWorld, October 13, 2003

⁴ www.mysql.com/news-and-events/success-stories/nasa.html

⁵ *Why MySQL grew so fast*, April 19, 2004

of excellent books and guides for those needing to quickly learn MySQL. Finally, MySQL offers professional certification in the MySQL database server, which helps professionals prove their skills in using, maintaining, and administering MySQL.

Elevating the trust level even more is seeing a growing customer list that contains names of technically savvy corporations who have switched to MySQL, along with another list of major hardware/software vendors supporting MySQL. With names like Yahoo, Google, and Sabre Holdings, you can feel confident that companies who demand both high performance and around-the-clock availability for their heavy-duty systems are proving that MySQL is ready for prime time. And when companies like Hewlett-Packard ⁶announce that they will certify, support, and jointly sell MySQL on their HP servers, you know that more third party hardware/software vendor support can't be far behind.

Technical Reasons for Migrating to MySQL

So just how good technically can a “free” database be? Once you pass the business case test for MySQL, you then come to the technical hurdles. Even if migrating to MySQL makes financial sense, and a good comfort level is found at the business level, it doesn't mean anything if the database can't perform and meet the data lifecycle needs of demanding corporations. While this document isn't intended to list all of the technical abilities of MySQL, let's look at the big things that an enterprise-class database should have, as well as some small but critical items that can make a big difference in how DBAs perform the day-to-day management of a database server.

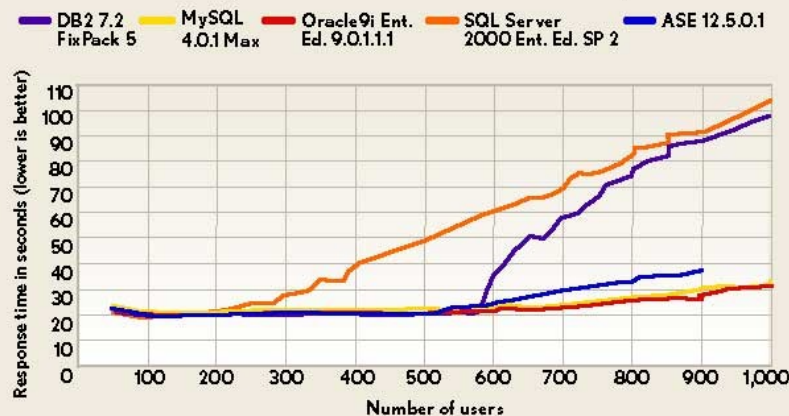
Making the Technical Case for MySQL Part 1 – Is it Enterprise Ready?

The first question to be asked of MySQL is simply “Can it scale and support serious enterprise-class systems?” Can MySQL support large amounts of data as well as lots of constant user activity? While MySQL AB can point to customers like Sabre who run very intense and visible systems on MySQL, the answer to this question was answered in the affirmative by eWeek Labs and PC Magazine who conducted an ⁷independent benchmark of database performance among all the top database vendors, including MySQL. It must have shocked the database giants to see MySQL nearly tie Oracle for the top performance spot and soundly beat every other major database competitor in the areas of both performance and throughput.

⁶ www.hp.com/hpinfo/newsroom/press/2004/040601a.html

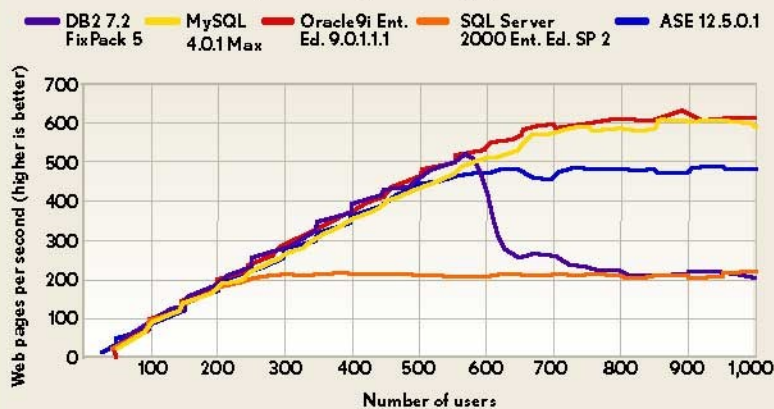
⁷ www.eweek.com/article2/0,1759,293,00.asp and www.pcmag.com/article2/0,1759,4182,00.asp

Oracle9i and MySQL offered the fastest response times



Throughput is in returned Web pages per second from the application server. Number of users is number of concurrent Web clients driving the load. Response time is the time to complete the six bookstore user action sequences, weighted by frequency of each sequence in the mix. All tests were conducted on an HP NetServer LT 6000r with four 700MHz Xeon CPUs, 2 GB of RAM, a Gigabit Ethernet Intel Corp. Pro/1000 F Server Adapter and 24 9.1GB Ultra3 SCSI hard drives used for database storage.

Oracle9i and MySQL top throughput



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The second question/issue on most database professional's minds concerns high availability. Will MySQL be able to provide constant uptime for application systems that tolerate little, if any, downtime? Clustering seems to be the de-facto plan of attack to ensure high availability for each database vendor, and MySQL is no exception. MySQL offers their own high availability cluster solution that ensures continuous database uptime, no single point of failure, automatic and fast failover, and high performance. In addition, other third party vendors like Emic Networks and Veritas offer cluster solutions for those wishing to use MySQL in a clustered configuration.

Finally, all IT managers are concerned about security these days. Can MySQL adequately protect the sensitive data assets and systems of worldwide businesses? Yes it can. MySQL offers security models that compare to all the major database vendors and even goes further in some cases. For example, a MySQL DBA can not only define user accounts with standard security, but can also either accept or reject user accounts based on what host computer they are coming from. MySQL is also smart enough to recognize hacker attempts at breaching the security of a database and will automatically block a host computer from logging in when a threshold of failed login attempts has been reached.

Making the Technical Case for MySQL Part 2 –The Little Things Count

Even if MySQL has demonstrated that it can meet or beat other database vendors in terms of performance, scalability, high availability, and security, what about all the other features offered by database vendors in the areas of concurrency, ease of use, automatic management, database object support, and more? Doesn't MySQL fall short in these categories?

Listing all the features of the MySQL server is beyond the scope of this paper. However, the following is a list of some of the items that are convincing DBAs and IT managers that MySQL has the technical merits needed to be included in enterprise data centers:

- **High User Concurrency** — MySQL has various locking mechanisms that include row level locking. MySQL also offers multi-version concurrency control where a user reading data will always see data as it existed at the moment their request is issued. This feature can be equated to Oracle's snapshot read ability, which ensures that readers should never block writers, with the end result being the reduced threat of data concurrency issues.
- **Automatic Storage Management** — MySQL can automatically grow data storage structures to meet the need of incoming data for more space. MySQL can also automatically "pause" a data load/insert operation that hits an out of space condition at the operating system level and wait for the system administrator to rectify the problem so it can continue on as normal. MySQL also offers compressed tables that both save storage space and offer increased read performance in some cases. Finally, MySQL provides binary portability of its database storage structures, which means you can directly copy MySQL files from a Windows laptop to a Linux server and they will run with no problems.
- **Flexible Table Types** — MySQL offers several different types of tables that can be used in any database. Tables can be created that offer very fast full text search capabilities, full ACID compliance in terms of transactions and foreign key references, in-memory tables for very fast reference functions, and clustered tables for clustering environments. Of course, tables may be indexed, and MySQL supports a wide range of indexes including standard B-Tree indexes and clustered indexes.
- **Advanced Memory/Performance Management** — MySQL's memory usage can be dynamically changed both at the server level and session level without requiring a server reboot. In addition, performance can be enhanced through data, index, and query caches that store often referenced data and SQL queries for fast

access and reduced parsing. MySQL can also automatically identify slow queries (where the definition of “slow” can be customized by the DBA) or queries that don’t use indexes, and write them to trace logs for later investigation.

- **Robust Replication** — MySQL offers a complete replication model with simple setup and flexible configuration and replication options.
- **Strong Object Support** — MySQL offers support for the majority of the most-used database objects (tables, indexes, etc.) with support for stored procedures and triggers appearing in version 5 of the database. MySQL offers some nice extensions to traditional object management, such as allowing the insertion of a new column anywhere in an existing table. For example, you can insert a new column above the last three columns in a table without requiring the rebuild of the table.

These features and more should convince anyone that MySQL is far from a Microsoft Access styled database and worthy of a serious look at running enterprise applications.

Easing the Migration to MySQL

Once the business and technical hurdles of switching to MySQL are cleared, the final difficulty to be tackled is the actual migration itself. Migrating to any new platform generally involves three considerations:

1. **Installation, setup and maintenance of the new database** – how hard is it to get MySQL installed, configured, and then maintained across the enterprise?
2. **Physical migration tasks** – how difficult is it to convert existing database platforms, with data, to the MySQL server?
3. **Personnel learning curve** – how quickly can existing database personnel get up to speed and be productive on the MySQL platform?

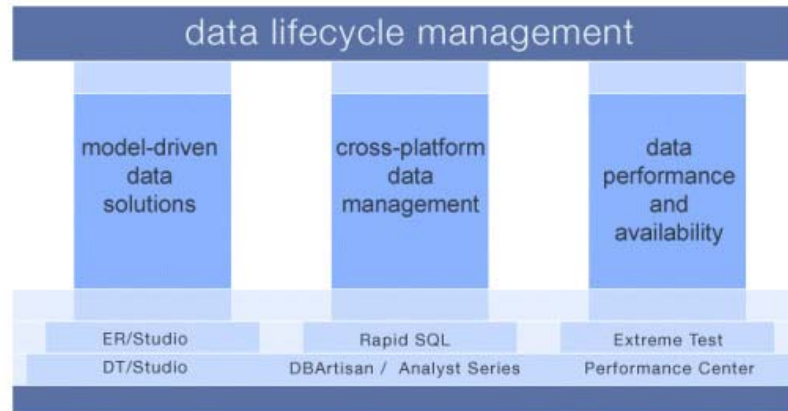
Tackling the installation and setup of MySQL isn’t something that typically requires much effort, regardless of the platform. As an example, the engineers of Embarcadero Technologies recently compared the installation of an Oracle9i database on a new Red Hat Fedora Core machine with a MySQL 4.0.18 install on the same machine. With Oracle, it took over three hours to find and download all the necessary patches, configure the machine, and work through the installation. With MySQL, the engineers were finished with their installation and at a MySQL client prompt, ready to work, in seven minutes. After the installation, the setup and maintenance process is typically straightforward and simple. MySQL provides a number of sample configuration files that can quickly be used for different environments (small, large, etc.)

Once MySQL is installed and ready to go, what obstacles exist in terms of actually migrating existing systems to MySQL? Such migration efforts, whether large or small, can oftentimes take a long time to complete and involve a lot of complexity. Fortunately, tools from Embarcadero Technologies can make short work of any migration to MySQL, no matter the size of the system being converted.

Embarcadero Data Lifecycle Management Solutions

Embarcadero Technologies offers solutions for every area of the data lifecycle. All Embarcadero lifecycle management products offer near-instant ROI and dramatic cost savings because of their ease of use and powerful, timesaving productivity aids.

Embarcadero's integrated product set consists of six core products that handle the bulk of data lifecycle management tasks, along with a number of supporting products that round out the complete data lifecycle suite. Embarcadero offers complete cross-platform coverage, so it doesn't matter if Oracle, Microsoft SQL Server,



DB2 UDB, DB2 z/OS, Sybase, or MySQL is being used; everything looks and feels the same. Plus, all database platforms can be seamlessly managed from within the same core consoles, so a data professional doesn't have to jump in and out of separate products to manage their heterogeneous environment.

The migration of any existing RDBMS platform to MySQL basically involves three steps:

1. Migrating the existing database structure to MySQL.
2. Migrating the existing data to MySQL.
3. Test the new MySQL installation for quality and performance assurance.

Let's look at how each step can easily be accomplished using tools from Embarcadero Technologies.

Migrating Database Schemas with Models

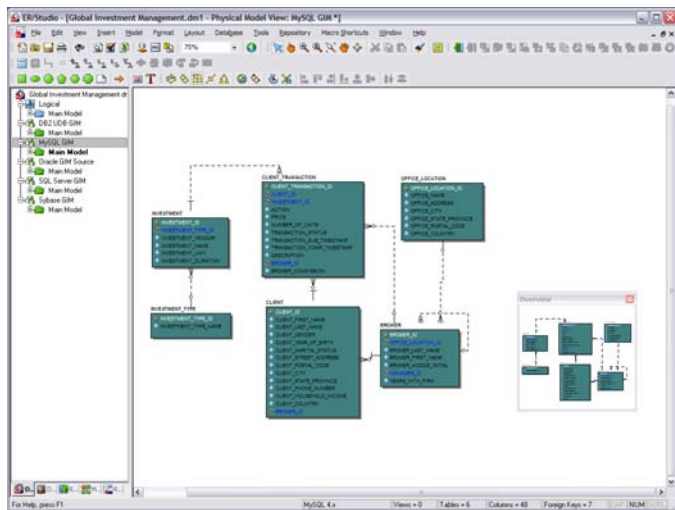
It's obvious that database professionals need to practice formal logical and physical data modeling, however such activities take expertise, time, and attention. Modeling tools can not only assist with the creation of a new database design, they can also play a key role in migrating existing database designs to new systems.

Migrating models and physical designs are not functions to be carried out with pen and paper; instead, they should be facilitated through the use of strong modeling tools that assist in the proper creation of logical models as well as in the building of physical designs that target actual database engines. There is a vast array of features that data architects, modelers, and DBAs should consider when choosing a data modeling tool and such a complete list is beyond the scope of this document. However, a core set of must have features include:

- **Multi-level design environment** — the modeling environment should support both logical and physical modeling with intelligent mechanisms to sync either way.
- **Data dictionary support** — to support data standardization and data element reuse, data dictionary support should be present.
- **Reverse/Forward engineering** — the tool should be able to perform changes against an existing MySQL database through reverse engineering an existing design, as well as be able to build a completely new database through DDL generated by a physical model.
- **Documentation strengths** — to promote understanding and communication of logical and physical models, the modeling environment should be able to document designs in a variety of ways (HTML, Microsoft Word, etc.)
- **Team based collaborative abilities** — large models and designs are normally constructed through a team of architects or modelers, so the modeling environment should support the ability for team members to work on parts of a global model and then merge them back into a single, consolidated model.

Embarcadero's ER/Studio meets all the requirements listed above for a robust modeling solution plus offers much more. Its powerful combination of logical modeling and physical design capabilities make it the ultimate solution for serious MySQL data architects, modelers and database administrators. Data architects and modelers will appreciate the complete support for graphical logical design and data dictionary support in ER/Studio, and DBAs will enjoy the near instantaneous transformation of a logical model to a physical MySQL design that the tool can produce.

Once a DBA or data architect has put the finishing touches on their MySQL design in ER/Studio, they are only a few mouse clicks away from generating all the DDL necessary to create a physical MySQL database along with all accompanying objects (tables, indexes, procedures, triggers, etc.)



Along the way, ER/Studio can create full documentation sets for both logical and physical models in Microsoft Word format, as well a fully functional Intranet web site that documents a design complete with the graphical model. And should the design effort require a group of modelers, ER/Studio's optional repository provides the mechanisms necessary for a team environment to operate with complete check in/check out and merge capabilities being present.

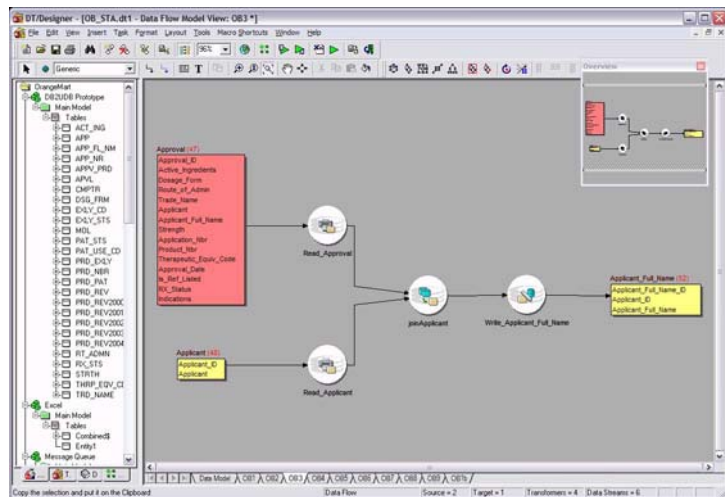
Once an architect or modeler builds a physical MySQL database through ER/Studio, the next step is to migrate data from an existing system to the newly created database. To assist with this process, models once again come to the rescue.

Moving Data with Models

Data movement and migration projects are rarely simple assignments. MySQL Developers, DBAs, and Extract-Transform-Load (ETL) specialists oftentimes struggle to wrap their arms around complex migration efforts. Some use custom scripts coupled with MySQL `mysqlimport` or `load data infile` utilities, but when it comes to serious and ongoing data movement challenges, the need for more capabilities is often expressed. Large migration projects are especially difficult for the following reasons:

- **Data source and target understanding** — the need to deeply understand the source and target systems is oftentimes complicated by the sheer number of source or target destination objects (or both) and all their inter-relationships.
- **Large data volumes** — moving a few hundred megabytes is one thing, but moving half a terabyte is many times a different matter.
- **Complex data transformations** — rare is it that data is moved without modification from a source to a target database. More often than not, the data is sliced and diced in many different ways so it can become usable on the new target system.

To cope with complex and large MySQL data migration projects, DBAs, developers, and ETL specialists can turn to Embarcadero's DT/Studio. DT/Studio is a model-driven ETL solution that uses models to facilitate the understanding of source and target systems. The visual modeling interface of DT/Studio allows those involved in ETL efforts to represent their source and target systems in models found in data design tools like ER/Studio, which takes all the guesswork out of knowing how data is to be moved. Users of DT/Studio can visually design their dataflows between systems and not have to worry about the underlying complexities of how data is read or written, although they can control every aspect of such operations if they wish. DT/Studio supports all the major database engines as well as being able to deal with data that is housed in flat files, XML files, and more, so if another platform is involved in a data migration effort other than MySQL, DT/Studio will have it covered.



MySQL professionals needing to move large amounts of data can do so confidently with DT/Studio because the solution is able to scale to meet the challenges of very large database installations. DT/Studio's data movement engine is written to run on many different operating system platforms (MS Windows, Linux, UNIX, etc.) and take advantage of multi-CPU machines so even large data movement tasks are completed in the time window desired.

When it comes to transforming incoming MySQL data, it's hard to beat DT/Studio's extensible transformation framework. Common transformation tasks (horizontal, vertical partitioning, etc.)

can be designed through visual wizards. Detailed transformations can be carried out through the use of DT/Studio's over 1,000 built-in data transformers or through customized data alteration tasks that can be written by ETL specialists and saved for later use. Built-in scheduling abilities let ETL professionals create data migration jobs for recurring execution.

Migration tasks that are built in DT/Studio can be versioned, which allows rollbacks to previous migration tasks to be performed as well as comparisons between versions. Task reporting is also available, which makes the tracking of ETL operations from a business perspective clear and easy. These features and more leave no room for doubt that DT/Studio has what it takes for serious ETL projects to be successful.

Ensuring the Success of a New MySQL Application

A successful migration to MySQL means more than just converting a database schema and data over to a MySQL server. For a migration project to truly succeed, the IT team performing the migration has to do more than just hope that a new MySQL application will be able to hold up under a serious production load or handle 'N' number of transactions per second. Instead, they need to properly stress test the new MySQL-driven system to ensure that the application will perform as expected on Day One of production.

Proper performance testing catches the showstopper and performance vampire problems that inadequate user and quality assurance testing miss. In a nutshell, performance testing simulates what is expected from real world use. It stresses MySQL in ways that could otherwise only be accomplished by opening the floodgates of the production user community.

Smart performance testing uses the following elements to pull off a realistic simulation of what a database will experience during expected production usage:

- **Anticipated user presence** — it is critical that the test simulate the number of user connections that are expected during peak times and normal working hours. This is the major area where manual methods that pick a subset of users to test a database and application fail. The database server may run just fine with 15 or so user connections, but may fall over when 300 connect to the system.
- **Repetitive user activity** — once the anticipated user sessions have connected to the database, they obviously have to “do something” for the system to be stressed. And they can't just “do something” once. Either all or a portion of the connected sessions need to repetitively perform tasks as they would occur during a normal workday. For an OLTP system, this may mean entering multiple orders. For a data warehouse, this may mean issuing long running analytical queries. The key is that the work is repetitive so repeated blows are dealt against the database.
- **Extended duration** — once a DBA sets a number of sessions performing repetitive work, they next need to ensure that the work continues for a period of time that makes the test meaningful. What a DBA is looking for is to unearth problems that take time to develop. For example, a MySQL table may not become fragmented after 30 minutes of OLTP work, but may surprisingly fragment in a dramatic fashion after 2 or more hours of repeated action.

So how is this practically accomplished? How can performance testing address both the hit-the-wall problems along with the silent killers of database performance? How should a DBA arrange tests to flush out all the major headaches that threaten a database server? Even database professionals who understand the need for real world testing of their database and know what areas need to be stressed are oftentimes at a loss for practically creating the scenarios they need for pulling off a true performance test. This isn't surprising when one considers all the manual work that has to go into such an effort for it to yield the answers that will give the Go/No go signal to a database project team. It's oftentimes much easier to perform a small test with a selected group of willing users and then cross your fingers on the first day of production or when a massive upgrade begins.

This doesn't have to be the case. Embarcadero's performance testing tool, Extreme Test, is designed to bring peace of mind to a database staff by allowing them to know what areas of a MySQL server and accompanying application/web system will break prior to it going into production. By simulating production or accelerated user and data volume, Extreme Test can make a database server unbreakable by letting a staff understand the weaknesses of a database server before the end users find them, with the end result being ironclad availability and performance for production systems.

Extreme Test allows a DBA to capture and simulate the activity of hundreds or even thousands of users, and then apply the resulting workload in varying amounts against a target database. While generating database load, Extreme Test monitors the underlying database components to identify the ones that are struggling to handle the stress. It captures and stores test results in a central repository that a DBA can query for further analysis and reporting. Extreme Test makes it exceptionally easy for an administrator and QA team to implement repeatable testing, to isolate bottlenecks, and to measure the impact of corrective actions on overall database performance. And for those wishing to test system components other than a database (application server, web server, etc.), Extreme Test can build a single performance test against all defined components to produce a real world picture for an entire system.

So to ensure a DBA doesn't have an unwelcome surprise waiting for them in a database server, they need to apply proper performance testing to a system to uncover all problem situations before they impact a business. The best way to do this is to use intelligent and powerful testing solutions like Extreme Test that can provide the answers needed before a database server sees the first day of production or before a large upgrade occurs. Nothing serves as a better confidence builder than knowing what to expect.

Reducing the MySQL Management Learning Curve

IT organizations are oftentimes hesitant to switch to another database platform for fear that their personnel who are experienced on an existing RDBMS will not be productive on a new platform. The learning curve, they fear, may be too steep. However, there are two reasons why database professionals can feel confident that the migration to MySQL will be an easy one.

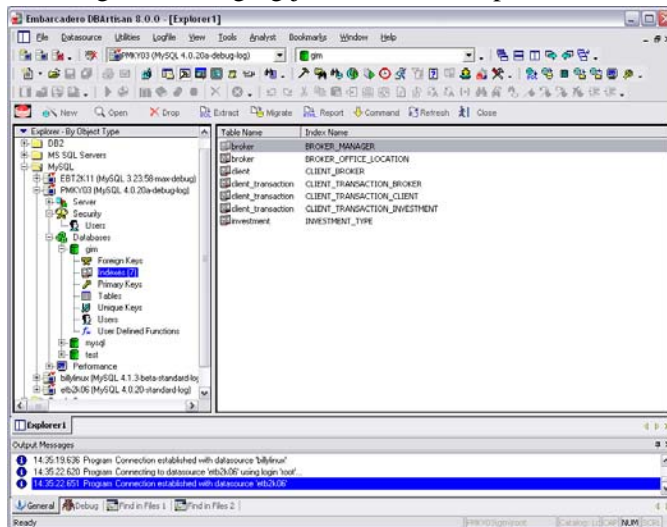
First, the MySQL RDBMS is an uncomplicated model that adheres very much to the SQL 99 standard. This means that database professionals can hit the ground running with MySQL and not have to worry much about learning an entirely new method of working with a relational database.

Secondly, database management software from Embarcadero Technologies can greatly ease the process of managing one or many MySQL systems. There are three core sets of software that database developers and administrators will find valuable.

For developers, Embarcadero Rapid SQL is a cross-platform development IDE that contains a powerful SQL programming environment and supersedes anything found in the industry. Developers will enjoy powerful code generation abilities, many coding aids (cross-database search utility, visual object creation wizards, data imports from Excel spreadsheets, etc.), along with built-in version/source code control integration with all the popular source code software vendors. A Rapid SQL version supporting MySQL is expected in Q1 of 2005.

Administrators will find DBArtisan the answer to their need for a full, cross-platform database administration solution that supports MySQL. DBArtisan greatly reduces the learning curve of switching from any database system to MySQL because everything looks and feels the same across all platforms. Everything from storage and security to object management is handled via visual wizards and editors that guide those unfamiliar with the MySQL syntax through the process of creating and managing databases and objects. Powerful utilities make short work of extracting object DDL, running object checks, documenting databases, and monitoring performance. With all this and more, DBArtisan can make any DBA productive on the MySQL platform in no time. A DBArtisan version supporting MySQL is expected in Q1 of 2005.

Finally, developers and administrators alike often struggle with the process of scheduling and monitoring database and system jobs. Creating and managing jobs across multiple servers can be a real challenge, but not with Embarcadero Job Scheduler. Job Scheduler is an enterprise-wide job scheduling tool that dramatically reduces the time it takes to create, run, manage, and monitor cross platform database jobs, including those for MySQL. A DBA or developer can easily create SQL jobs from their Windows desktop and then immediately deploy them to any Windows, Linux, or UNIX machine running in their network. A central desktop console allows everything to be controlled and managed from one place. Job Scheduler also offers tight integration with DBArtisan and Rapid SQL so DBAs and developers can create and schedule any SQL job without leaving their favorite development or administration tool.



The bottom line with respect to a MySQL learning curve is that there really isn't one to worry about. The uncomplicated MySQL database server combined with database management tools from Embarcadero ensure that database professionals will be up to speed and productive with MySQL in the shortest time possible.

Conclusion

The increasing popularity of MySQL has caused more corporations to evaluate and implement the MySQL server to drive the critical applications that run their business. Making the financial case for MySQL isn't difficult to do, and just a quick review of the independent performance tests and industrial strength customer base of MySQL should convince any database professional that MySQL is ready for enterprise-wide deployment. With the business and technical cases made, organizations are now looking for the best ways to successfully migrate to the MySQL platform.

Whether such migrations are small and straightforward or large and complex, Embarcadero Technologies offers the shortest path to a successful MySQL migration. With its model-driven data solutions, Embarcadero can quickly and accurately migrate anyone to MySQL from any of the major database platforms. Embarcadero can also ensure that the new MySQL system will hold up under expected production loads with its performance testing solutions. Finally, Embarcadero dramatically reduces the MySQL learning curve with its visual database administration and development tools.

The combination of MySQL and Embarcadero Technologies is one that is hard to beat, with the end results netting out to reduced costs, high performing information systems, and a well-equipped and productive database staff.

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