

Major Range Control Center *Relies on Open Source Database*

The Range Operation Control Center (ROCC) at one of the major US missile and space test ranges is being upgraded to modernize and provide increased functionality. The ROCC manages the data flow from multiple sensors, processes the data and provides operator displays, all to guarantee the test mission objectives are met.

Real-time data from radar sensors are processed to track and predict the path of space objects including asteroids and meteoroids. To make these vital real-time predictions, the ROCC built a real-time data warehousing application that relies on the performance and reliability of MySQL.

One of the first questions in the ROCC design phase was: "How we are going to store and access our data?" The activity requires almost real-time storage and retrieval of information gathered from multiple sensors. The range utilizes a number of radar sensors to achieve its mission.

However, multiple sensors provide benefits as well as challenges. One of the biggest challenges is identification. Do the two sensors see the same object or two different objects? Is the object which one sensor sees now or is it one, which another sensor saw one minute ago? In space the objects don't have labels, they are not going to tell you who they are. The software solution stems from a solid knowledge of celestial mechanics as well as careful analysis and comparison of past and current measurements from the sensors.



ROCC relies on a number of MySQL servers to that processes up to 10 MB/sec of real-time data from four major sensors.



High Throughput & Zero Administration

Previously these measurements were saved in the disparate flat files, in multiple formats and across various locations. This situation made it difficult to ensure the accuracy and integrity of the acquired data. So, replacing flat files with a database was the first decision. Next, a number of databases were evaluated against the following criteria:

When the developers found out that MySQL support is delivered by actual developers and not through "support personnel", MySQL became the clear choice.

Relational vs. Object Oriented

The designers had to choose what type of database it was going use: a relational (RDBMS) or object-oriented (OODBMS). However, which database to choose was not easy. Object-oriented database could efficiently store very complex objects. The proponents of the RDBMS countered that the space object measurements don't have very complex structures. Moreover they pointed out that selected repository should have excellent reliability which OODBMS sometimes lack.

Platform Independent

Two other aspects were important for the design of modern Control Center: use of Open Source Software (OSS) and Java. OSS allowed the Control Center's software to be hardware independent. And Java provides operating system independence as well as excellent object-oriented capabilities. Also, JDBC enabled the designers to avoid any vendor lock-in issues.

Another important consideration was the fact that sensor measurements could be efficiently modeled as a stream of data. A RDBMS can handle streams very well because they consist of periodically repeatable structures resembling well-known database records



High Quality Support

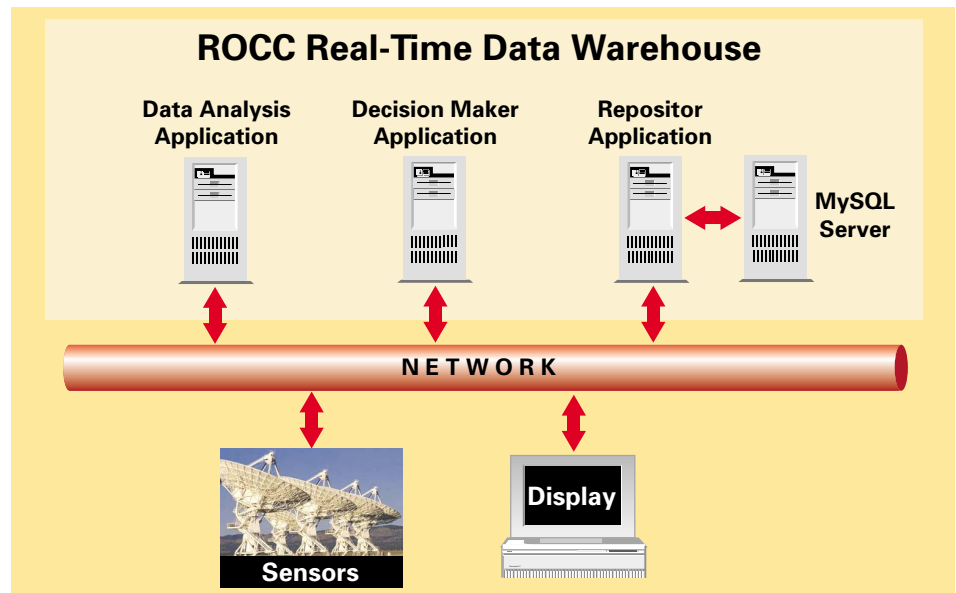
High-Performance

Now the question was which database is the fastest to insert and retrieve those records? The target throughput was 10 MB/second. The main purpose of the Control Center repository is to store the measurements from the sensors, which need to be accessed in real-time. No data can be lost, so the server must be able to keep up with incoming data,

To measure how successfully a relational database could be used as a sensor repository, the database group developed special benchmarks imitating the real sensor dataflow parameters. Those benchmarks were run on different types of hardware for many hours. From the benchmarks, the group concluded that MySQL and Oracle were the final database candidates.

Low Level Administration Overhead

The database needed to run without significant administration. The designers did not want to dedicate valuable resources to administering the databases in different locations. MySQL proved itself as a low administration database, whereas Oracle would have required a DBA.



ROCC relies on the performance and reliability of MySQL to make vital, real-time predictions.

Cost

Another concern was the cost of licensing. The Control Center could require multiple database servers; so multiple licenses would be required, which could result in significant additional expenses.

Support

An additional concern was the quality of support. When the developers found out that MySQL support is delivered by actual developers and not through "support personnel", MySQL became the clear choice.

Flexible Storage Engine Architecture

The design relies on a number of MySQL servers to that processes up to 10 MB/sec of real-time data from four major sensors. The Control Center uses the flexibility of the MySQL Server pluggable storage engine architecture to optimize performance and functionality. MyISAM table type is used for real-time information access to determine if more sensors are needed, for example. InnoDB is used for more sophisticated storing of data where inserts and updates are required.

Technical Environment

A typical MySQL configuration:

| | |
|-----------------------|--|
| <i>Hardware:</i> | Dell |
| <i>OS:</i> | Red Hat Linux |
| <i>CPU:</i> | Intel Xeon |
| <i>RAM:</i> | 8 GB |
| <i>Hard Disk:</i> | Ultra SCSI 320 |
| <i>Database:</i> | MySQL Server, Connector/J |
| <i>Web Server:</i> | Tomcat |
| <i>Language:</i> | Java |
| <i>Database Size:</i> | ◆ 1 TB ◆ 100 Million records ◆ 50 Tables |

About MySQL

MySQL AB develops, markets, and supports the MySQL database server, the world's most popular open source database. With over five million active installations, MySQL has quickly become the core of many high-volume, business-critical applications.

Major corporations such as Yahoo!, Sony Pictures Lucent Technologies, Digital Entertainment, HP, Motorola, NASA, Xerox and Cisco rely on the ultra-fast, highly-reliable MySQL database. MySQL is available under the free software/ Open Source GNU general public license (GPL) or a non-GPL commercial license.

For more information about MySQL, please go to www.mysql.com.



The World's Most Popular Open Source Database

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