MySQL Database Replication and Failover Clustering

The increasing use of information and critical data using the Internet and other networked environments has made high availability a necessity for enterprises. More companies are relying on Online and Electronic means for business growth. This increased dependence on the Internet as well as on other networked technologies to meet business goals, is forcing organizations to deliver ‘always on’ availability to maximize revenues and to satisfy customer expectations. Moreover, downtime for such applications can mean an immediate loss in revenues.

High availability is a core requirement for all organizations that depend on real-time systems for their business. For organizations, system downtime results in loss of revenue and a significant increase in cost. Services with a high-end clustering solution, such as MYSQL- an Open Source database, can be used as a failover mechanism to considerably reduce system downtime.
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Introduction
The increasing use of information, critical data, and transactions on the Internet and other networked environments has made high availability a necessity for organizations. Many companies are now relying on Online and Electronic means to augment their business, improve efficiency on various fronts, and cut costs. This increased dependence on the Internet and other networked technologies to meet business goals is forcing organizations to deliver ‘always on’ availability to maximize revenues and to satisfy customer expectations. Moreover, downtime for such applications can mean an immediate loss in revenues. For example,

- **Company portals** that provide self-service applications over the Internet must be able to lodge the growing online community and the exponential growth in data that needs be delivered.

- **Financial institutes** must continue to accommodate the increasing volume of users and time sensitive transactions without sacrificing real-time performance requirements.

- **Network/Telecom Service Providers and Operators** are required to provide non-stop, continuous available service to an increasing number of users for competitive reasons.

- **e-Commerce organizations** and other companies of similar nature that are increasing their online sales channel must accommodate the growing audience of online shoppers.

- **Information portals** that are used to assist companies and customers by means of information gathered on the server database can not afford to have downtime.

For these types of IT enabled service organizations or for that matter any organization that cannot afford downtime, a high availability database solution is central and critical to their success in business. Organizations rarely compromise their stream of revenue due to lack of data. Therefore, a balance needs to be maintained so that the Total Cost of Ownership (TCO) required for implementing a high availability model should not cross the budget. A proprietary database requires high software licensing costs, in addition to large hardware and software investments. Traditional solutions of high availability database are expensive and complex, making them cost-prohibitive for many organizations.

Clustering Overview
Since the conception of the first commercially available UNIX clustering product, developed in the early 1990s, there has been a false impression that high availability has been beyond the reach of most moderate-level IT organizations. Though there are additional costs and complexities involved in clustering solution, there is an easier way of ensuring high availability for business continuity. In the Clustering world, there are many products available with multiple features that are being improved further. Clustering for Application Services or Databases is an important segment in the clustering world. Database clustering is not a novel concept. The ability to distribute a single, logical, relational database across multiple servers has existed for years. The primary use of Database clustering is to provide a model for adding high availability.

High Availability
Clustering is deployed today to add high availability. Many operating systems and applications lack this ability by default. To compensate these disadvantages, middleware products can add cluster fail-over capabilities to main Application Service or Database. This software helps in clustering two or more server nodes. These clustering nodes can be viewed as a single node/server. Showcase of single server instead of multiple clustered nodes is accomplished by sharing common resources. These resources can be Disk storage, IP addresses, and application instances.

Each clustered node is responsible in providing service whenever the other counterpart does not. Typically, in case of the Database cluster each node will have active resource simultaneously. In this case synchronization
among database content and transaction is an important aspect. This is accomplished by means of the 
Database replication feature. In the event of one of the nodes failing, the other node will immediately take 
over active ownership of all the resources from the other node.

**Cluster Design**

Database clusters are designed to support additional nodes, with two primary architectures:

1. **Shared Storage**
2. **Shared None**

The shared storage type of architecture stores the entire database on storage disks that can be directly 
accessed by each node. This model has typically been the best for scaling the database to handle a large 
number of concurrent clients, especially in an Online Transaction Processing (OLTP) environment.

The ‘Shared None’ architecture usually involves partitioning the database into private slices, which are then 
maintained by each node. The concept is known as Database Replication and is used to maintain the same 
copy of database content across each node in cluster. Replication helps the slave node in maintaining a 
duplicate copy of the data from the master node of that cluster.

**MySQL and High Availability**

MySQL is an Open Source Database proven for its ease of use, faster database architecture and reliability. 
The major benefit of MySQL database comes from its feature of reduction in Database TCO. It is also the 
world’s first Open Source Database cluster for high availability. MySQL uses distributed architecture in its 
Cluster products thereby resulting in no single point of failure. Cluster design with the help of MySQL can be 
achieved by means of its Replication and failover mechanism.

**Replication**

Replication is the mechanism in which each database read/written in the Active master node will result 
in the update to other node in the cluster. This helps the cluster to maintain the latest copy of database 
content in case the master node fails. In order to eliminate downtime, MySQL database management 
system provides a distributed fault tolerant architecture that replicates data to other machines so that they 
continue to run without interruption in the event of hardware, network or application failure. The advantage 
of synchronous replication is that it eliminates the time consuming operation of recreating and replaying log 
files for applications to fail over successfully.

**Failover**

Switchover and failover is the process of bringing up database instance on a different node in a cluster. In 
both cases, the application and its network identity is brought back to a chosen node.

**Failover Detection**

MySQL and High availability software provide the capability to detect failures in a service and cluster 
nodes. Database failover detection provides mechanism to detect failure of a database service running on a 
particular node. Failover occurs when Node failure detection gives a signal to the chosen node in the cluster 
to start a new instance of database with the same identity.
Typical Simple Cluster design will look like in the diagram shown below;

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**Advantages of using MySQL Clustering**

**High Availability Reduces Downtime**
In order to eliminate downtime that can prove expensive, database management systems must provide a distributed fault tolerant architecture that replicates data to other machines or across regions so that they continue to run without interruption in the event of hardware, network or application failure. MySQL Cluster, due to its cluster solution, not only lowers license costs, but also reduces system downtime significantly.

**Hot Backup without System Interruption**
MySQL Cluster enables companies to make online backups and restore backups without having to interrupt or take down the database system. Its also saves administration time and resources.
Automatic Fast Failover without Custom Programming
MySQL Cluster provides failure detection and fast failover time to ensure that applications remain available in the event of a failure. This is critical to banking and airline domains, where reservation systems are time sensitive. MySQL Cluster uses synchronous replication to propagate transaction information to all appropriate database nodes, so that applications can automatically fail over to another node extremely quickly.

Incrementally Scale Applications to Meet Capacity
The ability to scale in a near linear fashion is necessary to cost-effectively grow any system. The MySQL parallel server architecture enables MySQL Cluster to scale in a near linear fashion. This gives organizations the flexibility to begin in an undersized manner and thereafter make incremental investments to increase capacity as their needs grow. This eliminates the need for a large initial hardware and software investment in what tends to be an over powered configuration. In addition, adding machines (nodes) to a system can be done while in operation, without any downtime.

Reduce Hardware Costs
MySQL Cluster requires fewer investments in hardware as compared to other proprietary clustering solutions. The ‘shared none’ architecture of MySQL Cluster eliminates the cost of a Storage Area Network, a centralized data storage.

Services and Support
Support is freely available and accessible through the online community via the Internet as well as from MySQL. Most companies are now supporting MySQL database and clustering products with free online and multiple levels of paid support. MySQL provides extensive technical support services to ensure the success of any organization’s database application project. MySQL currently offers MySQL Cluster under its “dual license” business model. It will be provided at no cost under the free software/open source GNU General Public License (GPL) for open source projects and also under a commercial license for software vendors and other commercial MySQL customers.

Easy to Use Administration
An easy-to-use management command-line interface facilitates monitoring and maintainance of the database. It is easy to configure the server locally or remotely using management clients that connect to the management servers. Further, a management API makes it possible to write programs that automatically monitor and maintain the database.

Conclusion
High availability is essential for all organizations that depend on real-time systems as a part of their business. This is because system downtime results in loss of revenue and increase in cost. This can be avoided by means of using failover mechanism for critical application services like MySQL, an Open Source database with its high end clustering solution.
About Open Source & Linux Practice
From understanding business pain areas, recommending and implementing solutions to providing support, the OSL practice at TCS helps enterprises to overcome the challenges moving to Open Source, achieve tangible results and optimize the Total Cost of Ownership (TCO). The OSL practice offers secure and scalable solutions, built around Linux & Open Source, that cover Application Development, Re-engineering, Migration, Product Porting, Application Consolidation and Kernel Programming.

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