The Application of Oracle Data Guard in the Logistics Distribution Management Platform

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***Abstract*—Aiming at the Logistics Distribution Management Platform's disaster recovery, this paper brings forward a resolution basing on the Oracle Data Guard technology. By building a physical standby database, transferring the redo log which record the change of the primary database to the standby database, and applying the redo log in the standby database, it ensures the data consistence, and thus resolves the Logistics Distribution Management Platform's database's backup and disaster recovery. Basing on the resolution, this paper designs a Logistics Distribution Management Platform's database's disaster recovery subsystem, the disaster recover testing and the long time running proves the validity of the resolution.**

Keywords- primary database; standby database; Oracle Data Guard; disaster recovery

I. INTRODUCTION

Database backup and disaster recovery technology develops along with the formation of the database. Because of the existences of database backup and disaster recovery technology, database can give us more confidence when we store critical information in it, which promotes the development of database. So we can say it is the database backup and recovery technology that makes the database system more complete and developing more rapidly.

The collapse of the World Trade Center made more than 800 companies and organizations lost their critical data, numerous enterprises have become sacrificial victims of the terrorist incident. While we were regretting this very disappointing, the financial giant Morgan Stanley's miraculously announced global sales department can work as usual the next day. The remote backup and disaster recovery system which created previously protected the important data. Since then, people see more clearly about the important of the backup and disaster recovery system.

As for the database disaster recovery, Oracle and other software and hardware vendors have provided lots of solutions from the aspects of software and hardware, which includes Oracle's Advanced Replication Technology (Advance Replication), Operating System-level Replication Technology, Store-level Replication Technology, RMAN Backup Technology, Disaster Recovery Technology Based on the Standby Redo Log Technology .

There are so many disaster recovery technologies; we must select a most suitable one for the Logistics Distribution Management Platform. Because Advanced Replication does not support the long raw field which is frequently used in the Logistics Distribution Management Platform, so we can't choose it for the disaster recovery. RMAN Backup can't backup large data to a remote site because it needs a large network bandwidth. And if the disaster makes the data center or the city crash, RMAN can't recovery the data for the copy also save in local site, and its recovery process required a rather long time. Therefore it is not meet for the Logistics Distribution Management Platform's database disaster recovery. In addition to Storage-level Replication Technology, the Operating System Logical Volume Copy Technology and Data Guard technology, they achieve similar functions, but in the aspects of network bandwidth consumption and the product cost, Data Guard has a great advantage.

In this paper, we used the Oracle database disaster recovery technology Data Guard to design and implement a disaster recovery subsystem for the Logistics Distribution Management System.

II. LOGISTICS DISTRIBUTION MANAGEMENT PLATFORM

The logistics distribution management platform can simultaneously provide logistic distribution information service with multi-species, multi-channel, multi-transport informative services for hundred of logistic enterprises. Through the application of enterprise-level computing technology, the platform is more availability and reliability. It takes a lead among domestic logistic software by adopting national logistic standards, develops standardized software components for logistic distribution. By using the intelligent planning techniques, it realizes the intelligent planning and layout for the cargos, channels, transportations, routes and distribution centers. It achieves full & real time monitoring to distribution business, by vitally combining GIS, GPS, SMS, WAP and other advanced technology.

The overall logistics distribution management platform can be divided into five levels, which are the infrastructure level, base support level, logistics services support level, logistics service level, logistics application level, and the information expression level. Its system structure is shown as Figure 1.

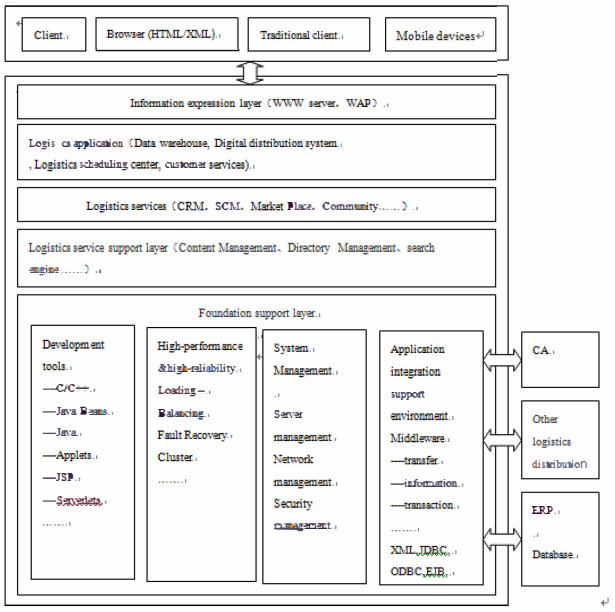

Figure 1. The logistics distribution management platform's system architecture

The platform database belongs to the infrastructure level, we chooses Oracle10.2.0.1.0 under UNIX to meet the need for capacity, speed of response, database security, stability and scalability of the database.

The platform database is an important support to the operation of the logistics distribution management platform, and all the data changes will be recorded in it. Once the data is lost, it will directly affect the normal operation of logistic distribution business. So it is vital to ensure the safety of data in database. In the beginning of the development, the database only used easy periodic logic copy, so when the database crashes because of the system cash or backdoor storage crash, the data between this backup and last backup will be lost.

III. DISASTER RECOVERY SUBSYSTEMS BASED ON DATAGUARD TECHNOLOGY

A. *Origin and Definition of Data Guard*

Oracle Data Guard produced in Oracle 7.3 version. It was formerly known as the standby database and then was renamed to Data Guard in oracle9i. It was the infrastructure of the management, monitor and automation software. Data Guard creates maintains and monitors one or more standby databases to protect enterprise data from failures, disasters, errors, and crash. Data Guard was mainly used for Oracle database disaster recovery and it was one of the Oracle database backup and disaster recovery solutions[1].

Oracle Data Guard makes standby database easier to use, with more robust failover features and an easy to use GUI interface. It essentially combines the primary and standby databases into a single “high availability” resource. Oracle’s native standby database functionality (which can be managed under the Data Guard umbrella) has been enhanced to allow the primary database to be used as the new standby, instead of being discarded as in previous versions of Oracle.[2]

B. *The Architecture of Data Guard Disaster Recovery Technology*

A DATAGUARD disaster recovery system includes one primary database and maximum nine standby databases. DATAGUARD disaster recovery system connects each other with the Oracle network protocol, and can be dispersed in various regions. The place the database is installed has no limit, as long as they can communicate with each other through the network. For example, you can have a main database and the standby database in the same system, but can also have two standby databases on the other system.

A Data Guard disaster recovery system contains only one production database, namely the primary database. Applications will connect to the database primarily[3].

A standby database is a copy of the primary database in transaction-level. Standby database forms from an initialization backup of the primary database. Once the standby database is established, Data Guard will automatically transfer the redo log files from the primary database to the standby database, and apply them to maintain the standby database.

The Architecture of Data Guard Disaster Recovery Technology is shown as figure 2[4].

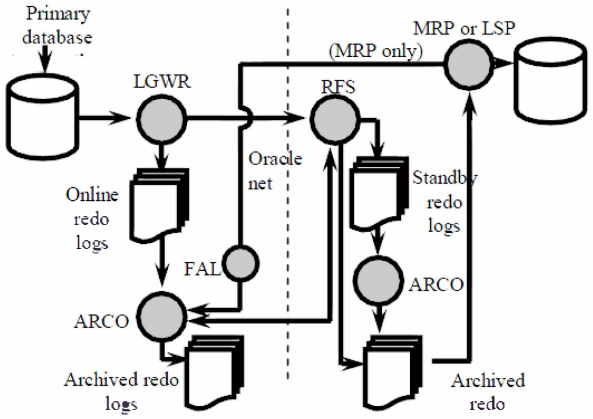

Figure 2. The architecture of data guard disaster recovery technology

C. *Log transfer of Data Guard*

The working mechanism of Data Guard is to transport logs to the standby machine, and then apply them on the standby machine to keep the standby database consistent with the primary database. Logs are transported under the following situations[5]:

1) *To make logs synchronous by setting LGWR processes.*

In this case, when the network is unblocked, the primary database writes online redo logs using LGWR as well as standby redo logs using the RFS process. when the primary database switches logs, the standby database also switches standby redo logs ,generates archived redo logs and applies the

logs by MRP or LSP processes. When the network is disconnected, there will be a gap between the primary database and standby database. After the network is connected, the standby database will initiatively search the needed archived log from the primary database, get down it, and apply it to the standby base by the MRP or LSP process to make up the gap.

2) To make logs synchronous by setting ARCH processes.

The primary database transports the archived logs to the archived logs' catalog of the standby database though the RFS process, and then apply it with the MRP or LSP processes to realize the data synchronization. When the gap produces after the network disconnect, the solution is the same as above.

D. Log apply of Data Guard

Data Guard provides two methods to apply this redo data to the standby database and keep it transactional consistent with the primary, and these methods correspond to the two types of standby database supported by Data Guard[6]:

1) Redo Apply, used for physical standby databases
2) SQL Apply, used for logical standby databases.

E. Equations Disaster recovery subsystem's implementation based on DATAGUARD technology

1) Generate the required files in the primary database.

Generate a static parameter file named Pfile using dynamically parameter file, and then create a standby control file.

2) Copy the required files to the standby database.

Generate a list of data files to be copied. Generate a list of log files to be copied. Shut down the main database. Copy parameter file initstd.ora, standby control file stactl01.ctl, data files in the list and log files in the list to the standby system. Start up the main database.

3) Alter the parameter file and generate the standby database.

Alter the parameter file and add the required parameters of the physical standby database whose suffix is as follows: remote_archive_enable,standby_archive_dest,standby_file_management, fal_server, fal_client; Create the password file, and start up the database to the standby database; Run the restore command to let the standby database consist with the primary database.

4) Alter the parameters of the primary database for data synchronization

First, Alter the parameters of the primary database to archive the redo log files to the standby database, i.e. add network service name 'standby' to the tnsnames.ora which point to the standby database. Second, Alter the parameters of the primary database and then start the remote archive to ensure the data consistency between the primary database and the standby database.

5) Switch redo log to ensure the synchronization

After configuration, we should execute command to switch the redo log file of the primary database, and see the number of the newest redo log number from the alert log. And then we should check the alert log of the standby base to ensure the synchronization. We also need to check the dictionary view to ensure the log has been applied to the standby database.

Through the above steps, we can successfully configure the standby database in the local area. When the crash occurred in the primary database, we can recover the data through the standby database and ensure the database not losing data.

IV. TEST AND RUN

The Logistics Distribution Management Platform starts to run formally at the end of December 2009. In order to ensure the high availability of the Logistics Distribution Management Platform's database. We chose Oracle10.2.0.1.0 installed in the UNIX AIX6L as its database system and configured real application cluster. The system structure of the database's disaster recovery subsystem is shown as the Figure 3.

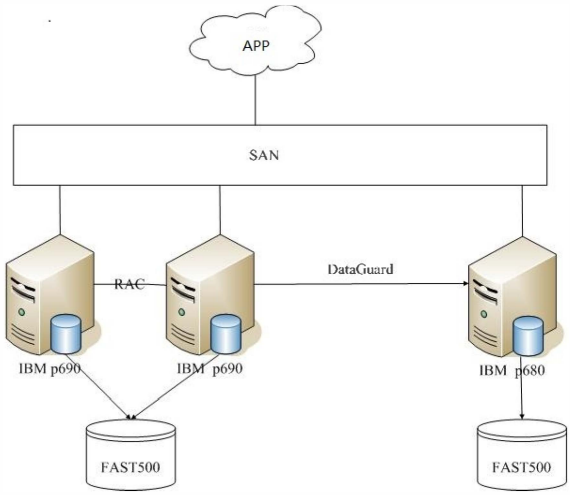

Figure 3. The system structure of the database's disaster recovery subsystem

The database configures the oracle real application cluster through two IBM p690. When a database server failure occurs, the application will automatically be switched to connect to another database server. When the background storage failure occurs or two database servers are all failure, we can switch the application to connect to the standby database.

After 2 weeks of installation and commissioning, we had realized the data synchronization of the primary database and the standby database. We conducted a test of the primary database crash in 2010. When we simulated that the primary database crashed, we successfully switched the application to connection to the standby database within 5 minutes and continue to provide the data store services for application. After switching, the database did not lose any data, and the business transactions were continuity.

CONCLUSIONS

By the application of the Oracle Database Disaster Recovery Technology Data Guard, we can ensure the availability of two databases with the same data at the same time, and thus realize the database's disaster recovery. Our

technical solutions have been successfully used in the logistics distribution management platform, which ensures the security and reliability of the application data. It also can meet the security requirement of the slimily logistics distribution management platform.

ACKNOWLEDGMENT

Project Supported by the National Natural Science Foundation of China. (Gran t No.11072260)

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