NEC ExpressCluster

Integrated Disaster Recovery Solution for Transactional Applications and Data

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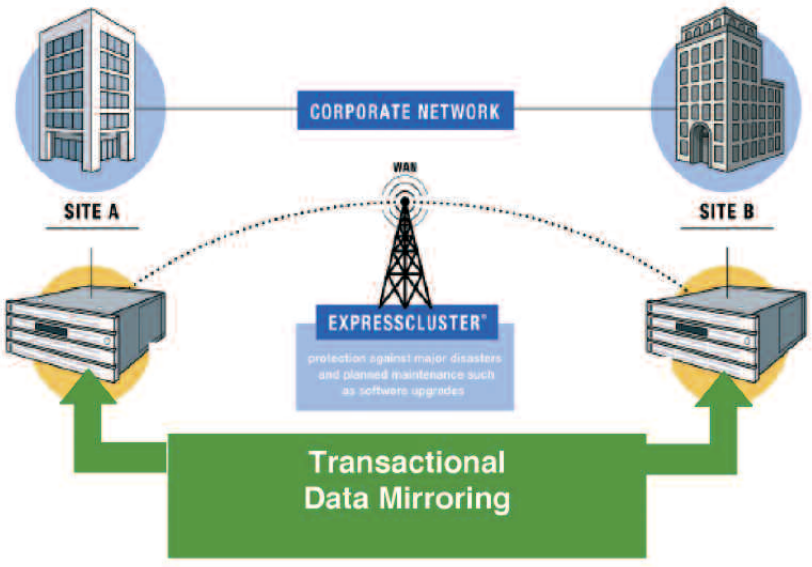
NEC ExpressCluster X

In today's dynamic business environment, organizations of all sizes are finding it ever more important to maintain access to critical applications and data even in event of natural and man-made disasters. The challenge is particularly acute for the database (e.g. MS SQL, Oracle DB, IBM DB2) driven transactional applications and data that are often essential to the core business processes and operations of an organization. NEC has developed its award winning ExpressCluster X is to meet this particular challenge with a solution to provide integrated and continuous protection of critical transactional application and data (see Figure 1). NEC's intelligent approach to both application failover and data mirroring management offer customers radical system availability benefits such as disaster recovery within minutes.

With ease of deployment and manageability as key design elements, NEC delivers a significantly reduced total cost of ownership when compared to alternative solutions.

NEC's ExpressCluster X offers customers high availability and total cost of ownership (TCO) benefits achieved through its integrated application and data recovery capabilities. In addition, ExpressCluster X's proven synchronous data mirroring technology ensures transactional data integrity that virtually guarantees no data loss even over great geographical distances.

This paper provides an overview the comparative benefits of ExpressCluster X in the context of providing comprehensive disaster recovery solution for database driven transactional applications and data.



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Disaster Recovery Technology Landscape

A broad spectrum of approaches based on various technologies are available today to help IT organizations recover business critical applications and data in the event of hardware, software, and/or site failures. The approaches are generally divided in to 2 categories: data protection/recovery and application protection/recovery. Some of the more popular approaches include :

Data Protection/Recovery Approaches

Tape Backup

This approach consists of solutions that backup important data on disk to tapes on a regular or ad-hoc schedule to guard against system failures. Backup tapes are typically manually transported and stored to a different site to guard against primary site failures. Tape backup solutions are attractive because they are :

1) based on well-established technologies,

2) relatively inexpensive to deploy, and

3) offer additional benefits beyond system failure recovery such as human error recovery and historical archive capabilities.

Nonetheless, tape backup solutions offer only limited recovery capabilities against system failures because

1) the underlying data backup technology is inherently asynchronous so significant amount of business critical data could be lost in between backups,

2) data recovery from tape to disk usually takes hours due to required data format conversion steps, and

3) data backup/recovery alone is not enough for system recovery because applications must also be recovered. In many respects, especially for business critical systems, the real value of tape backup solutions is not the ability to recover in case of system failures but rather in case of data corruption due to human errors.

File Replication

The file replication approach improves upon the tape backup approach with solutions that copy important disk files to a backup disk on a regular or ad-hoc schedule. The comparative advantages against tape backup include higher data I/O speed and random access capabilities of disks compared to tapes. The comparative disadvantages against tape backup include much higher media cost and lack of portability. In any case, this approach is still based on asynchronous data replication so it has the same deficiencies as the tape backup approach with respect to business critical system failure recovery.

Disk Mirroring

The disk mirroring approach offers real-time synchronous replication of entire disks that store important data. Solutions based on this approach virtually guarantees no data loss since any data written to the primary disk is written to the backup disk at the same time. In terms of data recovery in event of system failures, disk mirroring is the most effective solution because it offers data recovery with no data loss and fast recovery time. However, disk mirroring does not offer the capability to recover from data corruption due to human errors available in tape backup solutions. So, disk mirroring and tape backup solutions are really more complementary than competitive. Up until recently, most disk mirroring solutions relied on proprietary hardware technology that only worked with vendor specific disk arrays thus very expensive but newer software based disk mirroring solutions such as ExpressCluster X have made disk mirroring price competitive with file replication and eliminated the requirement for proprietary disk arrays. In short, disk mirroring is the most effective way to guarantee fast data recovery time with no data loss.

Database Replication

Lastly, database replication is a specialized type of data protection that does not actually replicate data directly but it's described here for sake of completeness. In database replication, a database query (i.e. SQL statements) is executed on two or more database servers to produce the same data that is then stored on different physical storage media. As such, the same data is indirectly replicated on separate systems. In comparison to the other data protection approaches, this approach is quite restrictive in the following ways :

- Works only for database records data. Typical real-world systems have some combination of database records and other data that need to be protected and recovered in event of disasters.
- Highly inefficient resource usage. Database servers must run simultaneously on primary and standby systems in order to perform database replication. This means standby system is tied up doing the same resource intensive workload as the primary system leaving little spare resources to do other work.
- Proprietary to each database vendor. Database replication technologies are completely proprietary thus database replication requires the same brand and version of database servers to be run on the primary and standby systems.

In addition to the above restrictions, database replication does not provide automatic or incremental data resynchronization to restore a failed primary system. In comparison, ExpressCluster X supports fast and automatic resynchronization by tracking all changed data since primary system failure and only resynchronize the changes in the primary system restoration process. Despite the limitations, database replication does provide some interesting capabilities (e.g. as replicating a different subset of a database to different remote systems to increase remote client read access performance) that may be considered complementary to the other data protection technologies. However, in general, database replication is a much more costly and less effective way to protect data for fast disaster recovery purposes when compared to other data protection technologies.

Application Protection/Recovery Approaches

High-Availability/Failover Clustering

This approach offers fast recovery of business critical applications by maintaining an application installation on a backup server that is identical to the primary server. In event of primary server system failure, the clustering management software will automatically failover (i.e. activate) the application to the backup server. The typical failover process includes starting the application on the backup server after the reassignment of OS and application resources (e.g. host IP address, host name, network directory names, etc.) to the backup server. Failover clustering is an effective way to ensure fast application recovery in event of system failures and it is generally attractive because it does not require target application source code to be modified. However, a limitation in most failover clustering solutions (e.g. Microsoft Cluster Service) is the shared-disk requirement that calls for both the primary and backup servers to be connected to a common disk array which is only practical when the servers reside at the same site. Therefore, most failover clustering solutions with shared-disk requirement do not offer protection against site failures. ExpressCluster X is one of the very few failover clustering solutions that do not have the shared-disk requirement thus making failover clustering effective against site failures in addition to hardware and software failures.

High-Performance/Load-Balancing Clustering

Load-balancing clustering originated as a scalability solution for large scientific applications where each application installation consists many identical application components that reside on different servers so each server can take on a portion of the overall application workload.

Typically, the application components can be added or removed dynamically to accommodate the overall application workload. This capability has the side benefit of making the entire application installation inherently highly available and resistant to single server failures. Despite the attractive benefits of load-balancing clustering it has yet to be adopted broadly for enterprise applications because it requires the applications to be effectively redesigned and reimplemented from scratch. In addition, load-balancing clustering has similar limitations as failover clustering in that a shared disk array usually required so load-balancing clustering does not offer protection against site failures.

Integrated Application and Data Protection in WAN Environment
The Key to Effective Business Critical System Disaster Recovery Solution

The following types of solution for protection against business critical system failures are available on the market today :

	Description	Advantages	Disadvantages	System Recovery Time/Data Loss
Asynchronous Replication Only	Backup data periodically using a tape backup or file replication solution. In event of system failure a new system is built from scratch including installation of necessary application components then data is recovered from backup media. Any data that has not been backed up will need to be recreated if it is possible to do so.	• Inexpensive to buy and use • Backs up significant amount of data • Protects against data corruption due to human errors	• Significant data loss potential • No transactional integrity guarantee for database backup • Long system recovery time	Slow/Medium
Synchronous Mirroring Only	Mirror data in real-time to backup disk using a disk mirroring solution. In event of system failure a new system is built from scratch including installation of the mirrored backup disk as the new primary disk along with necessary application components.	• Virtually no data loss • No backup schedule to maintain • Transactional integrity for database mirroring	• No protection against data corruption due to human error • Long system recovery time	Slow/Low
Failover Clustering Only	Implement backup server with application and OS installation identical to primary server is implemented along with an external shared disk array. In event of primary server failure the application instance on the backup server is automatically activated to take over workload for the failed primary server. The same external shared disk array is still used after the backup server is activated.	• Automatic application recovery • Short application service disruption	• No data backup or mirroring • No protection against site failure • No protection against storage array failures	Slow/High

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	Description	Advantages	Disadvantages	System Recovery Time/Data Loss
Ad-Hoc Failover Clustering /Asynchronous Replication	Implement backup server with application and OS installation identical to primary server is implemented using a failover clustering solution. In addition, an asynchronous data replication solution (e.g. tape backup or file replication) is implemented to periodically backup data from primary to backup server. The failover clustering and the asynchronous backup solution are then integrated using custom developed programs or scripts to coordinate application failover and data replication operations. In event of primary server failure the backup data may need to be recovered first then application instance on the backup server is activated to take over for the failed primary server. Any data that has not been backed up will need to be recreated if it is possible to do so.	• Automatic application recovery • Backs up significant amount of data • Reduced system recovery time	• Significant data loss potential • No transactional integrity guarantee for database backup • High custom integration cost with low solution manageability	Medium/Medium
Ad-Hoc Failover Clustering /Asynchronous Replication	Implement integrated solution that provides both failover clustering and synchronous disk mirroring on a backup server. In event of primary server failure application instance on the backup server is automatically activated along with up-to-date mirrored data to take over the workload for the failed primary server without any manual intervention.	• Complete solution for fast application and data recovery • High manageability and reliability • Transactional integrity for database mirroring	• No protection against data corruption due to human errors	Fast/Low

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Conclusion

In today's non-stop competitive business environment the need to ensure maximum availability of business critical applications and data is now imperative. Given the myriad of technologies and products available today IT managers can easily become confused. However, for IT managers looking for a comprehensive and TCO effective solution to protect database (e.g. MS SQL, Oracle DB, IBM DB2) driven transactional applications and data against hardware, software, and site failures the clear and superior choice is ExpressCluster X.

To learn more about NEC ExpressCluster X
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