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High Availability for Databases

Protecting Sybase Databases with Veritas™ Cluster Server

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Introduction

In years past, IT solutions were deployed to support back-end business functions such as inventory management, accounting, and human resources. In today's world, the IT solution increasingly *is* the business. These days, the repository for nearly all business application data is high-end database servers—and Sybase is a major player in this field.

This paper will discuss the various options available for providing high availability (HA) for single-instance Sybase databases, as well as dependent applications. It will demonstrate how Veritas™ Cluster Server can provide cost-effective high availability for Sybase databases.

The challenge of Sybase database availability

Customers who employ Sybase databases are, more often than not, using them for mission-critical applications. Their primary concern, therefore, is to keep those databases as available as possible. However, that concern is complicated by the need to:

- Control costs
- Reduce complexity
- Address dependent, multi-tier applications
- Address disaster recovery requirements

Traditional high-availability failover solutions do not provide parallel access, but can provide a very short recovery time objective (RTO) at significantly reduced cost and complexity. All operating system vendors and several third-party software vendors provide classic high-availability failover products. Most of these products were designed for—or operate best in—a traditional active-passive failover configuration. In this configuration, the “active” node or server runs a database instance, and the “passive” failover node stands idle, waiting for failure. This configuration does help sell additional servers, but it is not a cost-effective solution from the customer standpoint.

Because most companies do not operate a single database but, rather, a large number of databases supporting mission-critical applications, there is a cost-effective solution that provides solid, dependable high availability. The Veritas Cluster Server high-availability solution from Symantec™ is designed to provide cost-effective “roaming spare” or “no spare” failover configurations for mission-critical Sybase environments.

Veritas Cluster Server from Symantec

Veritas Cluster Server from Symantec is the industry-leading cross-platform high availability clustering solution. With an application-centric approach to availability, Veritas Cluster Server provides customers with a high degree of flexibility in determining the application failover behavior best suited to their business requirements.

Veritas Cluster Server provides high availability to mission-critical applications by managing each application within a construct known as a *service group*. Each service group contains the specific Sybase components needed to manage a Sybase instance, along with all of the network and storage resources required by the database. The service group is the single unit of failover within a Veritas Cluster Server cluster.

Key features

Veritas Cluster Server is a feature-rich, best-in-class high availability clustering solution. Key features include:

- Intelligent failover logic with service group workload management
- Out-of-the-box support for most major applications
- Automated disaster recovery (DR)
- DR and local HA failover test suite
- Management console for multi-cluster and multi-site management

Components of Veritas Cluster Server with Sybase support

Clusters

A single Veritas Cluster Server cluster consists of multiple systems connected in various combinations to shared storage devices. Veritas Cluster Server monitors and controls applications running in the cluster, and it can restart applications in response to a variety of hardware or software faults.

A cluster is defined as all systems that share a common cluster configuration and utilize a common interconnect network. The Veritas Cluster Server cluster interconnect consists of redundant physical Ethernet interconnects, generally over two or more dedicated private networks. The communications layer carries heartbeats between systems within the cluster, as well as membership and state change information.

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Clusters can have from one to 32 member systems, or “nodes.” Within a single Veritas Cluster Server cluster, all member nodes must run the same operating system family. For example, a Solaris™ cluster would consist of entirely Solaris nodes—likewise with Linux®, AIX®, HP-UX®, and Windows® clusters. Within a given cluster, multiple versions of the operating system can be deployed to support specific upgrade scenarios.

Applications can be configured to run on specific nodes in the cluster. Storage is configured to provide access to shared application data for the systems that are hosting the application. In that respect, the actual storage connectivity will determine where applications can be run: Any node that shares access to the associated storage is “eligible” to run an application.

Agents

Agents are the Veritas Cluster Server software components that handle the starting, stopping, and monitoring of all resources contained within a service group. Agents receive instructions on when to monitor, start, or stop a resource from the Veritas Cluster Server engine, and the agents then return the results of those actions to the engine. Bundled with the Veritas Cluster Server package are a collection of agents to manage the storage and network resources required by an application managed by Veritas Cluster Server.

Veritas Cluster Server ships with agents to control all common system functions such as file systems, and network addresses. It also provides out-of-the-box support for most enterprise applications such as databases, application servers, and Web servers. This includes complete out-of-the-box (no customization required) support for the Sybase database and network components.

How Veritas Cluster Server manages a Sybase database server

Veritas Cluster Server support for Sybase consists of two agents—one for SQL Server and another for Backup Server. These agents, which include type declarations and agent executables, are represented by Sybase and SybaseBk resource types, respectively. The two agents work together to make Sybase highly available in a Veritas Cluster Server cluster. The agent for Sybase starts a Sybase SQL Server, monitors the server processes, and shuts down the server using the standard Sybase commands. Similarly, the agent for SybaseBk starts a Sybase Backup Server, monitors the server process, and shuts down the server using standard Sybase commands.

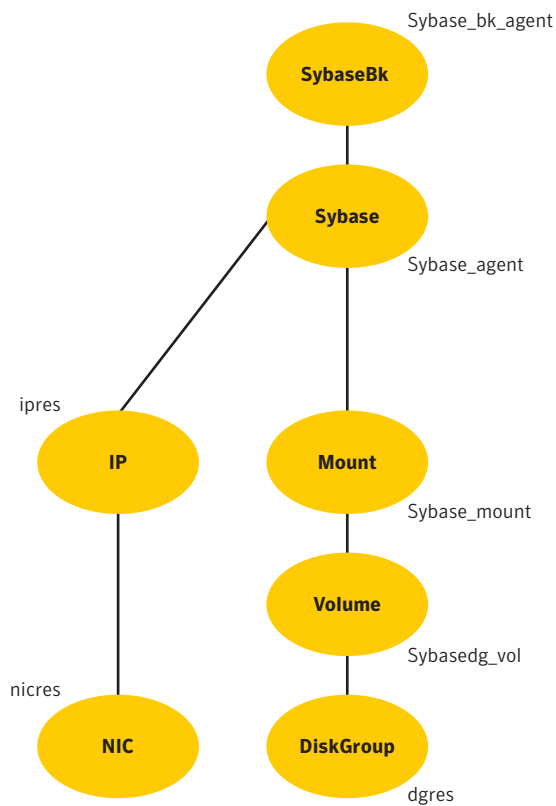
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The Veritas high availability agent for Sybase provides two levels of application monitoring:

- **Basic monitoring**—In basic (first-level) monitoring mode, the agent monitors the Sybase daemon processes to determine whether they are running.
- **Detail monitoring**—In detail monitoring mode, the agent performs a transaction on a test table in the database to ensure that Sybase is functioning properly.

Anatomy of a Sybase failover with Veritas Cluster Server

To understand the sequence of events that occurs when Veritas Cluster Server fails-over a Sybase database, it is helpful to understand how a Veritas Cluster Server service group is configured for Sybase. The figure below illustrates a typical Sybase service group configuration in Veritas Cluster Server:



This diagram depicts a single Sybase database configuration. It contains a disk group with a single volume and file system. The file system is managed by the Mount resource and is

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dependent upon the volume. The volume is managed using a Volume resource, which in turn requires a DiskGroup resource. The network identity for the Sybase server is managed using the IP and NIC resource types. The Sybase server can be started after each of these resources is brought online. The Backup Server is started after the Sybase SQL Server is online.

The lines connecting the resources demonstrate the various dependencies between the resources, which dictate the correct start and stop sequence for all the resources in the service group. For example, the Sybase database should not be started before the file system—which contains its database files—is mounted.

In a planned switch-over event—i.e., one in which a conscious decision has been made to move the Sybase instance from one system to another in the cluster—the following sequence of events will take place once the command is issued:

1. The Sybase instance is shut down.
2. The virtual IP address is removed from its network interface.
3. The file system is unmounted.
4. The disk group containing the file system is deported.

On the target node—the node chosen by the administrator to host the failover database—the above sequence is reversed.

Of course, not all failover events are planned. Depending on the nature of the problem that caused the failover, Veritas Cluster Server may or may not be able to gracefully shut down all the resources within the service group. In the case of a server panic or power outage, none of the resources will be brought down cleanly, and the reverse sequence described above will take place. What is different in this situation is that when the Sybase agent starts the Sybase database, Sybase will perform its database recovery routine to ensure transactional consistency—and that any needed file system checks on the file systems will be performed before mounting. It is vital to understand that the database recovery on a failover is identical to the normal Sybase instance recovery following any local server issue.

How Veritas Cluster Server with the Sybase agent addresses customer challenges

Beyond the simple ability to move a Sybase database instance from one system to another in response to a failure, Veritas Cluster Server also provides significant additional benefits to the customer in the problem areas of controlling costs, reducing complexity and providing high availability to the upper tiers of the application stack that depend on the Sybase database.

In this section, we will explore the question of how Veritas Cluster Server addresses these customer challenges—and how it provides automated disaster recovery.

The need to control costs

Traditional approaches to high availability have entailed the clustering of mission-critical applications with pairs of servers in active-passive (standby) configurations—which works well enough in a smaller environment with only one or two mission-critical applications. But in a larger environment with many such applications, the cost of the required hardware spares and additional software licenses is prohibitive. Veritas Cluster Server allows the deployment of large clusters with advanced failover logic that can make “intelligent” failover target selections based on server capacity and application load. With Veritas Cluster Server, all a company’s servers that are running mission-critical applications can be grouped together in a single cluster, and then one or two spare systems can be added easily to that cluster to handle failovers. This is called $N+1$ clustering, where N represents the number of servers with active applications and 1 indicates a single spare. In a larger cluster, this might actually be $N+2$ or $N+3$.

A variant of this cluster topology is N to N . In this topology, there is no spare server per se, but each server has some amount of spare capacity to host additional applications. The paragraphs that follow will discuss these topologies in more detail.

$N+1$ “roaming spare” clusters

This cluster topology has a number of active servers, plus one idle server as a spare. For this example, we will consider a three-node cluster with two database instances, Sybase A and Sybase B, active on two separate servers, Server 1 and Server 2. Server 3 is, initially at least, the spare server.

Upon cluster startup, Sybase A is started on Server 1 and Sybase B is started on Server 2. Server 3 is idle. If a fault occurs on Server 1, Sybase A will fail-over to Server 3. When Server 1 is

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returned to service, there is no automatic fail-back of Sybase A, as a fail-back would introduce an additional unnecessary outage. Instead, Server 1 simply becomes the new spare. This is what's meant by the term "roaming spare."

In larger N+1 clusters, the intelligent failover logic that Veritas Cluster Server offers with its *service group workload management* capability becomes evident. This management capability associates a numerical load value with each service group (application) and a numerical capacity value for each server. The cluster considers and evaluates these values when it selects a failover target. Absent an intelligent method of selecting a target server for failovers in the event of multiple failures, applications tend to be stacked onto one or two servers.

N to N clusters

This cluster topology does not include a spare server. All systems that host a mission-critical application are placed into the cluster, with the assumption that each server has some extra capacity to host additional applications in the event of a failure.

As with N+1 clusters, each service group (application) is assigned a numerical load value and each server in the cluster a numerical capacity value. Since the cluster has no idle server, the cluster must be able to select failover target nodes based on load and capacity; conventional ordered list selection simply will not work.

This topology also lends itself well to server consolidation efforts, because the cluster will automatically attempt to "stack" applications on all of the cluster's servers in a balanced fashion. Veritas Cluster Server provides an additional construct known as *limits* (for servers) and *prerequisites* (for service groups). This permits a user to define the upper limits of a server's resources, and the minimum amount of those resources that must be reserved for the application it hosts. For example, consider a case where the user has configured adequate shared memory, semaphores, etc., in the kernel configuration to host a maximum of two running databases on each of four servers. The user can then define a *limit value* of "Databases=2" for each server. Each service group hosting a database can then have a *prerequisite value* of "Databases=1." When a service group that is hosting a database comes online on one of the database servers, the service group's prerequisite value is deducted from the server's limit value. If no server exists with an adequate limit value remaining, the service group is not allowed to come online. By using a combination of capacity vs. load and limits vs. prerequisites, the user can create an automated system to choose the best possible host in a failover, yet prevent any specific server from being

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overloaded. This capability is unique to Veritas Cluster Server; it is not possible to do this with traditional cluster products that use a simple list of servers for failover decision-making.

In contrast to this capability, other cluster products select a failover target from a simple ordered list of servers. In general, this list is set so that an application runs on one server in the cluster under normal circumstances, but will move to a designated spare upon failover. This practice is fairly adequate until subsequent failures cause the designated spare to become overloaded as multiple applications fail-over to it.

The need to reduce complexity

Veritas Cluster Server reduces complexity in a number of ways. Because of its consistency across OS platforms, Veritas Cluster Server reduces the administrative burden by providing a consistent clustering solution across the enterprise—so systems administration and operations staff only have a single user interface to learn, regardless of the OS platform in use.

Because the agent for Sybase is built specifically to manage Sybase databases, there is no custom scripting necessary to get a Sybase instance under Veritas Cluster Server control. To cluster a given instance of Sybase, the user simply supplies the Sybase and SybaseBk agents with the following basic parameters: the Sybase instance name, the name of the Sybase user ID, the Sybase home directory path, and the specifics of the database version.

The need to manage dependent, multi-tier applications

A Sybase database is rarely an island unto itself. More often than not, the database is the first tier of a multi-tier application stack that also encompasses application and Web tiers. All too often, a customer will cluster the back-end database of a multi-tiered application stack but neglect the upper portions of the tier. Then, when a failure occurs on a server that hosts the Sybase database, the cluster dutifully handles the failover of the database—but the upper-tier components of the application must be manually restarted because they have lost their connection with the database server. To sequence the startup and shutdown of the separate tiers correctly, these upper tiers—for example, a WebLogic application tier and an Apache Web server tier—can be placed in the same cluster as the Sybase database instance, with their service group (application) dependencies established.

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In cases where the various tiers are running on separate OS platforms, which is the case more often than not, Veritas Cluster Server provides a remote group agent to establish cross-cluster service group dependencies. This capability is key to multi-tier application control and unique to Veritas Cluster Server.

The remote group agent is configured to point to a service group running on another cluster in the data center. When a failover occurs, the remote group resource will wait for the service group in the remote cluster to come online before bringing the local service group online. This allows a properly sequenced startup of applications, even when the applications are running on separate OS platforms.

The need to address disaster recovery requirements

More often than not, Sybase databases are the cornerstone of an organization's most critical applications. In the event of a disaster that causes a complete data center outage, it is imperative that these applications be brought online as quickly as possible at an alternate site.

Veritas Cluster Server HA/DR enables *global clustering*, which extends the concepts of local high availability to wide-area disaster recovery failover. In a Veritas Cluster Server *global cluster* configuration, a Veritas Cluster Server cluster is deployed at each of two to four data centers. Communications are established between the clusters over an IP network, and each cluster is configured with an identical service group. Keep in mind that the primary Veritas Cluster Server cluster can have multiple service groups. In combination with the global clustering feature of Veritas Cluster Server, this capability provides flexibility in replicating the critical applications of the business—which can significantly reduce the cost of the total disaster recovery solution. The Sybase database files are replicated between storage devices at each site, and the service group is capable of failing-over not only within its own local cluster in response to a localized failure, but also to another cluster in the event of complete loss of the entire data center. Veritas Cluster Server HA/DR includes agents for most enterprise storage replication solutions (e.g., EMC SRDF and IBM GlobalMirror), as well as for Veritas™ Volume Replicator. The idea behind the disaster recovery capabilities of Veritas Cluster Server is to protect the application, not just the data.

In order to provide regular validation that a wide-area failover will work when the time comes, Veritas Cluster Server provides a testing feature called Fire Drill that allows for non-disruptive testing of the disaster recovery configuration. When a test is run, Veritas Cluster Server creates a storage snapshot of the application data at the secondary data center and then brings the application up at the secondary data center without its network identity. In the case of a Sybase

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database, Fire Drill will start the database instance without its corresponding IP address, or any DNS changes. (The network components are omitted in order to ensure there is no interference with the production application running at the primary data center.) The user can then confirm that the database can start successfully, and a systems administrator or DBA can connect to the database to confirm that it can process transactions. Fire Drill fully tests the validity of all required replicated storage, because most DR failures occur due to storage configuration changes at the primary site that are not propagated to the secondary site.

Once testing is complete, the application is brought back down and the snapshot is released. The production application running at the primary data center is completely unaffected by the Fire Drill test at the secondary site.

In a real disaster scenario or planned application movement, the process is only slightly different. The actual database replica is mounted, and all related network components such as the IP address and any DNS updates are started so that database users can continue to operate.

In the case of a planned application movement from one data center to the other, the direction of replication is reversed so that database consistency is maintained at both sites.

Managing multiple clusters

In larger enterprises, it is common for multiple clusters managing Sybase databases to be deployed not just across multiple OS platforms, but across multiple data centers as well. This practice can pose an administrative challenge, especially when dependencies exist between applications running in different clusters or when applications are capable of failing-over across data centers. To ease that challenge, Symantec offers a consolidated Veritas Cluster Server Cluster Management Console, which provides full visibility into and management of all Veritas Cluster Server clusters throughout the enterprise, across multiple OS platforms and across multiple sites.

The console permits management and operational control over all Veritas Cluster Server clusters from a single “pane of glass.” In addition, it further extends wide-area disaster recovery management capabilities by providing a simplified site migration function that allows all applications under Veritas Cluster Server control to be relocated from one data center to another.

A rich set of pre-defined reports, such as application up-time reports for SLA compliance, can be produced from the Cluster Management Console—and it can also provide complex metropolitan- and wide-area cluster visualizations.

The Cluster Management Console was introduced starting with the Veritas Cluster Server 5.0 release and is included as part of the base product. It can be downloaded from the Veritas Cluster Server product page at <http://go.symantec.com/Veritas Cluster Server>.

Additional benefits of Veritas Storage Foundation™ HA for Sybase®

When Veritas Cluster Server is bundled with Veritas Storage Foundation for Sybase, databases derive additional benefits in the form of increased performance, flexibility, and reliability.

Storage Foundation for Sybase consists of the following components:

- **Veritas Volume Manager:** Veritas Volume Manager provides simplified disk management with striping and mirroring for improved performance and availability. This includes the ability to mirror across sites within metropolitan area cluster (MAC) distances of about 50 miles. Dynamic Multipathing (DMP) provides availability and load balancing across storage connections (host bus adapters [HBAs]).
- **Veritas File System:** Veritas File System is a high-performance, fast-recovery file system that is optimized for business-critical database applications and data-intensive workloads. Veritas File System offers online administration, letting you perform most frequently scheduled maintenance tasks (including online backup, resizing, and file system changes) without interrupting data or system availability. Veritas File System also provides support for large file systems (of more than eight exabytes in a 64-bit environment) and large files (in the exabyte range in a 64-bit environment). Veritas File System offers the following performance-enhancing features that are of particular interest in a database environment:
 - Veritas Quick I/O—Improves the throughput for Sybase databases built on Veritas File System file systems. It delivers raw device performance to databases run on Veritas File System, providing the administrative advantages of using file systems without the performance penalties.
 - Veritas Cached Quick I/O—Further enhances database performance by leveraging large system memory to selectively buffer frequently accessed data.
 - Veritas Concurrent I/O—Improves the performance of regular file systems on a Veritas File System file system without the need to extend namespaces and present the files as devices. This simplifies administrative tasks and allows relational databases that have no sequential read/write requirement (such as Sybase) to access files concurrently.
- **Veritas Enterprise Administrator:** Veritas Enterprise Administrator is the infrastructure that allows Veritas Storage Foundation for Sybase, Veritas Volume Manager, and Veritas File System information and features to be accessed through the graphical user interface (GUI).

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Summary

Veritas Cluster Server from Symantec offers the highest degree of flexibility and cost-effectiveness in protecting Sybase databases from both localized and data center-wide failures. When deployed in an enterprise-wide environment, Veritas Cluster Server protects Sybase databases, along with their dependent applications, across multiple OS platforms and multiple locations. When Veritas Cluster Server is deployed in conjunction with Veritas Storage Foundation for Sybase, an unparalleled level of reliability, performance, and manageability is possible.

About Symantec

Symantec is a global leader in providing security, storage, and systems management solutions to help businesses and consumers secure and manage their information. Headquartered in Cupertino, Calif., Symantec has operations in more than 40 countries. More information is available at www.symantec.com.

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