

Minimizing downtime  
and maximizing  
performance in  
Microsoft® SQL Server  
64-bit environments



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## Audience

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This paper is intended for IT and business managers interested in the benefits of employing Symantec software products to quickly recover from disaster, ensure high data availability and improve database performance in Microsoft SQL Server 2005 64-bit environments that use HP Integrity™ 64-bit, Itanium-based servers. This document assumes that the reader has an understanding of database applications in general and SQL Server in particular.

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## Abstract

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Applications and servers, affordable and relatively easy to install, have proliferated over time in response to growing business and user demands. If not managed correctly, this expansion can lead to processing bottlenecks, hardware contention and productivity slowdowns, resulting in revenue losses and reduced returns on investment. In addition, Microsoft Windows® applications and data are growing in size and complexity. Some applications running on 32-bit platforms may be reaching the limits of the architecture, specifically regarding scalability (number of processors and amount of addressable memory), reliability and performance.

To reduce maintenance fees and to lower total cost of ownership (TCO), enterprises are scaling up to 64-bit platforms and migrating from complex, proprietary platforms to lower-cost, standards-based Windows solutions. Consolidating multiple database instances, servers and storage can reduce costs significantly, decrease management complexity and physical space requirements, improving resource utilization.

The need for better storage management and performance tuning due to increased user and resource demands in the 64-bit environment, requires automated, centrally managed, cost-effective and comprehensive solutions. Properly managed and tuned Microsoft SQL Server™ databases can save companies—across a wide range of industries—hundreds of millions of dollars annually by minimizing revenue lost due to downtime and poor performance. Trial-and-error approaches to manage and resolve these performance issues contribute to downtime and create patchwork systems that consume human, financial and hardware resources.

Symantec software products help organizations quickly recover from disaster and improve database performance in SQL Server 64-bit environments. Symantec's NetBackup™, Veritas Storage Foundation™ HA for Windows and Symantec i3™ for SQL Server automate SQL Server database backup/recovery, storage management and performance tuning processes, cutting downtime and improving application performance and database availability.

Any system is only as strong as its weakest link. As systems grow, application performance in the SQL Server environment is increasingly tied to the reliability, availability, serviceability (RAS) and flexibility of the hardware infrastructure. By eliminating platform and processing bottlenecks and providing RISC-level RAS, 64-bit HP Integrity™ servers offer exceptional RAS and flexibility for the SQL Server environment, meeting the needs of organizations that are outgrowing current x86-based systems and improving memory and parallel processing capabilities. As an alternative to deploying or replacing mainframe/RISC and UNIX® systems/applications, HP Integrity servers using Intel® Itanium 2 microprocessors running Microsoft Windows Server 2003 and SQL Server 2005 (64-bit) offer proven performance and scalability advantages.

The unique synergy of the Symantec software solutions described in this document and HP Integrity 64-bit, Itanium-based servers provides unprecedented scalability and availability, ensuring the highest levels of SQL Server 2005 database performance.

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## Business Scenario

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Microsoft Windows and Microsoft SQL Server–based solutions have proven their worth in enterprise settings. Many companies are moving to consolidate applications and servers to reduce operating costs, increase the responsiveness of their infrastructures, simplify operations, save space and boost business agility.

Organizations are upgrading to 64-bit platforms because 32-bit platforms have exceeded 32-bit limits. The advent of 64-bit applications for Windows operating environments means enterprises can now enjoy the key benefits of larger addressable memory and an increased number of processors.

At the same time, relatively low costs and ease of implementation have resulted in the proliferation of applications and servers. If not properly managed, this trend can create unwanted complexity, higher administrative costs, inadequate and poorly configured hardware and servers, unplanned downtime, database performance issues and, ultimately, lost revenue and unreachable IT investment goals. Organizations must be prepared to handle the influx of data from a growing number of sources and efficiently and accurately deliver this data to more users.

## Costs of Downtime and Poor Performance

As the database scales and the enterprise adds more storage, data availability, performance management and backup and recovery strategies become increasingly critical. Without the use of proven, reliable tools to ensure proper management of the SQL Server environment, downtime costs may escalate.

Downtime-related revenue and productivity losses in the enterprise can be hard to pinpoint. The causes of downtime may have multiple roots,<sup>1</sup> including hardware failure, application instability and human error.

Studies show that downtime drains dollars from IT budgets across industries. A 2003 report based on case studies of six large companies showed losses of up to \$96,632 per hour of network downtime. This study also found that network outages and degradations resulted in productivity and revenue losses in the range of 1/10<sup>th</sup> of 1% to nearly 1% of annual revenue.<sup>2</sup> A 2004 survey documented downtime costs of up to 3.6% of total revenue annually.<sup>3</sup>

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<sup>1</sup> Infonetics Research, The Costs of Downtime: North American Medium Businesses 2006

<sup>2</sup> Infonetics Research, The Costs of Enterprise Downtime 2003

<sup>3</sup> Infonetics Research, The Costs of Enterprise Downtime, North America 2004

The chart below illustrates average revenue losses per industry, per hour:

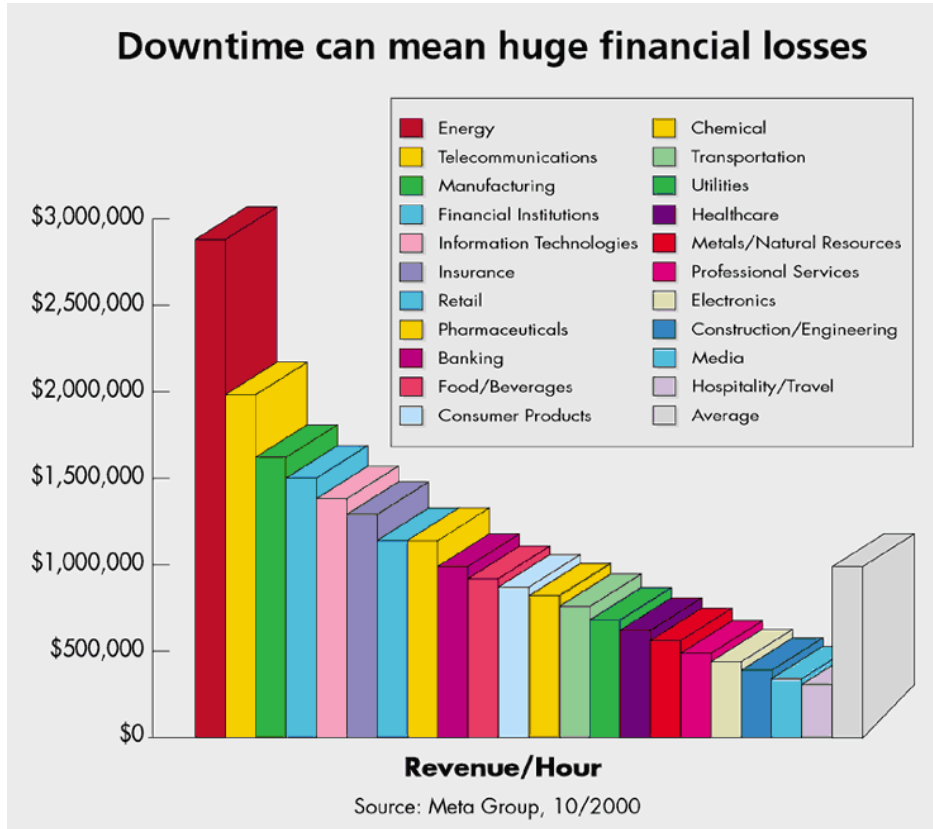


Figure 1: Revenue losses caused by downtime per industry per hour.

Revenue losses calculated per employee-hour illustrate the importance of high data availability and optimal application performance:

**THE COST OF DOWNTIME**

INDUSTRY SECTOR	REVENUE/HOUR	REVENUE/EMPLOYEE-HOUR
Energy	\$2,817,846	\$569.20
Telecommunications	2,066,245	186.98
Manufacturing	1,610,654	134.24
Financial institutions	1,495,134	1,079.89
Information technology	1,344,461	184.03
Insurance	1,202,444	370.92
Retail	1,107,274	244.37
Pharmaceuticals	1,082,252	167.53
Banking	996,802	130.52
Food/beverage processing	804,192	153.10
Consumer products	785,719	127.98
Chemicals	704,101	194.53
Transportation	668,586	107.78
Utilities	643,250	380.94
Health care	636,030	142.58
Metals/natural resources	580,588	153.11
Professional services	532,510	99.59
Electronics	477,366	74.48
Construction and engineering	389,601	216.18
Media	340,432	119.74
Hospitality and travel	330,654	38.62
Average	\$1,010,536	\$205.55

Source: IT Performance Engineering & Measurement Strategies: Quantifying Performance Loss, Meta Group, October 2000.

**Figure 2: Revenue losses per employee hour segregated by industry.**

Large enterprises may juggle hundreds, even thousands, of memory- and hardware-intensive applications, many developed internally. Add to this a variety of architectures, and the database administrator is with a complex performance management scenario.

Increased user demands in a scaled-up environment mean developers, project managers, database administrators, network administrators and other IT personnel may be required to concentrate on the short-term necessity of ensuring that applications function adequately to produce the desired output within a potentially stifling framework of project deadlines and IT budget restrictions. Applications, frequently peppered with last-minute functionality may be released to satisfy deadlines and budget guidelines. As IT personnel scramble to tackle the next application development project, existing application performance may begin to erode.

Although IT personnel debug, repair and re-release offending applications, the “fix” is actually a temporary patch. This approach of patching up poor performance leads to a domino effect of short-term fixes evolving into long-term performance issues, leading to productivity slowdowns and lost revenue.

Dealing with the requirements of database management, complex hardware infrastructures and the need for supercharged applications that can handle and process massive data flow, database administrators are often unprepared to anticipate or untangle bottlenecks and promptly respond to user complaints.

Without a comprehensive performance management solution, the process of data requests and SQL statement processing may be murky, with no efficient means of forecasting trends, tracking patterns and preventing or predicting performance degradation.

## Typical Approaches

Typical solutions include the following approaches:

- Research
- Additional training
- Using available tools packaged with Windows and SQL Server in a trial-and-error approach

These approaches are not entirely without value. Research and training may lead to a better understanding of the needs and goals of performance tuning and best practices associated with the SQL Server environment, such as

- Locking and blocking
- Indexing strategy
- Normalization
- Smaller result sets
- Optimized data storage
- Concurrency management
- Optimized hardware resources

However, relying on application logs, error logs, SQL Server Profiler, SQL Server Query Analyzer, Windows Performance Monitor and other tools to track performance can be time consuming and inefficient. IT teams can develop scripts to complement the tools, but custom scripts can become corrupted, and the need to run them continuously may contribute to a further degradation in database performance. Inexpertly performed traces have the potential to degrade the production environment. In addition, the expertise required to analyze counters and internal baselines, study data, interpret trends and implement best practices may not be readily available.

Though network administrators can track the health of data packets in the network infrastructure, they have no insight into the individual requests in each packet. DBAs can monitor a SQL statement for efficiency; however, the upstream application and downstream storage environments are largely invisible. Transformed into I/O, the application's data access request traverses multiple layers of abstraction before it accesses the physical hard disks of the storage array. The tools available to the storage administrator allow excellent visibility into the nature of potential performance-restricting conflicts at the I/O level but cannot provide the context needed to assess which I/Os are critically important to the business.

Diagnosing performance problems is further complicated because IT environments are almost never homogenous. Application servers, operating systems, SANs, storage arrays, storage management software, database servers and database management systems come from many different vendors. Not surprisingly, the vendor-supplied tools

used to identify and diagnose performance bottlenecks on one platform prove limited when looking at the architecture as a whole. Diagnosing performance problems in a distributed environment often requires that the DBA be a master of every performance monitoring tool available.

Trial-and-error approaches result in half-fixes. Sufficient time, resources and knowledge are often not available to process the information, stored in various formats, and take the necessary actions on a timely basis, to achieve the desired results. Adding to the dilemma, the IT budget can become strained due to the resources being spent on deciphering a torrent of new data and troubleshooting the system.

It can be concluded that typical approaches do not provide the consistent, 24x7 performance monitoring, data collection, analytical, reporting, management and backup and disaster recovery solutions required to manage overall database performance in large organizations. Further, although most organizations are aware of downtime and performance issues, without integrated, automated tools, management of these issues is not a simple task.

The following sections outline comprehensive solutions from Symantec for reducing or eliminating unplanned downtime and performance problems in 64-bit SQL Server environments through storage management, backup and recovery operations, data protection and performance management tools.

## Flexible Capacity and Secured Availability

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As SQL Server scales, storage management and availability become increasingly critical, requiring integrated, comprehensive storage management software solutions. Keeping data and applications functioning 24 hours a day, seven days a week, is the desired norm for critical applications. A high availability solution is built on top of a backup strategy and provides the following benefits:

- Simplifies error-prone disk administration tasks, such as adding or moving storage resources or data
- Delivers reliable and pro-active fault tolerance to Windows-based applications
- Reduces planned and unplanned downtime
- Serves as a local and wide-area failover solution
- Enables failover between sites or between clusters
- Manages applications and provides an orderly way to bring processes online and take them offline
- Consolidates hardware in larger clusters and accommodates flexible failover policies, active-active configurations and shared standby servers for SQL Server

Storage management software decreases data downtime associated with disk and path failures by ensuring multiple copies of data are accessible and available. Clustering services protect against server, application and database downtime by eliminating the single point of failure found within a single server.

### **Veritas Storage Foundation HA for Windows by Symantec**

Veritas Storage Foundation HA for Windows is an integrated stack of storage management, replication and clustering software designed to deliver data and application availability to Microsoft Windows environments. Veritas Storage Foundation HA is comprised of two industry leading availability technologies: Veritas Storage Foundation for Windows and Veritas Cluster Server™ (VCS).

- Storage Foundation provides uninterrupted and consistent access to data through easy-to-use, on-line storage management tools for heterogeneous enterprise environments to reduce planned and unplanned downtime, enabling high availability and optimized I/O performance.
- Veritas Cluster Server is the industry's leading open systems clustering solution that protects critical applications and databases against downtime within local, metropolitan or wide area networks. It provides high availability for applications, databases and servers by monitoring the health and performance of resources and automatically restarting them on an available server to avoid complete failure.

In the event of an outage, Veritas Storage Foundation and High Availability Solutions help ensure that those systems are quickly and safely recoverable and provide online storage management tools to enable high availability of data and optimized I/O performance across multiple hardware platforms.

Highlights of the key features and benefits provided by Veritas Storage Foundation HA for Windows include the following:

- Single Graphical User Interface (GUI) based console for online management of heterogeneous storage across multiple hosts and operating systems, providing greater reliability and versatility and reducing the cost of storage administration
- Dynamic Multipathing (DMP) capability, integrated with Microsoft Windows MPIO framework, adds fault tolerance and I/O load balancing between hosts and disk storage.
- FlashSnap technology adds the ability to create independently addressable, point-in-time snapshot mirrors of original server volumes to enable quick recovery of mission critical applications, shrinks backup duration and provides off-host capabilities such as backup, testing and analysis.
- Dynamic Disk Groups extend Windows' native Logical Disk Management (LDM) capabilities to increase performance and availability in clustered and non-clustered environments.
- Maximize uptime of data, applications and databases and reduce planned and unplanned downtime
- Enable high availability solution for local, metropolitan or global clustering from within a single product set
- Test disaster recovery solutions without impacting production applications
- Optimize and plan cluster configuration and policies through a portable modeling and simulation tool

## Veritas Storage Foundation

With Veritas Storage Foundation, organizations can dynamically manage complex storage environments, seamlessly increase or reclaim unused storage capacity and virtually eliminate application downtime through online storage management. Moreover, Veritas Storage Foundation for Windows helps ensure the continuous availability of mission-critical Windows-based systems, applications and databases.

By creating virtual storage devices from physical disks and disk arrays, Veritas Storage Foundation removes the physical limitations of disk storage so you can configure, share and manage storage for optimal results. It provides easy-to-use, online storage management for enterprise computing and Storage Area Network (SAN) environments.

Veritas Storage Foundation is ideal for maximizing storage networking-based application uptime. It has intrinsic features that allow organizations to increase application availability by virtualizing physical storage resources within networked storage environments. Virtualizing and centralizing storage resources over a storage network reduces administrative overhead and provides a scalable foundation to manage the unpredictable growth of Internet-driven businesses.

## **Simplified, Centralized Storage Management**

Veritas Storage Foundation enables online administration from a single management console across multiple hosts and operating systems. The easy-to-use interface simplifies disk administration tasks, such as adding or moving storage resources or data. It reduces downtime by separating the storage requirements from application requirements in Windows environments, centralizing the management of disk arrays and storage area networks (SANs) and enabling organizations to make data and SQL Server databases easily available to other devices.

Several add-on modules are available, including mirroring of data to remote locations through the Volume Replicator option, disk path failover and load balancing with the Dynamic Multipathing (DMP) option and backup and recovery functionality through the FlashSnap option. Veritas Storage Foundation configures and monitors storage from leading hardware RAID arrays, manages SAN-based storage and supports clustering configurations with Veritas Cluster Server (VCS), which is included as the HA component in Veritas Storage Foundation HA for Windows, and Microsoft Cluster Server (MSCS).

## **Keeping Data Online and Available**

Veritas Storage Foundation can protect critical applications by mirroring data across different disk devices and subsystems, including RAID devices. It allows users to perform basic administrative tasks while data is online and available, cutting planned downtime. Advanced storage management tools include online storage configuration, online logical volume management and flexible I/O performance monitoring.

Veritas Storage Foundation enables dynamic disk movement via drag-and-drop to facilitate storage consolidation, DAS to SAN migration, performance optimization and Array updates and retirement, all of which are critical for maintaining highly available, high-performance storage on a variety of hardware devices. In addition, the FlashSnap option gives administrators the ability to create online copies of real-time data with minimal impact to applications or users.

Veritas Storage Foundation provides the flexibility for adding or removing servers and disks as needed without bringing the applications offline. Support for up to 32 servers in a single cluster with Veritas Cluster Server allows organizations to achieve availability of applications while achieving maximum hardware utilization. An automated process makes intelligent decisions to ensure applications are hosted on the best server available within the cluster and eliminates the need for a dedicated standby server within the environment.

## **Protecting Hardware and Software Investments**

Veritas Storage Foundation is not tied to specific hardware, providing a consistent approach to heterogeneous storage hardware environments, allowing organizations to protect current hardware investment and the freedom of choice for future purchases.

## Options and Agents

Option/Agent	Description
Global Cluster option	<ul style="list-style-type: none"> <li>• Monitors and manages the replication jobs and clusters at each site.</li> <li>• In the event of a site outage, this option controls the shift of replication roles to the secondary site, brings up critical applications and redirects client traffic.</li> </ul>
Veritas Volume Replicator option	<ul style="list-style-type: none"> <li>• Allows data to be replicated between hosts over an IP network.</li> </ul>
Dynamic Multipathing option	<ul style="list-style-type: none"> <li>• Adds fault tolerance and improved performance by making use of multiple paths between a host and its storage.</li> </ul>
FlashSnap™ option	<ul style="list-style-type: none"> <li>• Allows creation of independently addressable point-in-time snapshots that are full-mirror copies of the volumes on a server.</li> <li>• Snapshots can be easily moved to another server for backup or other purposes.</li> </ul>
Microsoft Exchange Server Agent	<ul style="list-style-type: none"> <li>• High Availability Agent for Exchange Server works to keep Microsoft Exchange Server highly available by detecting any failures and automatically bringing the application online again.</li> </ul>
Microsoft SQL Server Agent	<ul style="list-style-type: none"> <li>• High Availability Agent for Microsoft SQL Server monitors Microsoft SQL Server 2000 and 2005 on a VCS cluster to ensure high availability by automatically detecting faults and bringing a downed database back online.</li> </ul>
Veritas Volume Replicator Agents	<ul style="list-style-type: none"> <li>• Ensure that replication is highly available by monitoring replication services.</li> <li>• The VvrRvg Agent enables failover of the RVG within a cluster.</li> <li>• The RVGPrimary Agent ensures that applications are highly available across clusters.</li> </ul>
Hardware Replication Agents	<ul style="list-style-type: none"> <li>• Monitor the status of the replication service and, in case of failure, takes corrective action to maintain data replication between sites, regardless of distance.</li> <li>• Agents are available to support EMC SRDF/A, EMC MirrorView/A, Hitachi TrueCopy, HP Continuous Access XP, IBM PPRC, and Network Appliance SnapMirror</li> </ul>

## Quick Recovery

Quick Recovery is the process of creating and maintaining on-host, point-in-time snapshots of production data, such as Microsoft SQL Server databases, which can be then used to quickly recover from a disaster.

The Veritas Quick Recovery solution for Microsoft SQL Server integrates Storage Foundation FlashSnap Option with SQL Server's Virtual Device Interface (VDI) to enable creation of on-host, disk-based snapshot backup sets of SQL Server databases, providing for fast recovery from logical or other errors and reducing dependency on the time-consuming process of restoring data from tape. Note that in the upcoming release of Veritas Storage Foundation for Windows (Version 5.0), FlashSnap will integrate with Microsoft's Volume Shadow Copy Services (VSS) via the VSS SQL Writer.

Databases can be restored to a specific point-in-time, recovered using current log backups to the point-of-failure or restored to the time when the snapshot backup set was created or refreshed.

Quick Recovery uses a split-mirror snapshot method. A snapshot is a separate persistent volume that contains an exact duplicate of all the data on the original volume at the time the snapshot is created. This type of persistent physical snapshot is also known as a Clone (HP) or a BVC (EMC). Copy-on-write snapshots, also known as metadata snapshots, only copy changed blocks to the snapshot and do not create a separate physical volume.

## Why Implement a Quick Recovery Solution?

A Quick Recovery solution serves as a first line of defense to recover SQL Server databases that have been subject to accidental or malicious updates. Quick Recovery is designed to augment your traditional backup methodology. Maintaining a snapshot backup set requires just the few seconds it takes to detach (split) a snapshot mirror from its original volume. On-host snapshot recovery is faster than restoring a full backup from tape or other media; it reduces downtime and helps meet service-level agreements for application availability.

In addition to the primary benefit of recovery from logical errors, snapshot backup sets can be moved over a SAN to another server and used for other purposes including:

- Backup—more traditional backup to tape can be done without a performance impact to the application server.
- Application tuning and testing—data can be updated and modified in a realistic environment without impacting users.
- Business reporting and decision analysis—up-to-date data is available with minimal impact on the production environment.

## Understanding the Underlying Components of Quick Recovery

The Quick Recovery solution uses Veritas FlashSnap and FastResync technology along with SQL Server VDI to quiesce a database and ensure a persistent snapshot of the data. FlashSnap provides the ability to create and maintain the on-host point in time copies that are integral to the Quick Recovery solution. FastResync is a FlashSnap feature that optimizes the resynchronization of a snapshot volume with its original volume.

## FlashSnap

FlashSnap is a multi-step process used to create and maintain persistent, split-mirror snapshots that are copies of the original volumes they mirrored. In version 4.3 and previous versions of Veritas Storage Foundation, snapshot volumes are created as simple/concatenated volumes. With the release of version 5.0, snapshots may consist of multiple physical devices, with them being either striped or concatenated volumes. Original volumes can be simple/concatenated, mirrored, striped or mirror-striped. FlashSnap cannot be used with software RAID-5 volumes. In addition to specific command line utilities for Microsoft SQL Server (vxsnapsql) and Microsoft Exchange (vxsnap), FlashSnap includes the following generic snapshot commands:

- Snap Start—Creates a snapshot mirror and attaches it to the original volume.
- Snap Shot—Detaches the snapshot mirror from the original volume. This split-mirror snapshot volume is an exact duplicate of the original volume at the point in time the snapshot command is executed.
- Snap Back—Reattaches the snapshot volume to the original volume. The volumes can be resynchronized using either the original volume or the snapshot volume as the source. If a logical error has occurred on the original database volume, then the snapshot volume can be quickly restored to a consistent, point-in-time image.
- Snap Clear—Permanently removes the association between the snapshot volume and the original volume.
- Snap Abort—Aborts the snapshot operation after a Snap Start or Snap Back command is issued. Snap Abort permanently removes the snapshot mirror from the volume and releases its space.

## Off-Host Processing

Database performance problems frequently occur when workloads on a server compete for resources. Running backup processing, for example, at the same time users access an online transaction processing (OLTP) system, can slow response times because it is difficult to tune the system to simultaneously optimize the performance of both applications. Inevitably, transactions and backup programs compete for access to the same resources, resulting in slower backup processing and frustrated OLTP system users.

FlashSnap is fully integrated with NetBackup and Backup Exec for on- and off-host backup support, allowing the DBA to move processing of conflicting workloads off the primary host. Using point-in-time snapshot technology, a third mirror copy of a production volume is created and then split from the other mirrors. The snapshot can then be mounted to a backup server where off-host processing tasks continue without impacting primary database applications. Periodic resynchronizing of the off-host and primary database volumes is fast because only changed data is copied during the snapshot process. Database volume snapshots are a fast and effective means of ensuring consistent performance on a primary database server. With a few simple mouse clicks at the Veritas Storage Foundation GUI (Veritas Enterprise Administrator), the DBA is able to generate Flashsnap snapshots at will to offload performance-sapping processing from the main database server.

## Integration with SQL Server Virtual Device Interface (VDI)

Storage Foundation for Windows integrates FlashSnap with Microsoft SQL Server's Virtual Device Interface (VDI) to perform snapshot operations on SQL Server database volumes while the database is online and available. VDI quiesces the database for the short period of time required to create the snapshot set, and then immediately frees it. This quiescing allows SQL snapshots to be taken while the database application remains active.

FlashSnap integrates with VDI via the `vxsnapsql` command line utility to provide the ability to detach multiple snapshot mirror volumes from the original (production) volumes simultaneously. This allows you to snapshot all volumes associated with a specific SQL Server database at exactly the same point in time without taking the database offline. These snapshot volumes, together with the metadata file that is created during the process, form a snapshot backup set of the database. These persistent FlashSnap snapshots, taken through VDI, can later be used to quickly recover a database that has been subjected to accidental or malicious updates or otherwise corrupted.

### **Integration with Volume Shadow Copy Services (VSS)**

In version 5.0 of Veritas Storage Foundation for Windows, FlashSnap will integrate with Microsoft's Volume Shadow Copy Services (VSS) for SQL snapshot backups.

### **FastResync**

The FastResync capability optimizes the resynchronization of a mirror volume with its original volume. FlashSnap uses FastResync technology to track a volume's changed blocks via a log volume called a Disk Change Object (DCO) after a mirror is detached. Changes are tracked for both the original and snapshot volumes after the snapshot is detached. When the snapshot volume is resynchronized with the original volume, only the changed data blocks are copied to the volume to which resynchronization takes place. This greatly reduces the time and performance impact of resynchronization, which means that a snapshot backup set can be refreshed with minimal impact to production. It also lays the foundation for quick recoveries from disasters.

### **Veritas Cluster Server (VCS)**

For mission-critical CRM and ERP applications using SQL Server databases, Veritas Storage Foundation HA enables local, metropolitan and wide area high availability and disaster recovery (DR) using a single solution. Veritas Cluster Server (VCS) monitors an application and all of its dependent components, including the associated database, operating system, network and storage resources. When a failure is detected, VCS unobtrusively shuts down the application along with associated resources and restarts it on an available server, ensuring continuous availability to SQL data.

### **Availability across Any Distance**

VCS can scale from a simple 2-node local cluster up to a 32-node cluster, which can span local and metropolitan distances and, along with the Global Cluster Option, supports multiple clusters that can span thousands of kilometers across different IP subnets. Upon failover to a different IP network, VCS and GCO will update the application's network identity so clients can connect to the DR site. VCS and GCO can also automate the replication takeover so that replicated storage groups are imported and replication roles are reversed. Finally, users can increase heartbeat latency between sites up to 1,500 milliseconds in order to add additional timeout tolerance for distant clusters.

### **No Quorum Disk**

Differing from other clustering solution, VCS does not require a quorum disk to maintain cluster configuration information. Instead, each node in the cluster synchronizes its configuration information and status with the other nodes using a proprietary network protocol. As a result, there is no single point of failure with VCS, a vital requirement for true HA.

In addition, with VCS there is no requirement for a majority set of nodes to be online in order for services to continue running. Other solutions require extra server hardware to ensure that a majority is maintained after multiple failures or a site outage. By eliminating this requirement, VCS gives users the flexibility to run fewer servers at a DR site relative to a primary site cluster, saving hardware and administration expenses.

## Centralized Management

The Veritas Cluster Server Web-based Cluster Management Console (CMC) simplifies the task of managing multiple clusters. CMC provides a centralized GUI to monitor, manage, and configure every VCS cluster running in multiple data centers.

With CMC, it is possible to set cluster attributes for a single cluster or update values globally across all clusters with the click of a button. In addition, users can run detailed historical reports that measure SLAs in aggregate and track results over time. Notification policies across all clusters can be easily modified. Administrator rights and roles can be set for different users in the IT organization. Most importantly, CMC provides a single place to instantly view the health of all clustered applications in the data center.

## “Fire Drill” Disaster Recovery Testing

In today’s complex IT environments, it is vital that disaster recovery sites are tested regularly. Most companies never test their DR plans because traditional DR testing is risky and requires actual downtime at the primary site. With the VCS Fire Drill feature, it is possible to test DR plans without affecting operations at the primary site. Fire Drill creates a safe bubble instance on the secondary where applications are brought online using a duplicate copy of the data, which ensures that there is no chance of data corruption or interruption of replication. Only by actually bringing an application online from beginning to end can users be sure they will be able to recover operations to the DR site when a primary site outage actually occurs.

## Optimized for SQL Server

VCS provides off-the-shelf support for, but not limited to, SQL Server 2005 and NetBackup 6.0. VCS provides a utility to easily cluster any off-the-shelf or custom application using generic agents. VCS manages more than just the application instance; it manages the complete application stack, from runtime processes down to the NIC card and disk group, ensuring a robust and graceful failover of all associated resources.

## Advanced Failover Logic

With advanced failover logic, IT personnel can set failover policies based on server capacity thresholds and available resources. VCS chooses the best host for a specific application at the time of failure based on application needs and the current state of resources in the cluster. It allows true N+1 “roaming spare” capability for maximum availability, without the cost of dedicated spares per application.

It is possible to easily run eight or more application nodes at near maximum capacity, with one spare server. VCS automatically chooses the empty, or least loaded, server on any failure and automatically adds repaired servers back into this selection pool when they rejoin the cluster.

Advanced failover logic in VCS ensures that application uptime is maximized and that server resources are used efficiently.

## Replication Integration

Using only a data replication solution to keep a current copy of critical data at a remote location to protect against failure of an entire site does not by itself protect enterprises from costly and damaging downtime. A good disaster recovery plan should include both data and application availability against all odds. VCS and Veritas Volume Replication provide a fully integrated solution for data center availability.

VCS can be configured to manage replication services so that when an application failure occurs, replication is stopped at the primary site, replicated storage groups are imported at the DR site and replication roles are reversed. VCS is tightly integrated with Volume Replicator, the replication solution offered with Storage Foundation for Windows. In addition, VCS can manage multiple array-based replication technologies, including EMC SRDF and SRDF/A, EMC MirrorView and MirrorView/A, Hitachi TrueCopy, IBM® PPRC, IBM MetroMirror and Network Appliance SnapMirror.

## Backup, Recovery and Comprehensive Data Protection

Implementing a strong backup and recovery strategy is essential for reducing downtime in 64-bit SQL Server environments. Exponential data growth and larger, more complex databases demand more storage and better data protection.

### Veritas NetBackup™ 6.0 from Symantec

NetBackup for SQL Server offers the performance and flexibility required for effective backup and recovery operations within large SQL Server environments, providing comprehensive data protection and centralized management of all backup and recovery operations for the SQL Server database as well as non-database files. Intuitive, graphical user interfaces (GUIs) allow consistent, enterprise-wide backup policies. NetBackup controls all aspects of media management, including library sharing and individual tape drive sharing.

### Features and Benefits

NetBackup's flexible data protection options allow backup and recovery of databases, differentials, files, filegroups and transaction logs. Netbackup recovers data quickly because only damaged pages are recovered, and verify-only restores can be used to verify SQL contents of a backup image without actually restoring the data.

Following are highlights of NetBackup's features and benefits:

- **Superior Recovery**—Ensures faster recovery, as only damaged pages are recovered. Verify-only restores can be used to verify SQL contents of a backup image without actually restoring the data.
- **Point-in-Time Recovery**—Recovers SQL databases to the exact point in time or transaction log mark by rolling forward only the transactions that occurred prior to a user-specified date and time.
- **Copy-Only Backups**—Create an on-the-fly full backup copy without interfering with an established backup sequence.
- **Granular Database View**—Display of database object properties provides exceptional backup and recovery flexibility.

- **Synthetic Backups**—Consume less network bandwidth and decrease the impact on the application host since files are backed up only once. Multiplexing up to 32 different data streams to a single tape drive helps to realize the maximum rated throughput of storage hardware.
- **Automated Disaster Recovery**—NetBackup Vault option automates the disaster recovery process by helping to simplify tape rotation and the creation and management of tape duplicates for offsite vaulting.
- **Extensive Media Management**—Allows users to share an automated tape library between heterogeneous systems (UNIX, Windows, Linux, NetWare or network attached storage (NAS)), allowing NetBackup users to more effectively leverage expensive tape and drive resources.
- **Security**—Secure backup data by selecting from NetBackup software's 40-, 56-, 128-, or 256-bit encryption. NetBackup software's low-impact encryption option ensures the data is secure before it leaves the client. NetBackup Access Control offers the flexibility to restrict or provide specific access levels to NetBackup software's administrative functionality.
- **Storage Networking**—NetBackup software supports a broad range of tape library, tape drive and Storage Area Network (SAN) interconnect technologies from leading vendors. Dynamically share individual tape drives over SCSI or a SAN.

## Disk-based Data Protection and Synthetics

NetBackup's disk-based data protection solutions offer near instant data recovery while improving backup performance and reducing exposure to data loss.

Enhanced disk staging capabilities gives users additional flexibility when configuring backup and recovery strategies. Disk staging facilitates faster backups and restores since there is no tape device latency, and the non-multiplexed backup images generated through staging can be used for faster recovery from tape.

Synthetic backup functionality significantly enhances backup and recovery operations. Users can store incremental backups on disk and then synthesize them into a full backup and process the data to tape, reducing overall recovery time. NetBackup backs up new or changed files only once, decreasing the backup impact on the application host. Synthetic backups reduce the amount of data being moved over the network, minimizing the network bandwidth required for backup and recovery.

## Disaster Recovery

To enable fully automated disaster recovery, NetBackup Vault™ offers an option for complete vault management. This option helps simplify tape rotation and the creation and management of tape duplicates for offsite vaulting.

NetBackup Vault manages the ejection of tape duplicates to the robotic Cartridge Access Port (CAP) or Media Access Port (MAP), the creation of pick/pull reports, and the monitoring of the retention periods for offsite media. Vault facilitates the management of duplicate media created either concurrently with the primary backup or at a scheduled time, such as during non-production hours.

## Simplified application performance management

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Modern IT infrastructures and the interdependence between the components that comprise business applications have grown significantly more complex. To efficiently resolve performance problems, an organization requires

expertise and experience from many areas. More important, it requires a structured, planned approach to all aspects of application performance management.

DBAs are faced with contradictory demands for high-performing data access and easily managed database management systems. The complex infrastructure navigated by application data access requests often hampers the process of diagnosing application performance problems and undermines smooth day-to-day management. Potential bottlenecks may lurk along any connection in the data path, possibly interrupting the speedy processing of SQL statements. Lack of visibility into the process remains one of the most fundamental issues of performance management. Rapidly changing environments can affect application performance in unexpected ways; therefore, identifying problems quickly is essential, and maintaining a long-term view of data access patterns over time is equally important. In addition, detecting gradually degrading performance early can prevent surprises.

## Visibility

Performance monitoring and management tools are available at each layer of the data access stack, giving administrators specific insight into each domain; however, the complex mix of multi-vendor systems deployed in a typical IT infrastructure, and the nature of SQL statements to traverse many domains as they make their way from the application server to the database and back impedes the fast and effective diagnosis of problems.

A SQL statement passes in and out of the awareness of local system administrators. The further the SQL request is from the administrator's area of responsibility, the weaker the administrator's tools are for diagnosing the nature of a problem. This lack of visibility can cause frustration, slow responses and inaccurate, inefficient diagnoses.

Application server administrators have tools that can assess the efficiency of the server, but these tools are limited in that they cannot track the request once it is out on the network—and they offer no insight into the individual requests in each packet. Although at the database server, DBA tools can monitor a SQL statement for efficiency at the server, upstream application and downstream storage environments are largely invisible.

Diagnosing performance problems is further complicated because IT environments are almost never homogenous. Application servers, operating systems, SANs, storage arrays, storage management software, database servers and database management systems come from many different vendors. Not surprisingly, the vendor-supplied tools used to identify and diagnose performance bottlenecks on one platform prove limited when looking at the architecture as a whole. Diagnosing performance problems in a distributed environment often requires that the DBA be a master of every performance monitoring tool available.

## Time-based performance degradation

No matter how thoroughly an application is tested, it is difficult to recreate the real world of a production environment. Many performance issues only become apparent once an application is in production. The performance profile of a request will often change over time, complicating the identification of a problem and its root cause.

When addressing slowly degrading performance, comparing the speed of a query executed yesterday and one run today may show no measurable difference. Yet performing the same comparison between today's run and one three months ago will clearly illustrate anomalies. Time-based analysis allows the DBA to identify issues and analyze what has changed. Carrying out this level of diagnostic analysis demands a solid understanding of each application's baseline performance, since aberrant behavior can only be detected when compared to the norm.

Ongoing monitoring, therefore, is essential for developing a picture of normal application performance; however, typical monitoring tools that give the DBA detailed background data needed to build a long-term view of normal application behavior may create additional processing overhead. When applications continually demand more processing resources, the DBA may be required to switch off performance monitors or endure permanent application performance degradation.

## Managing Performance in a Rapidly Changing Environment

Managing database performance is an ongoing process, involving the assessment of monitoring data from the application infrastructure and the deployment of recommended fixes. In rapidly changing business environments, performance problems arise without warning, and the DBA must be able to respond quickly and confidently.

Fast access to diagnostic information about the application infrastructure gives the DBA the background necessary to identify and solve problems, but fixing a problem typically requires an interruption to end-user application access while the system is reconfigured. Users of business-critical applications often cannot tolerate any downtime, and IT service levels may be written such that system availability is guaranteed, with penalties levied for failure. This leaves little room for the DBA to make performance-enhancing modifications to the environment.

## Solution-based Performance Management

The issues faced by today's DBA demand a complete performance management, monitoring and remediation solution that satisfies the need for both visibility throughout the data path and tools to effect performance-improving changes. The DBA needs a complete performance profile of data access from the application infrastructure, through the database and into the storage environment. Having identified performance issues, the DBA needs to surgically apply changes to the environment without interrupting end-user access to data.

In complex, multi-tiered infrastructures, where a single database query crosses the domain of many different administrators, insight into every layer of the data path is critical if performance problems are to be resolved quickly. Finding the root cause of a performance issue, and avoiding finger-pointing between frustrated administrators, requires tools capable of quickly drilling down through the I/O stack to identify exactly what is causing a problem.

Typical approaches to performance management and tuning have the following disadvantages:

- Disparate monitoring tools providing incompatible data
- Multiple performance management options creating confusion and inefficiency among the IT staff
- Unable to monitor performance on a 24x7 basis
- Data that is difficult to analyze or manage
- Unreliable alerts
- Inadequate reporting tools
- Time-consuming and ineffective manual performance management

A highly performing SQL Server database platform is paramount to meeting business objectives, adhering to budgetary requirements and staying competitive. The SQL Server environment is continually tested with stronger demands by applications, users and customers. Thoughtful design, configuration, and load testing, up front, can

only carry the system so far. An automated, 24x7 performance management and tuning solution is required to ensure that the SQL Server database platform functions at top speed and efficiency with minimal downtime. As SQL Server scales up, decision makers must ensure that a proven method is in place to prevent downtime and degraded performance.

Following are some of the essential elements of an automated, single solution for performance management:

- Seamlessly monitor and tune application performance continuously, comprehensively and proactively
- Correlate performance metrics across multiple database instances
- Allow organizations to easily view statistical and current database activities, providing essential visibility
- Work with custom-developed, ERP (SAP, Peoplesoft, Siebel) and e-business environments
- Drill down to individual SQL statements and the underlying storage device
- Break performance data into narrow time slices
- Identify the causes of locking and blocking issues in the database
- Take advantage of “SQL Workspace” for SQL and database object tuning

These capabilities allow organizations to quickly, cost-effectively and accurately tune SQL Server databases to peak performance levels and solve application performance related problems in the most demanding environments.

## Performance Management Methodology

Unacceptable performance levels hinder an organization's ability to achieve its goals, and in extreme cases, may bring operations to a complete halt. Because of the potential urgency of performance problems, IT staff need to address them without delay, making it more difficult to focus on long-term tasks.

Performance management comprises activities aimed at minimizing, and ideally eliminating, periods where system performance is unacceptable. These activities may be a reaction to problems or can help predict and prevent them.

A performance management methodology is a structured way to effectively achieve performance management goals. A comprehensive methodology consists of two equally important components—the conceptual process that specifies which tasks to perform, and which measurements to make under different performance-related circumstances, and the toolkit required to support this process.

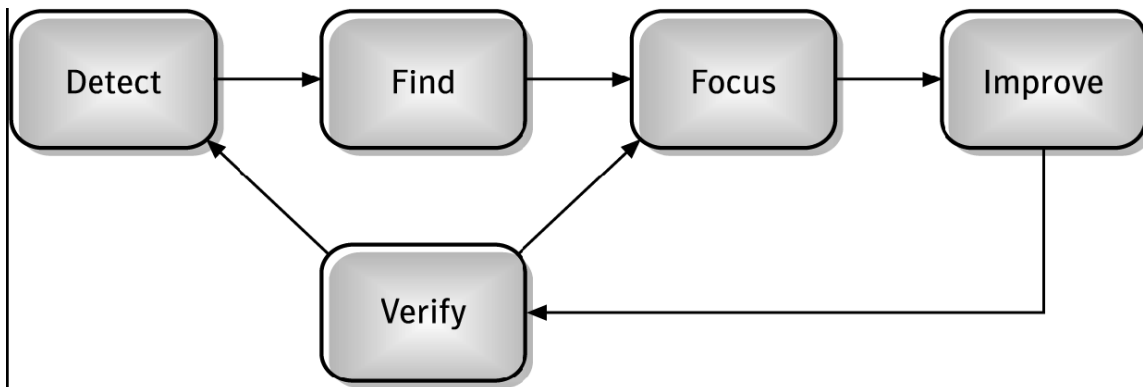
It is vital for organizations to understand the importance of a holistic approach to handling performance problems and to realize the inherent ineffectiveness of ad-hoc fixes and problem-solving. A comprehensive performance management methodology enables organizations to use a proven process, as well as proven support tools, to implement effective performance management.

## Performance Management Stages

Performance management consists of five stages:

- Detect—identify the symptoms that could indicate a performance problem

- Find—identify the source of the problem
- Focus—discover the root of the problem
- Improve—take the steps required to improve performance
- Verify—ensure that the steps taken have achieved the desired goal



**Figure 3: The five stages of performance management.**

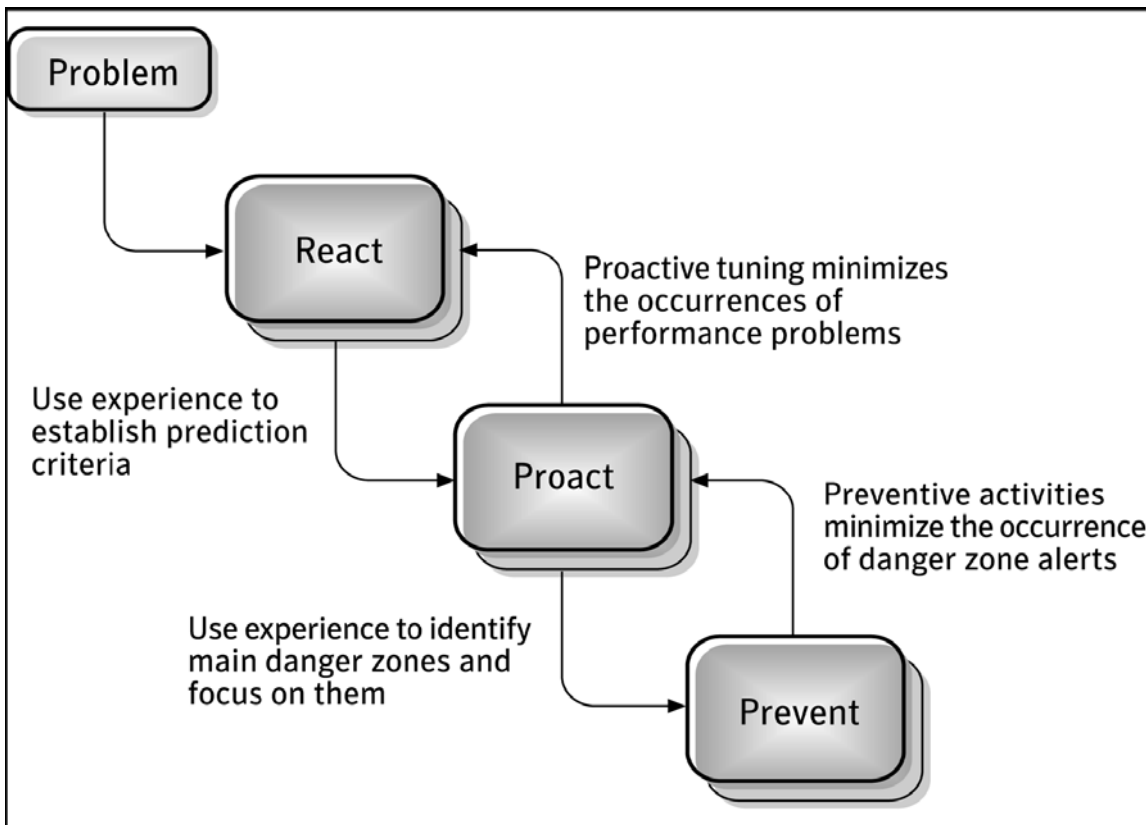
These stages combine to form a process that provides a systematic approach to finding and resolving all kinds of performance issues, including both the predictable and unpredictable.

### Stage 1—Detect

The Detect stage of the methodology process consists of triggers or events that start the performance improvement process. Detect is designed to alert you to the need for performance improvement. When you complete the Detect stage of the methodology, you will be able to answer the following questions:

- What are the indications that a performance problem exists?
- Where in the system can I observe the symptoms of the problem?

The Detect triggers fall into three categories: reactive, proactive and preventive.



**Figure 4: Three triggers may initiate the Detect stage of performance management.**

A reactive tuning process is triggered after a performance problem occurs. To validate that a real problem exists, historical information must be accumulated to understand the context in which the problem occurred. This requires having the tools to analyze the circumstances surrounding the problem—at the time the problem started.

To implement the proactive component of performance methodology, you must be alerted to a situation through a mechanism that monitors a set of performance metrics. Once such a metric exceeds a predefined threshold, or exhibits abnormal behavior, an alert is issued to attract attention to the problem’s symptoms. Setting alert thresholds correctly and verifying that the system is well tuned on a regular basis is critical to the effectiveness of proactive performance management activities.

Preventive performance management activities are aimed at eliminating potential risks to performance and tuning the mechanisms implemented for better problem handling. The trigger to preventive tuning is therefore not an actual problem but rather a decision on the part of the IT manager to initiate periodic preventive tuning, directed at those parts of the system with the most impact on long-term system performance.

An important element of the preventive performance management activity is periodic performance reviews. Each performance review results in a prioritized task list focusing on system components or activities that have exhibited negative performance behavior. Subject to IT staff availability and the priority of each item in the list, managers will then need to decide on the tasks that warrant immediate action.

## Stage 2—Find

The Find stage associates the symptoms of performance problems with the sources. One component of an application may have its symptoms in a different component or tier. The more complex the system, and the more internal and external interfaces it contains, the harder it becomes to trace a symptom's root cause.

Completion of the Find stage should answer the following question:

- Where is the cause of the performance problem located?

Find is a crucial step in performance management in almost any situation, providing a means to locate the cause of the problem without requiring an intimate familiarity with the particular component. It can help eliminate unnecessary investigation by narrowing down the search for the cause.

In the process of finding the source of the performance problem, you must examine the load and performance of the system as a whole, as well each tier or component, considering system load, usage patterns and system response times. These factors are compared with historical baselines to identify deviations from normal system behavior and with performance goals or SLA (Service Level Agreement) values to identify material breaches and poor service situations.

## Stage 3—Focus

Once the source of the problem is identified, the specific cause can be pinpointed. Completion of the Focus stage of the methodology can answer the following question:

- What is the root cause of the performance problem's symptoms?

Focus uses a white box analysis process to drill down into the component causing the undesired performance symptoms to identify the reasons for its behavior. By accurately identifying the problematic component, the appropriate staff can attend to the problem.

## Stage 4—Improve

The technicalities used to resolve each performance problem is determined by an organization's experience and expertise in its field. Each problem presents its own challenges, and hard work—instead of the available expertise—often leads to the solution. The Improve stage in the methodology process answers the following question:

- What are the alternative solutions that can be implemented to improve performance, and which one is the most suitable?

## Stage 5—Verify

A problem cannot be considered resolved until the effectiveness of the chosen solution is assessed and verified. The Verify stage of the methodology focuses on ensuring that the solution is successful. Upon completion of the Verify stage, the following questions will be answered:

- Has the solution solved the problem?
- Have the symptoms been entirely eliminated?

Verify backtracks through previous steps, verifying at each stage that the solution has had the desired effect.

## Symantec i3™ for SQL Server

Symantec i3 for SQL Server is a comprehensive suite of performance management products designed to support SQL Server 2005 databases that provides the techniques and tools to carry out performance management using a structured, methodical and holistic approach.

By using Symantec i3 for SQL Server to implement performance management, organizations can ensure that their activities are consistent and well supported by their toolkit. The seamless integration between the various Symantec i3 for SQL Server products means that they can be used consistently throughout the whole process.

The Symantec i3 for SQL Server toolset offers the following capabilities for detecting and resolving poor performance in the SQL Server environment:

- Single tool to monitor and analyze all tiers
- Correlation and association of data
- Intuitive drill-down and root cause discovery
- Baseline generation and comparison
- Continuous data collection
- Central data storage for analysis and correction
- Low overhead
- Simple deployment across the enterprise
- Reporting and proactive alerting
- Production monitoring, not simulated transactions in a test environment
- Real-time, current and historical view of data
- Unbiased view of performance metrics
- Schema changes with data and user information

Symantec i3 for SQL Server consists of three core components that work together to support the goals of the performance management methodology in a SQL Server environment:

- Symantec Indepth™ for SQL Server
- Symantec Insight™ for SQL Server
- Symantec Inform™ for SQL Server

### Indepth for SQL Server

Indepth for SQL Server helps perform a thorough investigation of the performance and inefficiencies of various components in the system. Indepth captures, measures and correlates performance metrics from all critical system components and helps detect and correct the root causes of database degradation before end users are affected, while maximizing the return on technology investments.

The easy-to-use, comprehensive approach of Indepth for SQL Server guides users through performance management from start to finish—from proactive monitoring and problem detection to problem identification, analysis, resolution and verification.

Indepth monitors the SQL Server environment continuously, capturing performance data for current, short-term and long-term performance analysis. To investigate a bottleneck (such as a locked session or a runaway process), users can view an up-to-the second snapshot of database activity or review historical performance data to pinpoint past problems.

Once Indepth detects a performance problem, a user can drill down to pinpoint the problem's cause. The software displays detailed performance information in easy-to-understand graphics to help users quickly identify the most serious problem areas.

## Insight for SQL Server

Insight for SQL Server is a high-level, system-wide analysis tool. It can help organizations analyze the activities of end-users, the service level they experience and the impact their activities have on the various components of the SQL Server environment. Features include the following:

- Web portal with a holistic view of the application via an intuitive interface
- Point and click monitoring and reporting across all application tiers
- Measures traffic at the TCP/IP stack between resources to gauge the performance
- Ability to drill down to the Indepth tools for detailed transactional data and statistics
- SLA management capabilities to determine uptime figures on a regular basis

## Inform for SQL Server

Inform for SQL Server consists of products that help promptly identify performance problems, potential performance hazards and components that will benefit from tuning. Inform creates performance-degradation alerts and reports based on information collected by Insight for SQL Server and Indepth for SQL Server. Features include the following:

- Reporting and alerting interface for the frontline IT team and their management
- Reporting delivered in PDF format
- Alerts delivered as email or directly to pagers
- Detailed and aggregate reports
- Alerting based on defined thresholds for proactive monitoring
- Baseline generation versus recent activity reporting to determine performance anomalies
- Change management reports for user objects

## A Complete Performance Management Solution

As enterprises increasingly adopt SQL Server 2005, Symantec i3 for SQL Server provides IT managers with a comprehensive set of end-to-end performance and service management tools to proactively monitor, analyze and

fine-tune applications and maintain performance and availability levels. The latest Symantec i3 for SQL Server offerings enable IT managers to set and maintain service levels for .Net applications and web services running on SQL Server 2005 databases.

Using Symantec i3 for SQL Server, enterprises can solve performance issues and realize a significant return on investment (ROI) and lower total cost of ownership (TCO) within the SQL Server environment. The IT team can accurately address performance tuning problems in order of priority, eliminating unnecessary hardware or software upgrades. Organizations can use the information provided by the Symantec i3 for SQL Server tools to plan projects based on accurate performance data, resulting in greater productivity and other benefits, which span the entire organization.

Symantec i3 for SQL Server software embodies the single, intuitive and comprehensive solution needed for systematically addressing performance management in the SQL Server environment.

As outlined previously, performance management comprises five core stages of performance management: Detect, Find, Focus, Improve and Verify. How does Symantec i3 for SQL Server meet the requirements of these five performance management activities?

- The Detect stage comprises three tasks: reactive, proactive and preventive.
  - Performance Warehouse, supplied with Symantec i3 for SQL Server, can provide the historical data necessary to carry out these reactive management tasks.
  - Inform Alerts, a component of Symantec i3 for SQL Server, provides the alerting mechanism required to support proactive performance management.
  - Inform Foresight, another component of the Symantec i3 for SQL Server toolkit, provides the mechanisms required to support preventive performance management activities of the methodology through automated performance reviews.
- The Find stage is inherently a process of black box analysis, a crucial step in performance management in almost any situation. Insight, another component in the Symantec i3 for SQL Server toolkit, provides the tools to perform this critical black box analysis.
- The Focus stage requires a white box analysis process to drill down into a component causing the performance symptoms to identify the reasons for its behavior. Within the Symantec i3 for SQL Server toolkit, the Indepth and Insight features provide the information to conduct timely and effective root cause analysis.
- The Indepth component of Symantec i3 for SQL Server assists in gathering the information required to identify and assess possible solutions to performance problems, identifying alternative ways to improve performance and which one is the most suitable for each unique challenge.
- The Verify stage backtracks through the previous steps to determine whether the problem is solved and whether the symptoms have been eliminated. The same tools used to identify the problem—Indepth for SQL Server, Insight for SQL for Server, and Inform or SQL Server—are used to verify the solution.

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## Hardware Reliability, Availability and Serviceability

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The introduction of 64-bit solutions for Windows offers an unprecedented opportunity for migrating complex applications from costly, proprietary systems, and for deploying new applications as well. HP Integrity servers

with Windows Server 2003 and SQL Server 2005 (64-bit) deliver a powerful, scalable and cost-effective solution to meet current data management requirements.

By eliminating platform and processing bottlenecks and providing RISC-level RAS, the 64-bit HP Integrity server offers an increased—and more affordable—level of scalability, reliability and flexibility for Windows-based business solutions, including large online transaction processing (OLTP) applications, large, high-volume e-commerce websites and organizations consolidating multiple Windows-based applications.

## The Need for HP Integrity Servers

As businesses seek to take advantage of the ability to automate business processes and extract value from corporate data, they rely on their IT department to deliver cost-effective solutions that enable employees to work more efficiently and to analyze business data in increasingly complex ways. To make timely and informed business decisions in dynamic, competitive environments, organizations must store and analyze growing amounts of diverse business data.

By leveraging the scalability and memory addressability of the Intel Itanium architecture, HP Integrity servers can host larger and more complex SQL Server 2005 (64-bit) database and analysis applications. Many database applications can benefit from massive in-memory caching of data as well as larger data structures for procedure cache, sort space, lock memory and connection memory.

The Integrity family of servers, designed to meet rigorous standards for system quality, resiliency and fault management—including support for cluster failover with the Microsoft Cluster Service—provides the system reliability and availability to meet demanding uptime requirements.

### Reliability

HP Integrity servers feature design and production enhancements that provide Windows customers with reliability and availability typically found only in RISC-based servers.

### Availability

To increase system availability in business critical environments, HP Integrity servers support failover clustering through the Microsoft Cluster Service. HP Integrity servers are certified for use in clusters of up to eight nodes, including clusters between servers and clusters between partitions of mid-range and high-end Integrity servers. HP provides HP Cluster Extension XP software for use with HP Integrity servers and HP StorageWorks XP storage arrays. Cluster extension software enables geographically separated clusters as well as robust cluster quorum synchronization.

### Serviceability

HP Systems Insight Manager (SIM) combines the best of Compaq Insight Manager, HP Tootools and HP Service Control Manager to provide a common management platform for all HP platforms, increasing uptime by providing powerful monitoring and control tools and capabilities. The agents also provide pre-failure alerts to help prevent unplanned system downtime.

## Benefits of HP Integrity Servers in SQL Server Environments

The HP Integrity server family, with Microsoft Windows Server 2003 and Microsoft SQL Server 2005 (64-bit), offers an efficient, cost-effective, nonproprietary solution for scaling up and consolidating database environments. With this solution, customers are able to consolidate multiple instances of SQL Server 2005 (64-bit) running on

multiple 32-bit servers on one HP Integrity server that scales those databases beyond 8 processors (up to 64 processor cores in a single instance of Windows Server 2003 Datacenter edition). Consolidation not only simplifies system management but also improves efficiency through faster access to larger amounts of data and support for increased users.

Data warehouses and business intelligence (BI) solutions that process large data cubes or complex queries with multi-step query plans are ideal for HP Integrity server solutions with SQL Server 2005 (64-bit). Because SQL Server 2005 (64-bit) can address much larger amounts of memory than a 32-bit solution, more data can be loaded, stored and kept in memory, resulting in faster analysis, better, faster decisions and improved customer service

Intel Itanium 2 processor-based HP Integrity servers running the 64-bit version of Windows 2003 and SQL Server 2005 continue to set dual-core benchmark records, demonstrating superior transaction processing performance for demanding OLTP environments. Over time, the total cost of operation (TCO) for SQL Server 2005 for Itanium-based systems may be less than 32-bit SQL Server 2005, and 64-bit performance can be significantly greater than on an x86-based equivalent. Additionally, the 64-bit platform provides far greater headroom, which means that the hardware lifecycle is likely to be longer, especially with the release of multi-core 64-bit CPUs. The HP Integrity platform also supports multiple OLTP and analytical workloads within the same server, thus reducing hardware, license, operations and infrastructure costs while meeting customer requirements for a longer period, conserving floor space and lowering maintenance expense.

Comparing the Itanium 2 processor-based systems to the x86-64 systems, tests have shown that the Itanium 2 systems deliver the best return on IT (ROIT) for demanding SQL Server applications. When all the criteria of the deployment are taken into consideration, customers actually save money at the top end of complex applications/work loads, when the better long term ROI of the HP Integrity servers is compared with x86-64 systems.

By leveraging the architectural advantages of HP Integrity servers, Microsoft SQL Server 2005 can handle cumbersome query workloads, consolidate database applications, and otherwise scale to meet processing and performance demands.

## Summary

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As the SQL Server database scales and more storage added, data availability becomes increasingly critical. Many companies are moving to consolidate applications and servers to reduce operating costs, increase the responsiveness of their infrastructures and boost business agility. With the advent of 64-bit applications for Windows operating environments—and the introduction of Itanium 2 based HP Integrity servers—enterprises can now take advantage of reliable architectures and cost-effective consolidation solutions that provide flexibility, availability, reduced total cost of ownership (TCO) and increased revenue.

The Symantec software products discussed in this white paper reduce or eliminate unplanned downtime, help organizations quickly recover from disaster, ensure high data availability and improve database performance in the SQL Server environment. Independent analysis of these database and storage performance management and monitoring solutions has determined that these products dramatically improve DBA productivity, lower the cost of each business transaction, improve response times and result in significant savings.

NetBackup delivers comprehensive data protection for SQL Server 2005, allowing centralized management of all aspects of backup and recovery for SQL Server database and non-database files through intuitive, graphical user interfaces (GUIs).

Symantec i3 and Storage Foundation High Availability (HA) for Windows offer complete performance monitoring and management solutions for the SQL Server 64-bit Windows environment. Sub-second, non-intrusive sampling of the database, combined with information gathered from across the entire data path, gives administrators unparalleled end-to-end insight into the workings of each application request for data. Symantec i3 embodies the single, intuitive and comprehensive solution needed for systematically addressing performance management in the SQL Server environment. The high-performance infrastructure provided by Storage Foundation offers the tools needed to resolve problems with minimal impact on applications and end users. This solution-oriented approach to performance monitoring and storage management allows database, application, network and storage administrators to collaborate effectively and quickly in identifying and resolving performance-related data access problems.

By leveraging the architectural advantages of HP Integrity Itanium-based servers, Microsoft SQL Server 2005 (64-bit) can handle large and complex query workloads, consolidate many database applications and otherwise scale to meet increased processing and performance demands. HP Integrity servers offer a 64-bit solution with mission critical reliability, availability and serviceability for demanding Windows data management workloads.

Together, the Symantec software products outlined in this document and the proven reliability, availability, serviceability and flexibility provided by HP Integrity Itanium-based servers offer an exceptional solution for reducing downtime and improving performance in the SQL Server environment.

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## About Symantec

Symantec is the world leader in providing solutions to help individuals and enterprises assure the security, availability, and integrity of their information. Headquartered in Cupertino, Calif., Symantec has operations in more than 40 countries. More information is available at <http://www.symantec.com>.

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## About HP

HP is a technology solutions provider to consumers, businesses and institutions globally. The company's offerings span IT infrastructure, global services, business and home computing, imaging and printing. More information about HP is available at <http://www.hp.com>.

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## About Scalability Experts

Scalability Experts is a software development, consulting, and training company focused exclusively on Microsoft SQL Server. Scalability Experts' software development team builds practical SQL Server management and migration tools, solving difficult scalability, reliability, and serviceability problems for Fortune 500 and mid-sized businesses.

In recognition of excellence in delivering Microsoft-based customer solutions, Scalability Experts is a two-time winner (2003 and 2005) of the Specialization Excellence Award in Advanced Infrastructure Solutions, with a focus on Data Management and Consolidation.

Scalability Experts is a Microsoft Gold Certified Partner with double competencies in Advanced Infrastructure Solutions and Data Management Solutions and a Microsoft SQL Server 2005 Expert Content Provider. Scalability Experts recently conducted Application Compatibility Labs worldwide for Microsoft, assisting software vendors with installing updates to Microsoft SQL Server 2005.

## For more information

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For more information about Symantec's storage management, backup/recovery and performance tuning solutions for the SQL Server environment, visit <http://www.symantec.com>.

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