



**Optimizing
Business Continuity and
Disaster Recovery Capabilities for
Microsoft® SQL Server**

A WHITE PAPER

Abstract: FalconStor® Software's Solution for SQL Server delivers rapid, reliable, quality backup, restore, and recovery associated with routine and unplanned events. This solution minimizes downtime, maximizes availability, streamlines storage administration, and reduces associated costs. The result is improved performance, availability, resource utilization, and management in an enterprise SQL Server environment.

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Introduction

This white paper highlights the challenges associated with data protection in a Microsoft® SQL Server environment as well as illustrates how the FalconStor Software® Solution for Microsoft SQL Server can improve both business continuity and disaster recovery capabilities in a SQL Server environment.

This paper, as well as the FalconStor Solution for SQL Server itself, focuses on the challenges and capabilities associated with Microsoft SQL Server 7.0, Microsoft SQL Server 8.0, and Microsoft SQL Server 2000, Windows platform, 32-bit agent.

The FalconStor products and features referenced here—including IPStor®, TimeMark®, TimeView®, DiskSafe™, IPStor® Snapshot Agent for Microsoft® SQL Server, IPStor® Backup and BareMetal Recovery, IPStor® Remote Replication Software, and IPStor® Active-Active Failover—are part of a comprehensive array of integrated, scalable software options available in the FalconStor Solution for SQL Server. Functionality is the focus of this paper. For additional details, please refer to the FalconStor product datasheets and brochures that are available via the company's website at www.falconstor.com.

Data Protection Challenges in a SQL Server Environment

Enterprise success today hinges on critical application and data availability. Data management and business intelligence applications—databases—are the business-application pinnacle. Demonstrating their effectiveness, SQL Server databases are implemented widely for enterprise information collection, warehousing, and serving. Countless users within a single organization—across disparate locations—expect and require SQL databases to be intact, up-to-date, and accessible at all times and under all conditions. Application and data unavailability resulting from downtime of any sort, for any reason, even in the event of a disaster, is unacceptable. Business continuity is paramount. Consequently, data protection schemes must provide for rapid, seamless, non-disruptive backup, restore, and recovery.

SQL Server excels in performance and dependability, and boasts low implementation and maintenance costs. However, due to the explosive growth in popularity and use of SQL Server, coupled with the equally explosive growth in associated data volume, companies relying on SQL Server often find themselves with a proliferation of servers, storage, and data—at both local and remote sites—that can be difficult to administer, manage, and protect. This can promote ongoing and broad resource inefficiency, affecting enterprise performance, productivity, and bottom lines. The typical SQL Server-dependent enterprise hosts numerous databases, multiple servers, and increasing terabytes of associated storage capacity. Because enterprises typically grow in a piecemeal manner, the de facto result is often a disconnected, often redundant infrastructure, unnecessarily complex processes, higher overhead, wasted assets, and hindered application availability—even in an otherwise-promising enterprise SQL Server scenario.

While SQL Server applications feature some built-in self-management and data protection capabilities,¹ total enterprise data protection—comprehensive and efficient backup, restore, and disaster recovery—in such a critically important and dense environment can be daunting, let alone ineffective. Ultimately, enterprises choose SQL Server for its availability. As such, they absolutely need to design and implement highly available SQL Server environments. Yet, in the most common scenario, SQL Server availability is restricted not by the application server's performance or capabilities, but by backup, restore, and recovery windows,

¹ SQL Server offers self-tuning and self-configuring capabilities to optimize database performance, inherent baseline backup and restore capabilities to capture and recapture associated data, and automated log shipping capabilities to facilitate operation restart in the event of a disaster. For additional details, see <http://www.microsoft.com/technet/prodtechnol/sql/2000/books/c11ppcsq.msp>.

which are driven by process- and task-time. As a result, the key to the most effective and highly performing enterprise SQL system is the optimization of data protection capabilities.

In any SQL Server environment, the heightening availability requirements and burgeoning user traffic—impacting the rate of data change and corresponding resource requirements—as well as the associated volume of data growth command constant attention from any database or IT administrator. Frequent data protection challenges and concerns include:

- Shrinking backup windows but larger backup requirements (making more traditional methods of backup less realistic)
- Hard-to-achieve recovery point and time objectives (putting enterprise data and business continuity at risk in the event of unplanned downtime due to a disaster)
- A constant need to reconfigure disk resources and add storage capacity (a result of growth in data volumes and application servers, producing an inability to dynamically manage storage and storage capacity growth across multiple servers)

Slow and Inadequate Backup, Restore, and Recovery

Most data protection regimes provide for data copying. Even SQL Server itself—through inherent baseline functionality—supports automatic backup of control files as well as of database log archives, individually or in groups.² However, the speed and quality of enterprise replication varies by implementation, from solution to solution, and is largely affected by the associated storage solution. Where backup capabilities might have sufficed in the past, for many enterprises, they are no longer adequate in the current environment.

Depending on the particular enterprise and the level of associated database transactions over a given period, the rate at which data changes—and, therefore, must be re-protected—varies immensely. Many storage and data protection solutions simply force SQL Server administrators to duplicate entire databases and data volumes every time, pushing the boundaries of storage capacity and management by precluding rapid, efficient, incremental data protection.

Most traditional solutions also mandate either online (“hot”) or offline (“cold”) backup, but rarely are they flexible enough to support both methods. If a solution mandates online backup techniques, it likely reduces primary server and/or production environment availability by precluding effective offline data copying. If a solution mandates offline backup techniques, it likely reduces availability by precluding effective online data access. Either way, an enterprise customer depending on a traditional SQL data protection scheme is left with little choice. The same can be said for local and remote backup capabilities. Without an advanced solution, the ability to centrally replicate all enterprise SQL data is inadequate.

Regardless of the process functionality, SQL backup tasks can substantially affect critical SQL application availability because most data protection regimes and storage infrastructures were not designed to address the replication needs of today’s typical enterprise 24x7xForever SQL Server environment. In this context, optimized SQL data protection leads to maximum SQL application availability.

Data restore and recovery in a SQL Server environment is equally challenging. Here again, SQL Server offers built-in recovery capabilities. However, the ability to quickly resume operations after a version

² This includes complete, differential, transaction log, and file/file-group backup capabilities.

upgrade or after repairing and recovering a corrupt database—with assured data integrity and limited downtime—is not guaranteed.

Most traditional solutions provide slow and undiscerning data recovery at best, forcing IT staff to sort through a maze of data volumes and types, while users experience critical application downtime. In a high-growth SQL Server environment, these challenges are exacerbated. In addition, when attempting data recovery, those organizations that still rely on tape-only backup regimes experience higher degrees of data loss and unavailability as a result of infrequent, unreliable, or inefficient tape backups.

In short, in an enterprise SQL Server environment, administrators often spend too much time trying to meet backup needs, correct problem databases, and perform archive retrievals, emergency restores, or system recoveries. In the end, despite SQL Server capabilities, users do not experience the necessary application uptime because administrators cannot achieve the system performance required. Once again, backup, restore, and recovery optimization in a SQL Server environment is the key.

Complex and Unreliable Disaster Recovery

While many firms dedicate countless hours to disaster recovery strategies and plans, not many truly are assured of a fully operational recovery—with current data and its integrity intact—following a disaster. In an enterprise SQL Server environment, lost or inaccessible data due to an unplanned event can be catastrophic. The existing data storage infrastructure at some companies portends that the best-case scenario is resumption of business—often days later—under a dated or incomplete SQL database. Sometimes, the next-best scenario is resumption of business with a corrupt database from a sudden or rolling outage.

In addition, many enterprises set up duplicate hardware and software “hot-spare” combinations in an effort to protect themselves from a site failure. Oftentimes, however, if the hot-spare disaster recovery combination is not an exact match—in product type, configuration, and currency—of the primary server, production server, or combination of servers, effectively resuming SQL Server operations during or after a disaster remains elusive.

The bottom line here is that many of today’s enterprise SQL Server environments are not prepared to handle or recover from a disaster. Even with adherence to SQL Server disaster recovery guidelines, many of these environments certainly are not set up to do so with any sense of simplicity, speed, or reliability. At a minimum, most enterprise SQL Server environments bear a heightened level of data vulnerability, and the companies that rely on them operate at a heightened level of business risk.

Such a result cheats SQL application aptitude. With the proper data protection and storage solution, disaster recovery capabilities in an enterprise SQL Server environment can be optimized to reduce data vulnerability and business risk—as well as improve operating efficiencies and overall performance.

Difficult-to-Manage Infrastructure and Processes

In the typical enterprise SQL Server environment, the variety and placement of the infrastructure alone can make storage management difficult. Enterprise-wide, SQL systems can depend on a combination of storage types (DAS, NAS, and SAN), adding complexity and duplicity to data protection tasks, to say nothing of overall system management. Due to the complexity of the typical enterprise environment, database administrators on average spend a significant amount of time carrying out ongoing management tasks that

include provisioning, configuring, and mapping for performance tuning, space management, and system resource tuning.

For example, for each database, administrators must manage the database file system and volume manager as well as an endless number of associated files. In addition, the ability to scale SQL-associated storage without downtime (and, therefore, without disrupting database availability) is not a common capability. However, database data volumes can grow 20% or more annually, mandating additional storage capacity. Also, most database archival schemes were not devised for quick access, at a granular level, to archived data. The inability to rapidly recover a storage group or database in minutes means not just additional user productivity downtime, but the absorption of wasted administrative labor hours.

These and other difficulties compound the challenges facing today's database and storage administrators. Some of their management tasks can require dozens of manual activities and take days or weeks under a traditional storage scenario. FalconStor Software understands data storage and the critical nature of SQL application needs, especially in an enterprise environment. In response to this, the FalconStor Solution for SQL Server optimizes data protection—for backup, restore, and disaster recovery—in a SQL Server enterprise environment.

The FalconStor Solution for SQL Server

By combining a standard open architecture, advanced storage virtualization features, and intelligent storage management capabilities and services with advanced, application-specific tools, FalconStor ensures that enterprise SQL Server environments are reliably protected, highly available, and easily managed. The consistent results of the FalconStor Solution for SQL Server are:

- Optimized data protection and availability
- Efficient storage provisioning
- Maximized storage utilization
- Lower management costs
- Reduced downtime
- Lower total cost of ownership
- Increased return on investment

The FalconStor Solution for SQL Server enables the utmost in business continuity and disaster recovery by moving storage functionality and management—specific to the application—to the layer between the host and the storage device, into the storage network. The center of the FalconStor solution—FalconStor IPStor Enterprise—delivers an intelligent storage infrastructure across heterogeneous environments.

The software architecture is easy to understand, deploy, and manage. It is simple to integrate into an existing environment since the associated IPStor appliance (a standard, off-the-shelf, Linux- or Solaris-based server running IPStor software) sits between the servers and storage device, and supports any-to-any connectivity. IPStor places no limitations on hardware, software, or storage choices—an important point in today's varied SQL environments. It works with any type of storage system that uses Fibre Channel (FC), iSCSI, or direct connections, or any combination of those, from any vendor.

Implementing an IPStor-based storage solution in any environment (including in an existing enterprise SQL Server environment) is easy, and the associated services are readily available via the FalconStor intelligent wizard functionality. One or more IPStor appliances are simply positioned between the relevant application servers and the currently associated server storage. IPStor can immediately see and access the storage

devices that the servers originally were using. The original SQL data is neither moved nor modified (unless desired).

With the FalconStor Solution for SQL Server, data protection is improved without changing the existing storage paradigm (unless desired). The storage devices appear to their respective servers as the same devices that they were using before the solution was implemented. Once the solution has been placed in the “data path” between the host (the SQL application server) and the storage device, advanced data protection for backup, restore, and disaster recovery can be achieved immediately.

The FalconStor Solution for SQL Server offers rapid, simple, and comprehensive backup, restore, and disaster recovery capabilities, including:

- Point-and-click creation of transaction-consistent images of SQL databases
- Automatic, alternate-location (including offsite) creation of a SQL database replica
- Instantly accessible, full-integrity SQL database backups (which can be achieved online or offline) for disaster recovery (for example, in the event of a site loss or sudden or rolling disaster)
- Complete recovery from logical database corruption (such as the loss of a single mission-critical SQL database)
- Administrator-initiated restores

The FalconStor Solution for SQL Server also delivers the improved infrastructure and management efficiencies that come with any IPStor-centered solution. The following sections illustrate how the FalconStor solution optimizes SQL Server performance and availability in backup, restore, and disaster recovery scenarios, as well as how it elevates overall IT asset performance and availability.

Improved Business Continuity Capabilities

The FalconStor Solution for SQL Server offers end-to-end data protection; immediate recovery from hardware, software, and network failures; support for ongoing operations without downtime; and non-stop data availability. Whether it’s used to enable “what-if” scenarios or mitigate administrative errors, user errors, or data degradation due to outside events, the FalconStor solution ensures highly available, highly dependable enterprise SQL Server environments.

With FalconStor software (via the IPStor TimeMark option), administrators gain an instant, granular, point-in-time (PiT) rollback capability (via disk-based journaling) to protect data from soft errors such as accidental deletions, corruptions, and viruses. At any given point in time, an administrator can roll back to a database image from minutes, hours, days, weeks, or months prior. Even individual database files or table spaces, deleted outside of SQL supplemental data protection features, can be retrieved quickly and fully intact.

The FalconStor Solution for SQL Server permits the creation of continual, consistent PiT images of any managed volume (including of both data and logs) by using copy-on-first-write technology. TimeMark PiT snapshots behave much like physical copies of data, but, unlike a physical mirror, they do not require a significant amount of time or storage capacity to create. Snapshots require mere moments and only a fraction of the disk storage space demanded by the original application. Consequently, a greater volume of SQL data can be protected using snapshot technology, and backups and restores can be accomplished without negatively impacting data integrity or availability. The FalconStor solution can be used for both hot and cold backups, as well as for remote replication and PiT disaster recovery.

When a snapshot request comes in, the SQL database is put into online backup mode (i.e., a hot backup in archive-log mode, where the table spaces are altered to begin the backup). Normal database operations are then resumed (when the table spaces are altered again to end the backup). The Virtual Device Interface (VDI) exposes the backup/restore functionality inherent in SQL Server, permitting the more efficient FalconStor snapshot functionality to supersede. Because this process does not require reading the data from beginning to end, but, rather, simply capturing an image of the data on the disk, backup speed is greatly increased, and the backup window is dramatically reduced. Both process time improvements translate to greater database application availability.

With the FalconStor Solution for SQL Server, users can create up to 256 TimeMark “copies” per SQL data volume and still use only a small amount of storage—20% of the original capacity, on average. Snapshots can be scheduled to occur by the minute, hour, day, etc., for different intervals, using varying changed-data parameters. In other words, with the FalconStor Solution for SQL, customized data protection policies can be set for different SQL data volumes, further extending SQL data protection optimization.

Because only changed data is saved, less storage is required. As a result, incremental SQL backups can be stored online, making all backed up data from any of the 256 PiTs images immediately and easily retrievable. With this capability, restores require only the time it takes to make a few mouse clicks, not the time it would take to retrieve, load, and scan an actual linear storage medium like tape.

The FalconStor Solution for SQL Server also permits considerable flexibility in backup methodology. For example, a FalconStor customer can perform hot, online backups as described previously, or traditional cold, offline backups. In a cold, offline scenario, the SQL databases are shut down entirely (i.e., during non-business hours), and all data, log, and control files can be backed up rapidly and efficiently via IPStor snapshot capabilities. When the database is restarted, normal operations are resumed. The FalconStor solution captures an image of the “logical” definitions and data (as opposed to the physical data) in a temporary file or places a copy of the entire file on a backup server. Either way, backup window time is taken offline.

The FalconStor Solution for SQL Server (via the TimeView extension to the TimeMark option) also permits an administrator to mount any TimeMark snapshot as a virtual disk—or TimeView—and assign it to any server connected to the IPStor-managed storage network. Not only does the server then have full read-write access to the new disk, but TimeView copies can be subsequently backed up or mounted for other uses (such as “what if” scenarios and data mining), while the original data set is in use and unaffected. TimeViews can also be taken from replicated data copies, allowing operations such as backup, reporting, consistency checking, or retrieval of a lost record on a stable image in a remote location. The same functionality can be used for recovery when system reset is undesired. In addition, FalconStor snapshot capabilities enable database modeling without affecting the production database.

FalconStor software excels in supporting high-growth, high-volume database environments that require strict and dependable backup regimes. This is especially true for critical data-gathering, data-holding, and data-serving applications like SQL Server because FalconStor solutions are conceived, designed, and fully integrated to be application-specific.

Meeting Recovery Time Objectives with Snapshot Agents for SQL

FalconStor software solutions can offer rapid and reliable backup and recovery because FalconStor has combined IPStor functionalities (such as TimeMark and TimeView) with an application-aware, client-based snapshot agent—the IPStor Snapshot Agent for Microsoft SQL Server. This unique combination, the operability of which is certified via the FalconStor-Microsoft partnership, minimizes downtime with quick time-to-restore and ensures that active databases are backed up with full transactional integrity and PiT consistency, even if the data is spread across multiple drives and locations.

Advanced Backup & Recovery for SQL Server:

- IPStor Snapshot Agent for Microsoft SQL Server and the TimeMark feature increase backup frequency with 100% guaranteed data integrity
- IPStor TimeView feature delivers an accelerated, space-efficient recovery process designed to exceed recovery time objectives (RTOs)
- IPStor Backup & BareMetal Recovery guards against boot disk failure

With the FalconStor solution, when the TimeMark process is activated (either manually or automatically via scheduled policies), the SQL snapshot agent communicates with the appropriate SQL database to let it know that a snapshot is about to be taken. The SQL snapshot agent calls the SQL APIs to put the database in hot backup mode, momentarily quiescing the database. All transactions are flushed to disk (simultaneously for both the database and transaction log disks) to ensure database transactional integrity. Once the snapshot is taken, the database resumes normal operations. The result is a snapshot that contains a transactionally consistent picture of the database and associated logs. FalconStor IPStor snapshot agents are specifically written and tested for each database application, including SQL, to ensure that the application is correctly quiesced, resulting in a

PiT TimeMark that has guaranteed integrity.

Although multiple SQL databases can reside on the same device, each SQL database—particularly mission-critical databases and associated logs and database files—can be placed on separate disks to address both fault tolerance and performance issues. For example, in a single enterprise environment, three SQL databases might be placed on three separate disks to reduce data risk and availability impact. With many data protection solutions, this decision imposes the same scenario on the snapshot agent. The FalconStor Solution for SQL Server, however, delivers more options. With this solution, an administrator can put each database in backup mode individually, one database at a time, or together.

Further extending snapshot technology, the IPStor Snapshot Group feature allows disks to be grouped for snapshot synchronization purposes. Snapshots for all resources in a group are taken at the same time, whenever a snapshot is triggered. This feature, working in conjunction with the IPStor Snapshot Agent for Microsoft SQL Server, ensures integrity for transaction logs and database files that reside on multiple disks.

For both individual SQL databases and groups, snapshot agents make certain that each TimeMark is valid and mountable by the server. While many other data protection solutions fail to ensure that the data has been successfully written to the backup tape or disk, to meet recovery time objectives (RTOs), or to provide high-quality recovery, the FalconStor Solution for SQL Server excels by permitting rapid and complete data recovery. The FalconStor solution makes it unnecessary to perform time-consuming data validity checks (e.g., using the `chkdsk` command) and database recovery procedures in order to successfully mount the database.

SQL Server Continuity Challenge: Non-Disaster Hardware Failure

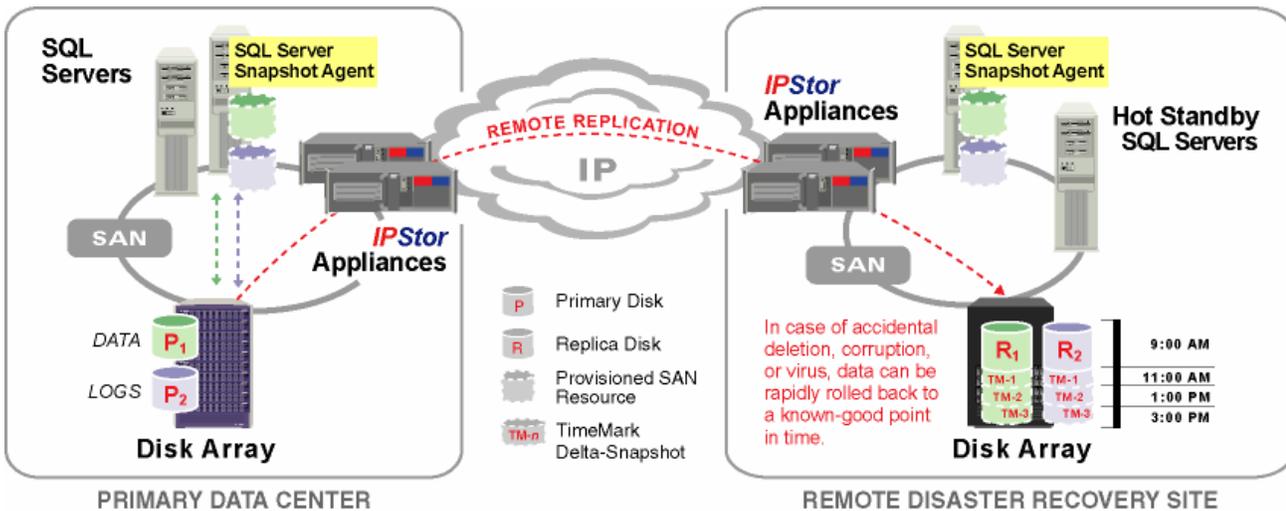
The FalconStor Solution for SQL Server protects against “soft” errors (i.e., when hardware operations are maintained, but a non-hardware-associated error affects continuity) as well as against “hard” errors (i.e., when software operations are maintained, but a hardware-associated failure affects continuity). This solution limits downtime and optimizes application and data availability in either scenario.

For example, many competing backup and recovery solutions for SQL Server protect against data loss but not against boot disk failure, forcing unnecessary downtime for hardware replacement or repair in order to restore the server to working order. If a SQL server cannot be rebooted, even the most fault-tolerant data protection scheme is useless.

The FalconStor Solution for SQL Server (with DiskSafe software) expedites data recovery even after boot disk failure on the server by capturing the system’s boot disk image and saving it to a separate, online disk. Return-to-service time is reduced to minutes rather than hours or days because the targeted system can be rapidly rebooted from the remote disk over standard protocols (iSCSI or FC), and normal operations can continue. Once the local boot disk is repaired or replaced, the boot information and data can be restored to the local disk all via simple point-and-click functionality. The FalconStor solution makes certain that both the SQL server and the associated SQL data are protected and highly available.

Improved Disaster Recovery Capabilities

The ultimate business continuity challenge is disaster recovery. End-to-end, enterprise business continuity—especially for mission-critical database applications—is mandatory, even in the event of a disaster. Many solutions are available to maintain SQL Server high availability. However, the FalconStor Solution for SQL Server ensures enterprise SQL Server business continuity in the event of all kinds of disasters—including sudden outages, rolling outages, and site loss—for all kinds of facilities, from the company headquarters to remote data centers and offices.



No matter what the cause, the FalconStor Solution for SQL Server secures business continuity before, during, and after a disaster strikes, without the expense or effort to integrate new, specialized storage arrays. With the FalconStor solution, disaster recovery-associated SQL data protection can be assumed the

minute FalconStor software is installed. In the event of any kind of disaster, SQL Server operations can be resumed rapidly with minimal data or production time loss.

Utility power failures, local or widespread fires or floods, high-level hacker attacks, and national emergencies all can cause unplanned outages that leave a company's IT systems vulnerable and, quite often, inoperable. In a mission-critical enterprise SQL Server environment, IT administrators must devise a strategy—as well as build an infrastructure—that permits quick and effective disaster recovery. The FalconStor Solution for SQL Server can enable just that.

Optimized Delta-Based Replication

The FalconStor Solution for SQL Server epitomizes the optimal enterprise SQL Server disaster recovery architecture in terms of both speed and flexibility. The FalconStor solution (via IPStor functionality) facilitates simple yet comprehensive protection of mission-critical SQL data between data centers, or between remote offices and data centers, via innovative remote replication over IP (using a process similar to a hot export backup to create a second instance of a SQL database).

Replication over IP is reliable, secure, and efficient:

- Reliability is achieved through automatic retry and resume in case of disrupted replication sessions.
- Encryption ensures the security of the data in transit.
- Data compression combined with a high-resolution microscan (identifying sector-level changes) enables optimal use of WAN links.

Using delta-based replication over IP, the FalconStor application-aware, transaction-based, remote replication capability (via IPStor Remote Replication Software) enables sites to replicate changed SQL data across any distance to similar or dissimilar hardware for continuous SQL application operation in case of a disaster. The remote replication capability integrates seamlessly with the IPStor Snapshot Agent for Microsoft SQL Server, maintaining consistent PiT copies of SQL data replicas for quick data recovery. And, with FalconStor, the performance of the SQL servers at the primary site is never affected.

After a quick, initial synchronization, the FalconStor solution easily protects even very large primary disk stores associated with SQL Servers. Data compression and encryption are used to maximize network bandwidth and provide data security. FalconStor software allows bulk transfer of the replica via either mirror-and-ship or by image backup/restore via tape, so that the SQL replica is always in sync, outside of changes that occurred during the shipping or backup process. The FalconStor solution can then scan the replica for departures from the initial map and sync up any differences (only changed blocks are applied). Once this is complete, the primary and replicated data are identical and concurrent.

Unlike traditional methods that demand more and more data volume duplication, driving up storage capacity and administrative requirements, the FalconStor solution optimizes SQL data protection and availability.

SQL Server Disaster Challenge: Site Loss

Specifically designed to help organizations cope with site loss, the FalconStor Solution for SQL Server provides automated, off-site data protection. This solution allows a replica disk to be pre-assigned to hot standby servers at the disaster recovery site. In the event of a disaster, the replica is promoted to primary status, and LUN assignment operates automatically. (LUN pre-assignment prevents the confusion that

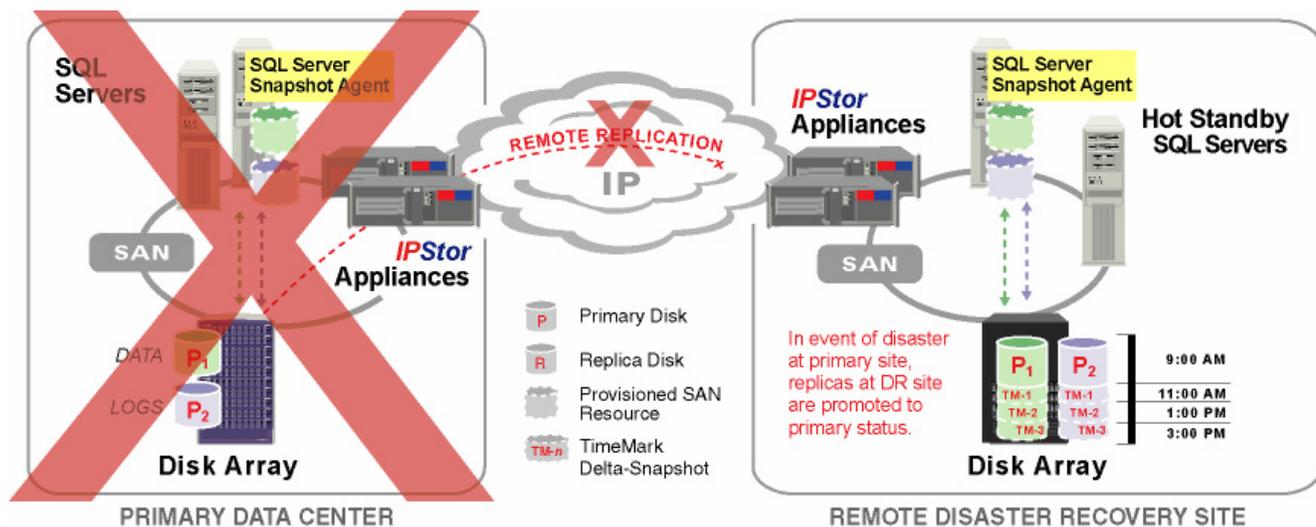
typically occurs in the midst of a disaster.) SQL and IT administrators have one less process to manage during their crisis.

After promotion and assignment, each standby SQL server is ready to be powered up. With the FalconStor solution, when the TimeMark PiT imaging option is enabled at the replica, each individual change is recorded. In the event of a disaster that causes SQL data corruption, for example, any of the previous 256 snapshots can be used in a rollback (both current and previous versions can be mounted for read/write access over IP). And, because replica changes are stored in a separate area and not written to the stored replica until the full data set is confirmed received and intact, the FalconStor Solution for SQL Server guards against replica corruption and interruption.

Advanced Business Continuity and Disaster Recovery for SQL Server:

- Pre-disaster
 - Remote replication of SQL LUNs via multiple TimeMarks and transactional integrity via snapshot agents
 - Pre-assignment of replica LUNs to standby SQL servers
- During disaster
 - Sudden disaster—RTO achieved through rapid promotion of replicas to the disaster recovery site
 - Rolling disaster—Immediate roll reversal, leveraging TimeMarks of primary and disaster recovery sites for business continuity
- Post-disaster
 - Reverse synchronization, scanning only for data that has changed, minimizes the time and capacity needed to re-establish the primary site

Unlike other solutions, in a disaster recovery scenario, the FalconStor Solution for SQL Server guarantees that both the data and the boot disk are safe. Applying the same functionality used in any type of unplanned downtime, the FalconStor solution provides expedited recovery of SQL data and databases—even after boot disk failure—and does not require server takedown. Rapid disaster recovery is achieved with a remote boot, especially in the case of a site loss, because the boot can be conducted from anywhere (with equivalent hardware), without productivity loss.



After the disaster recovery site has been promoted to production status, the remote standby SQL servers can service the entire enterprise.

SQL Server Disaster Challenge: Post-Disaster Restoration

Unlike most disaster recovery solutions, which do not address the methodology to quickly recover the primary site, the FalconStor Solution for SQL Server has been designed specifically to provide rapid, post-disaster restoration.

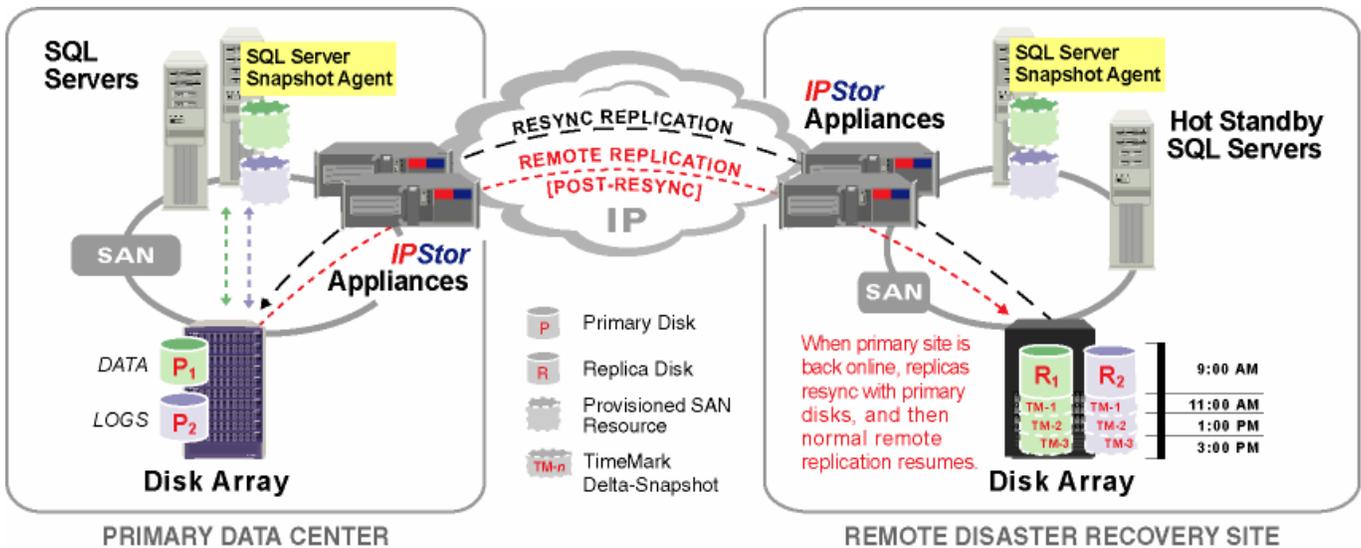
Following a disaster, to revive or restart the primary site after the problem or failure is rectified, reverse synchronization can be achieved by moving the SQL data from the disaster recovery site back to the primary site. The FalconStor Solution for SQL Server facilitates this "role reversal" by scanning for differences, minimizing the time and capacity necessary to re-establish the primary site.

Eliminating Potential Points of Failure for SQL Server Environments

FalconStor facilitates high availability for SQL Server environments. To accomplish this, the FalconStor Solution for SQL Server (via the IPstor Active-Active Failover option) empowers one IPstor appliance to take over the processing tasks of a second IPstor appliance in the event of a system failure, protecting the enterprise SQL environment from any single point of failure.

In the FalconStor high availability scheme, the primary and secondary IPstor servers are independent appliances. Each might have assigned clients that are being serviced (active-active mode), or one might not be serving any clients while it awaits a failover (active-passive mode).

The FalconStor Solution for SQL Server can also make use of multi-pathing software to heighten business continuity. The solution leverages multi-pathing software at the application server to create parallel active storage paths that transparently re-route traffic to a redundant storage path without interruption.



For continuous operation during a planned or unplanned outage, the FalconStor Solution for SQL Server delivers a highly redundant storage solution offering 24x7xForever availability. Whether the outage is due to hardware failure or planned maintenance/upgrades, this solution ensures non-stop data availability.

Improved Overall Storage and Management Capabilities

The FalconStor Solution for SQL Server unifies the overall storage infrastructure and streamlines processes, improving data protection as well as data storage and management capabilities. In an enterprise SQL environment, this translates to the highest in availability and the best possible performance.

First, the FalconStor solution is very flexible. It integrates into existing enterprise SQL Server, storage, and data protection environments without changes to the existing hardware infrastructure or paradigm. With IPStor and other IPStor software options, storage can be immediately virtualized, and storage services can be instantly enabled. Simple wizards direct all management functionality. SQL Server performance and availability are optimized via advanced data protection capabilities. Like all FalconStor solutions, the FalconStor Solution for SQL Server fits a customer's preferred method of doing business. FalconStor customers do not have to change their operations to fit FalconStor's way of doing business.

Second, FalconStor facilitates heterogeneous storage consolidation. IPStor maximizes capacity utilization through consolidation of application servers and disk resources across many different types of operating systems, cabinets, connections, and interfaces, regardless of the vendor. Storage managed by IPStor can be of any type (DAS, SAN, NAS, disk array, RAID, SSD), support any operating system (Windows, Linux, AIX, Solaris, HP-UX, NetWare, etc.), and reside at any location (local, remote). With FalconStor solutions, separate, disparate SAN islands can be unified over IP. Existing storage resources can be combined with new resources to create both SAN (block level) and NAS (file level) resources. As a result, in an enterprise SQL Server environment, IPStor capabilities can be extended across architectural and geographical boundaries to provide the utmost in data protection, while still maintaining infrastructure performance, reliability, and integrity.

Third, for companies that need to improve operations, performance, and availability while leveraging existing storage investments, the FalconStor solution allows for complete use of legacy tools, including tape libraries and other backup tools. In fact, for even greater protection and for critical archival purposes, backup to tape can be completed via TimeView from a replica with no impact on the production environment, application, or data availability. In addition, the FalconStor Solution for SQL Server leverages existing third-party backup software. FalconStor software solutions (such as HyperTrac™ Backup Accelerator and ZeroImpact™ Backup) accelerate third-party backups while offloading the backup process from the production server, centralizing management, improving overall SQL Server application availability, and further strengthening business continuity.

Management Benefits for SQL Server:

- Maximum utilization of storage, tools, and personnel
- Enhanced performance of storage, tools, and personnel
- Greater availability of applications, data, storage, infrastructure, and personnel
- Efficient management of applications, data, storage, tools, and overall infrastructure

Fourth, FalconStor delivers centralized, simplified storage management. In an enterprise SQL Server environment, this translates into improved management of both single and multiple groups. IPStor software merges storage and storage services management at the IPStor console, a single, unified, easy-to-use, go-anywhere, Java-based interface. Fast and easy point-and-click and wizard functionality can be used for storage provisioning, management, and administration tasks. SQL Server -associated data management is simplified and costs are lowered by consolidating storage via the IPStor appliances and the console.

Fifth, downtime and performance degradation due to routine and non-routine tasks are significantly reduced with the FalconStor Solution for SQL Server, freeing up IT staff for more pro-active and strategic assignments. Downtime and task performance time is greatly reduced or eliminated during disk upgrade or replacement, data migration from old to new storage, and data replication. Downtime and task performance time associated with recovery is slashed to minutes.

Finally, with the FalconStor Solution for SQL Server, for those enterprises using file system storage solutions (e.g., NAS), administrators gain the ability to add associated storage capacity (via the IPStor Capacity-On-Demand™, or CoD, function) without downtime or disrupting database application functionality. CoD enables administrators to set policies that control automatic storage capacity expansion of specified volumes at specified thresholds. This capability is critical in enterprise SQL Server environments, where data volumes grow exponentially each year. Projecting disk capacity requirements or space allocations 12 to 18 months in the future can be very difficult. With CoD, the worry, uncertainty, and cost inefficiencies associated with capacity planning are eliminated. The FalconStor Solution for SQL Server guarantees that storage capacity will always be available. Plus, IPStor can be used to serve other storage, further extending CoD benefits into the enterprise.

Conclusion

Successful business operations hinge on a company's ability to maintain a high level of enterprise data availability. Critical applications such as SQL Server demand advanced data storage management. In an enterprise SQL Server environment, the FalconStor solution optimizes application and data availability as well as storage management capabilities, delivering an enhanced backup, restore, and recovery regime that protects against soft and hard errors.

The result is not just greater business continuity, but also improved physical and human resource utilization, improved application and infrastructure performance, and easier and more efficient application and storage management. Most organizations cannot afford to lose precious operational uptime or valuable enterprise data. Most enterprises using SQL servers cannot function without them. Simple and dependable, the FalconStor Solution for SQL Server optimizes SQL data protection.

In summary, the key benefits of the FalconStor Solution for SQL Server include:

- Creating transaction-consistent images of databases
- Improving replication frequency and integrity while minimizing storage capacity requirements
- Conducting automatic, alternate-location (including offsite), instantly accessible, full-integrity data replication
- Rapidly recovering from a disaster, including a complete site loss or sudden or rolling disaster due to SQL-associated hardware or other infrastructure failure
- Rapidly recovering from logical corruption, including the loss of a group in a mission-critical database
- Eliminating downtime from boot disk failure
- Improving resource utilization, availability, and performance
- Better managing data storage and data protection

About FalconStor Software

FalconStor Software, Inc. (NASDAQ: FALC) is a leading developer of network storage software designed to optimize the storage, protection, and availability of enterprise data. FalconStor's flagship product, IPStor, enables corporate IT to deploy a hardware-agnostic, network-centric foundation to maximize operating efficiency and business continuity, and to meet the availability requirements of mission-critical applications. IPStor-powered network storage solutions are available and supported by major OEMs, as well as system integrators and resellers worldwide.

Founded in 2000, FalconStor is headquartered in Melville, NY, with offices throughout Europe and the Asia Pacific regions, including in Paris, Tokyo, and Taiwan. FalconStor is an active member of the Technical Support Alliance Network (TSANet), Storage Networking Industry Association (SNIA), and Fibre Channel Industry Association (FCIA). For more information, please visit www.falconstor.com or call 1-631-777-5188.

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