Utilizing Solid State Disks in the Financial Industry

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Section 1

Executive Summary

The Financial Services Industry faces new competitors and large mergers almost daily. Companies within this industry must be able to consistently earn new customers while also keeping their existing customers happy. Every customer transaction translates directly into revenue. The more customers a financial company can serve every day, hour, and minute – the more money earned and the better the likelihood that the company will remain a strong player in the Industry.

As a result of the highly competitive and fast paced environment, more and more Financial Services companies are seeking out technology that will enable them to process more transactions and handle more customers everyday. This is being accomplished by implementing faster servers, larger applications, high-bandwidth networks, and high-performance storage, such as solid state disks.

Solid state disks are a cost-effective way to improve application performance and maximize the number of transactions and users on the network. Traditional hard disk based systems incur a performance penalty because of the high access times of hard disk drives. Solid state disks resolve this problem with low access times and high bandwidth. Financial Services companies who have implemented solid state disks make better use of their server infrastructure, support increasing concurrent user loads with low response times, and improve user satisfaction.

The RamSan® solid state disk is the leader in high bandwidth, low latency storage; it quite literally is the World's Fastest Storage®.

Section 2

Problem: Poor Performance Causing a Loss of Revenue and Decreased Customer Satisfaction

Two common scenarios in the Financial Services Industry:

Company *A* runs a nightly batch processing job that compiles and sorts all the day's activities. As the company has grown, so has the length of time in which the batch job runs. What used to take 4-6 hours every night is now taking 10-12 hours or longer! The batch now runs into the business hours of the bank. This slows down the application server and creates problems for the tellers during morning transactions. Customers are waiting longer each morning to handle their transactions as a result of the tellers waiting on the network. The result: unhappy customers and bank employees and fewer transactions being processed every morning. What if the nightly batch process could be reduced to less than 6 hours?

Company *B* deals with online trading for individuals and institutional brokers. Every second of the day, Company *B* counts on the speed and reliability of its network to ensure each transaction goes through. Real-time processing of the transactions is a must. As Company *B* has had increasing success, the number of users trading online has increased dramatically. The application server has become overloaded with too many users, and customers attempting to trade online are experiencing 3 seconds or longer response times. Many transactions are dropped and not picked up again. Company *B* is seeing direct revenue loss from each dropped transaction as the system becomes increasingly swamped and unable to handle the increase in users and transactions. What if a simple solution could be implemented that would take less than a day and would enable Company *B* to have 4 times more transactions and customers every day?

The solution to these scenarios is solid state disk.

Solid state disks have been providing the financial market with a solution to the performance gap between fast processors and slow mechanical disks for the past 20 years. The two scenarios above are real financial customers, and they experienced dramatic results in less than a day from the implementation of RamSan® solid state disks.

Section 3

Solution: Improve Performance with Solid State Disks

With the performance gap between processors and hard drive-based storage systems widening, solid state storage is entering the limelight. Because solid state systems rely on memory chips for data storage, they offer unprecedented access times, which narrows the gap between the processor speeds and storage speeds. Companies have used solid state storage systems to resolve I/O performance problems for over two decades. These systems have become increasingly sophisticated, higher performing, and lower cost, which sends a clear message … there is no better tool for improving I/O performance.

Understanding Solid State Disks

Solid state disks are a proven technology. In fact, Texas Memory Systems has designed and manufactured solid state disks for over 27 years. Solid state disks are non-volatile storage devices that use RAM as the primary storage media. Solid state disks store and access data directly on RAM chips, which results in storage speeds far greater than conventional, magnetic storage devices. They achieve non-volatility through integrated internal battery and disk backup systems.

Solid state disks have the following characteristics:

- *Lowest possible access times.*
  DDR RAM-based solid state disks have access times below 20 microseconds, the best access times of any storage platform. As a comparison, a hard disk drive at 5 milliseconds has 250 times higher access times.
- *High bandwidth.*
  The enterprise solid state disk market includes products, such as the Texas Memory Systems RamSan-325®, which can support over 1.5GB per second of random data throughput and the RamSan-400® which supports over 3GB per second of random data throughput. Compare this to your local hard drive, which gets about 50MB per second: this is 30-60 times slower than the RamSan®.
- *High I/Os per second (IOPS).*
  Solid state disks offer extraordinarily high random I/O performance because of their low access times and high bandwidth. For more information, see the Texas Memory Systems SPC-1 IOPS results, below.
- *Low price for performance.*
  DDR RAM based solid state disks provide the best possible

price/performance of all storage devices. For more information, see the Texas Memory Systems SPC-1 IOPS results, below.

- *High availability*
  Solid state disks are inherently more reliable than hard disk drive based systems because their data path does not require moving parts.
- *Non-volatile.*
  Enterprise solid state disks offer non-volatile solutions. These solid state disks have internal batteries that maintain system power long enough to back-up data in memory to internal hard disk drives. Additionally, the RamSan® offers redundant memory protection with ECC error correction and IBM's Chipkill™ technology.

Solid state disks are an excellent solution for I/O bottlenecks, particularly those bottlenecks caused by the high access times of traditional disk based storage systems.

The Proof: Benchmark Results

Solid state disks offer incredible performance and an unbeatable price: performance ratio. As proof, an independent benchmark performed by the Storage Performance Council demonstrates the value and performance of the RamSan® Enterprise Solid State Disk. The results from Texas Memory Systems SPC-1 IOPS™ testing, including the cost per SPC-1 IOPS, are audited and verified by the Storage Performance Council.

These benchmarks examine the following environment:

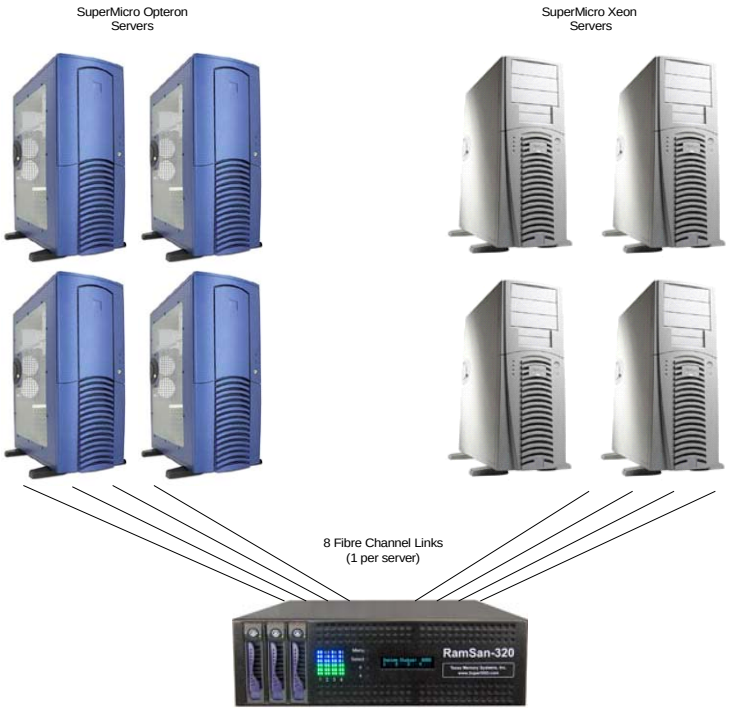

Figure 3: Simple Performance Test Environment

About the Storage Performance Council
The Storage Performance Council (SPC) is a vendor-neutral organization dedicated to the development and application of performance-based storage benchmarks. To ensure the validity of all performance claims, the SPC requires strict compliance to its benchmark specifications and full auditing of all published results by an official SPC auditor and full peer review following a successful audit. SPC member companies include virtually every key vendor in the industry, including Texas Memory Systems.

The Storage Performance Council is the first entity dedicated to helping users understand the value of storage performance and price: performance. Texas Memory Systems shares these objectives with the Storage Performance Council. Many storage benchmarks fail to replicate real world data access patterns. The SPC-1 performance benchmark was designed to accurately replicate real-world online transaction processing (OLTP). It is characterized by intense, random I/O requests made on the storage appliance. This benchmark is the first in a series of benchmarks to be established by the Storage Performance Council.

Initial, Audited Results of the RamSan® SPC-1 Benchmark
In March 2004, Texas Memory Systems and the Storage Performance Council broke all current I/O performance records while executing the first published SPC-1 measurement on a solid state disk—the RamSan-320.

The SPC auditor approved and submitted for peer review the following results:

Unit tested:	RamSan-320 (8 ports)
SPC-1 IOPS:	112,491.34
SPC-1 Price-Performance:	$1.50[1]
Total ASU capacity:	68.719 GB
Data protection level:	Other Protection Level
Audit Certification No.:	A00028

The Storage Performance Council SPC-1 results highlight that solid state disks are the best solution when you want the best performance and the best price: performance. When you look at cost per capacity only, solid state disks appear expensive. However, when you evaluate solutions to improve performance, **solid state disks offer the best value of any storage product**. In fact, the RamSan® produced better SPC-1 results than equipment priced nearly 10 times higher than the RamSan®. For details on other Storage Performance Council results, please see StoragePerformance.org.

[1] The SPC derives price from the total cost of the implemented solution, including Fibre Channel infrastructure and relevant support contracts. For details, see the SPC full disclosure report.

The SPC-1 analysis produced some additional interesting findings. First, the Texas Memory Systems test implementation is extremely simple. Where other storage products tested under SPC-1 have included dozens of host bus adapters and switched fabrics, the RamSan simply included eight servers each with one host bus adapter connected to the RamSan®. Secondly, the response time graphs from the test results show that, even under the heaviest loads, the RamSan® never took more than 70 microseconds to return data to the server. For other storage devices, as load increased response times increased. For test details, including the graphs mentioned here, see the full disclosure report on StoragePerformance.org.

Section 4

Results: Solid State Disk Storage Benefits

Replacing hard drive based storage with a RamSan® solid state disk has numerous benefits in improving I/O performance:

Improved Server Efficiency

When slow, conventional storage holds back the potential of expensive processors and servers, efficiency is reduced and money is wasted. Conversely, introducing a fast RamSan® solid state disk fully utilizes those servers, resulting in maximized return on investment (ROI). If your data only travels as fast as the slowest point in the network, then removing that bottleneck results in efficiency gains throughout the system.

Fewer Servers

The drive towards server consolidation means squeezing every drop of performance out of the remaining servers. When a RamSan® can improve server efficiency, then that efficiency increase can lead to server consolidation without performance loss. This is especially true in "server-bloated" environments, where adding additional servers or processing power solved the problem of I/O wait time. Consolidating servers and moving the hottest data to a RamSan® Solid State Disk reduces total cost of ownership (TCO) across the enterprise.

More Concurrent Users

When you install a RamSan® solid state disk, it typically takes the pressure off of whatever system was being thrashed in its place (a RAID array, server system memory, etc.). This approach frees up those resources for other applications and tasks. In the case of query-based applications, adding a RamSan® solid state disk can increase the number of concurrent users receiving their data at higher speeds. Conventional thinking suggests that adding concurrent users requires more servers. With the RamSan®, you scale concurrent users by improving server efficiency.

Faster Response Times

RamSan® solid state disks are famous for consistently decreasing the response times of demanding applications. Without mechanical storage devices to slow down performance, users and applications get data at the speeds they demand. At the core of any enterprise is a critical database. Whether employees, customers, or other servers query it, anyone can benefit from faster response times.

Increased Customer Satisfaction

In many environments, particularly online transaction processing (OLTP), increased customer satisfaction is the first priority. Eliminating I/O bottlenecks with a RamSan® solid state disk can improve the performance of all hardware depending on that data. Whether the application is e-commerce, OLTP, hot files storage, or any other use, higher performance, faster response, and greater transactions means increased user satisfaction.

Higher Profits

The Financial Industry knows the value of increased transactions per second. In this market, every additional transaction that the hardware can carry-out directly affects the bottom line. In such a situation, it is easy to see how the RamSan® solid state disk quickly pays for itself. This logic, however, can be applied to virtually any mission-critical application that requires a solid state disk to reach its potential. When you compare the cost of a RamSan® to alternative solutions that increase application performance from 2x to 10x, the choice becomes easy.

Section 5

Conclusion

Applications within the Financial Services Industry demand the highest performing environment. Solid state disk is the highest performing storage available and the RamSan® was able to achieve both the highest SPC-1 IOPS result and the lowest cost per SPC-1 IOPS. If you need performance, these results clarify that RamSan® solid state disks are the least expensive, simplest solution. Companies that have implemented solid state disk have seen numerous benefits to the bottom line by making better use of their existing servers, adding concurrent users, reducing response time delays, and improving customer satisfaction.

For more information on the Texas Memory Systems RamSan® product line, please contact Texas Memory Systems at 713-266-3200 or visit www.superssd.com.