

## Analyzing TCO for a Fiber Channel SAN and to Direct-Attached Storage

### Introduction

The growth of business data continues to explode, along with the need to store it. Workers generate more and more email messages and file attachments, users demand instant access to data like never before, IT managers install more storage-hungry applications, and aging paper-based data continues to be converted to digital form. Information growth is so intense, in fact, that spending on data storage is expected to outstrip server spending by 2005. And, according to a study by Merrill Lynch and McKinsey & Company, annual growth of data storage capacity will average a startling 76% over the next five years.

But with IT managers facing flat or shrinking budgets, the pressing challenge for them is to do more with less - to squeeze the most data storage out of every IT dollar. To achieve this objective, managers must start by assessing all data storage costs - those tied to initial equipment acquisition, as well as those for resource management, capacity use, and most importantly, system downtime.

For years, adding storage meant purchasing additional servers, tape libraries, and disk enclosures to attach to the server - a costly and inefficient approach that left large amounts of storage capacity and computing power unused. Today, storage area networks (SAN) - high-speed networks that connects multiple storage devices so that they may be accessed on all servers in a local area network (LAN) or wide area network (WAN) - have been proven to reduce management costs as a percentage of overall storage costs.

And there are many other benefits of SANs as well, including:

- Increased disk utilization
- Reduced data center/rack floor space
- Improved data availability
- Improved LAN/WAN performance
- Reduced storage maintenance costs
- Improved protection of critical data
- Reduced CPU loads on servers to free up more computing power

The iSCSI (Internet SCSI) protocol extends the cost benefits of SANs by allowing users to create storage networks using existing Ethernet technology, eliminating the need for costly proprietary alternatives such as fiber channel (FC). With iSCSI, expanding storage to keep pace with data growth is as simple and economical as purchasing a disk array or adding drives to an existing disk array.

But how can an IT manager gauge return on investment of an iSCSI SAN? One way is to determine total cost of ownership (TCO) for the iSCSI approach and compare it to the two alternatives: a fiber channel SAN or traditional direct-attached storage (DAS). This paper does just that, shedding light on how the iSCSI SAN is a cost-effective way for IT managers to scale storage to meet the demands of their burgeoning data growth.

## Disk Utilization

Storage must be flexible enough to allow for future growth. In a direct-attached storage (DAS) environment, this flexibility comes by purchasing enough storage capacity to meet current and future capacity demands, then using the unused capacity as your data growth warrants. But this approach reduces disk utilization and increases the cost of stored data as a percentage of storage capacity. By contrast, a SAN environment allows IT managers to maintain storage capacity in lockstep with actual need, thereby reducing storage costs.

The previously referenced study by Merrill Lynch and McKinsey & Company found that a typical DAS environment uses only about 50% of available disk space. The same study says disk utilization in a SAN averages about 85 percent, leaving only 15 percent of disk space unused, dramatically improving storage efficiency and return on investment.

## Backup and Recovery

Storage management also involves backup and recovery costs. In a DAS environment, there are three common backup options:

1. A tape drive or tape library attached to each server
2. A tape library attached to every other server (shared resource)
3. A tape library attached to a backup server(shared resource)

Only option 1 does not require backup data to travel over the LAN. However, the main drawback to option 1 is high cost. While tape drives are fairly inexpensive, individual tapes rarely provide enough storage space for backing up server data, forcing many IT shops to use tape libraries, which are expensive. For a better return on investment, many IT shops prefer to use a tape library for more than one server; the library, depending on size, is either attached to every other server (option 2) or to a backup server (option 3). The disadvantage of sharing a tape library in a DAS environment is that typically the backup data must travel over the LAN to reach the library, hampering both LAN and storage performance.

The key to high-performance, low-cost backup is a storage area network (SAN). A SAN can serve as the backbone of a high-quality, reliable tape library that provides centralized server storage. As such, the investment in a tape library can be spread across all the servers, also eliminating the performance issues associated with sending storage traffic over a LAN. In addition to providing centralized backup, SANs deliver better disk utilization and are much easier to scale than DAS.

### iSCSI SAN vs. FC SAN vs. DAS: A TCO Analysis

There are two types of costs associated with purchasing new storage. The first and most easily recognizable are the hard, or direct, costs. These costs bear directly on the IT budget and include capital spending, labor, outsourcing, professional services, support contracts, and training. Hard costs are usually out-of-pocket expenses at the time of purchase of new storage.

The second type of costs - soft, or indirect - are less tangible, and often hidden. They typically result from reduced staff productivity or lost business revenue when a system goes offline, such as for an upgrade, for repairs, or to accommodate large backup windows. Both hard and soft costs must be considered when calculating total cost of ownership (TCO) for any storage investment.

What follows is an analysis of what a typical company would go through in planning to expand its storage capacity by 2000GB (2TB) over the next 12 months, including how the company would calculate TCO for their various storage options. The types of storage the company is evaluating are:

- SCSI-based DAS
- SAN using high-performance but much costlier fiber channel
- SAN using low-cost iSCSI

In order to accurately evaluate its storage options, the company's IT management works with its finance team to determine the best value. The types of costs the finance team is most interested in are:

Hard Costs	Soft Costs
Total Acquisition Costs	Storage Availability
Total Annual Administration Cost	Cost per downtime hour (based on estimated downtime)
Total Capacity Utilization	

Factors most relevant to the IT team's evaluation include:

Hardware	Software
Installation	Administrative (discovery & configuration)
Support	Data management
Scalability	Reporting (usage & failures)

Using these criteria, both finance and IT would estimate TCO for each technology to determine its relative value. To complete the evaluation, IT would itemize the following hardware and software costs to deploy an iSCSI SAN, a fiber channel SAN, and a traditional SCSI DAS solution:

	DAS	iSCSI	FC
HBA / RAID Controllers	\$ 2,431	\$ 5,280	\$ 7,200
Switches		\$ 5,398	\$ 39,400
Cables	\$ 418	\$ 483	\$ 809
RAID Box / JBOD	\$ 12,787	\$ 23,947	\$ 60,778
HDD	\$ 18,357	\$ 18,357	\$ 18,870
Tape Library	\$ 15,039	\$ 13,889	\$ 13,889
TP Drives	\$ 10,438	\$ 5,219	\$ 5,219
Media	\$ 1,519	\$ 1,519	\$ 1,519
Cleaning TP	\$ 317	\$ 158	\$ 158
FC-SCSI RTR			\$ 4,149
Software	\$ 4,080	\$ 2,790	\$ 28,555
<b>HW &amp; SW Cost Total</b>	<b>\$ 65,386</b>	<b>\$ 77,040</b>	<b>\$ 180,546</b>

Once hardware and software costs have been estimated, the TCO and ROI for each technology can be calculated. Finance and IT work closely to develop a formula to calculate the TCO for both technologies.

### Determining Various Costs for This Project

#### *Administrative Costs*

The storage management ratio between DAS and SAN is 5:1 – meaning it takes five times as many administrators to manage DAS storage as the same amount of SAN storage. Additionally, one administrator can manage a maximum of 4800GB of SAN storage. Using the 5:1 DAS to SAN ratio, one administrator can manage 960GB of DAS storage.

### Capacity Utilization Costs

Based on the finding of the Merrill Lynch/McKinsey study that a SAN is far more efficient than DAS in using available disk space – 85 percent versus 50 percent disk utilization, respectively – a company doing a TCO analysis like this would calculate that a SAN provides 35% more storage available for future growth.

### Soft Costs

The primary factor used to determine soft costs in an analysis such as this is unplanned downtime. To calculate downtime, a company would review the reliability of its DAS system over the past year. Such a review in this sample analysis reveals 70 hours of unplanned downtime (5.8 hours per month), for 97.8% availability (based on 12 hours a day, 5 days a week). Based on industry data on SAN availability, a company could reasonably estimate that a SAN would experience only one hour of unscheduled downtime per year, for an overall availability of 99.96%. Thus, a company doing this analysis would base its soft-cost calculations on 97.8% uptime for a DAS and 99.96% uptime for SAN.

To determine the cost of downtime, a company doing this analysis could use the industry downtime cost estimates in "IT Performance Engineering & Measurement Strategies: Quantifying Performance Loss," an October 2000 report by the Meta Group. This study showed the average revenue lost per employee-hour for a 2,000-employee company was \$248.65, and the loss totaled \$497,300 if all systems went down during peak work hours. A company doing this calculation could assume that unplanned downtime would affect only 5% of its work force (a conservative estimate) and thus cost it \$24,865 per hour.

The table below shows total cost of ownership (TCO) for the first year of a SCSI DAS deployment versus both an iSCSI SAN and a fiber channel SAN. Because the revenue lost per employee-hour is subjective (depends on a variety of business specific variables) we have decided not to include the financial impact in the following table. As a guideline, the complete TCO for DAS could easily be 5-10 times more expensive than an iSCSI or Fiber Channel SAN.

Enterprise Storage Cost Comparison	DAS	iSCSI SAN	FC SAN
<b>Direct (Hard) Costs:</b>			
<b>Storage Acquisition</b>			
Planned Capacity - (12 Months) GB \$/MB	2,000 \$ 0.03	2,000 \$ 0.04	2,000 \$ 0.09
<b>Total Acquisition Cost</b>	<b>\$ 65,386</b>	<b>\$ 77,040</b>	<b>\$ 180,546</b>
<b>Storage Administration</b>			

Capacity per Administrator (GB)	2000 1.0	4800 0.4	4800 0.4
Number of Administrators Burdened Salary per Administrator	\$ 95,000	\$ 95,000	\$ 110,000
Total Annual Administrator Cost	\$ 95,000	\$ 39,583	\$ 45,833
Installation Installation Cost			
Capacity Utilization		\$ 800	\$ 5,000
Increased Storage to match SAN(GB)	50% 1,400	85%	85%
\$/MB	\$ 0.04		
Utilization Cost without SAN	\$ 45,770		
Total Cost of Ownership Based on Direct Costs	\$ 206,156	\$ 117,423	\$ 231,379
Total Cost of Ownership Based on Direct Costs (\$/MB)	\$0.10	\$ 0.06	\$ 0.12

#### Other Factors: Existing Infrastructure and Staffing Expertise

In this example, the company's existing IT infrastructure consisted of multiple Ethernet switches it could leverage to transfer data to remote or off-site locations for data mirroring using the iSCSI SAN approach. In addition, its IT staff required no extra training to manage and maintain an iSCSI SAN, since it was well-versed in Ethernet technology. Thus, using this existing infrastructure results in very clear staffing, scalability, and TCO advantages.

#### Conclusion

A thorough calculation of all hard costs has shown that, while a traditional SCSI DAS deployment has the lowest acquisition cost, it bears a much higher total cost of ownership (TCO) than either a fiber channel SAN or an iSCSI SAN. Additionally, the TCO of a fiber channel SAN is more than 1.6 times that of an iSCSI SAN.