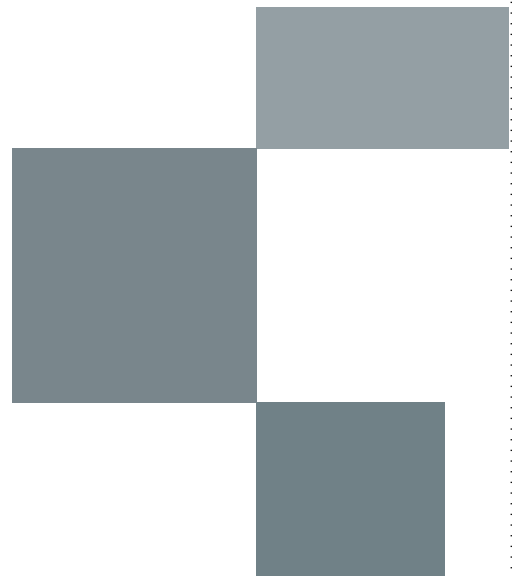


Extending D2D to Offsite DR: The ROI Case for WAN Vaulting

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Executive Summary

Inexpensive disks and new deduplication techniques with data reduction ratios greater than 20:1 have created an entirely new paradigm in data protection, offering significant operational benefits, and huge cost savings. Users are shifting their long-standing tape backup strategies to disk-to-disk (D2D) solutions, allowing them to retain months of data on disk, and greatly reducing their use of tape backup. The results are an excellent Return on Investment (ROI), reduced Total Cost of Ownership (TCO), and an extremely fast payback.

Furthermore, deduplication techniques are not limited to storing data on disk. By applying these advanced techniques to the transport of data across the WAN, this new paradigm of disk-based data protection can be extended to include multiple sites. The significant size reduction resulting from deduplication makes it possible for the reduced backup data to be vaulted over the WAN, expanding the benefits beyond local backup to include remote office data protection, multi-site tape consolidation, and offsite Disaster Recovery (DR) through optimized WAN Vaulting.

In addition to the improvements in operational efficiency and peace of mind from an automated and efficient Disaster Recovery plan, WAN Vaulting offers strong financial benefits. The results achieved by Data Domain users in the case studies presented in this paper include total savings of \$811K to \$1.16M, ROI of 100%-350%, and payback periods of 3-5 months. Clearly, there are strong financial reasons for users to move to this new paradigm.

This paper describes the benefits of deduplication and D2D backup and how it can be extended to deliver cost-effective offsite data protection and DR. It

demonstrates how to build a business case for WAN Vaulting, using direct and indirect savings, TCO, ROI and payback periods. Two case studies are presented covering actual users who have implemented WAN Vaulting for remote office data protection and Disaster Recovery. (Appendices include additional background information on the financial analysis used, the effects of D2D and WAN Vaulting on TCO Components, issues involving tape versus disk backup, and additional information on deduplication technology.)

As IT organizations consider how best to meet their increasing data protection and DR requirements, D2D is fast becoming a fundamental element. WAN Vaulting leverages D2D and deduplication technology, and extends the benefits to the network, driving a strong business case for WAN Vaulting.

The New Paradigm for Disk-based Backup and DR

With the advent of ATA disk technology, the base cost of disk has dropped to within the same range as tape. A simple cost comparison from W. Curtis Preston shows a midrange tape library at roughly \$4 to \$11 per gigabyte (GB) with disk prices hovering around \$3 to \$11 per GB without compression or deduplication. This drop in price has established the financial viability of disk-to-disk (D2D) backup, without even including the intangible benefits such as improved reliability and time to recover, or the added cost improvements of deduplication.

Data Reduction and Deduplication

Going one step further, the most significant change in cost comparison comes from the introduction of a new technology called data deduplication or data reduction. Deduplication is based on the ability to massively reduce data down to its smallest possible

size, in the amount of bytes stored. Though the algorithms and techniques vary across vendors, in general, deduplication uses redundant pattern recognition at a granular level, and goes far beyond traditional compression techniques (which generally yield compression ratios of 2:1). Deduplication technologies have shown data reduction ratios of 20:1 and more, in real customer environments. The case studies discussed here have seen ratios of up to 34:1. (For more information on how deduplication technology works, see Appendix E).

Extending the Paradigm over the Network - WAN Vaulting

With this 20:1 data reduction potential, D2D and deduplication provide an excellent option for local backup. In addition, these technologies can be used to address the offsite requirements of DR and regulatory compliance (often with very specific geographic distance requirements). By applying the 20:1 data reduction factor over the WAN, *deduplication can greatly reduce the network bandwidth requirements for offsite replication, making the transfer of large amounts of data across the WAN possible.*

D2D with deduplication and network replication between appliances brings a new alternative for meeting offsite DR requirements without shipping tapes. Furthermore, if there are multiple remote offices, (particularly if there is limited remote technical expertise), replicating over the WAN allows data protection to be centralized. This can eliminate remote office tape backup altogether, providing both centrally managed data protection and automated offsite DR for the remote and central offices.

Optimized WAN Vaulting - utilizing deduplication technology with the resulting data reduction factor of 20:1 - enables large volume data replication over the WAN, extending the new paradigm of disk based data protection to include remote office consolidated data protection and offsite DR.

Data Domain: An Innovative Leader

Data Domain has been a pioneer in combining inexpensive disk technology, a non-disruptive implementation, data deduplication, and cost-effective WAN Vaulting. With 3 U.S. patents granted and more than a dozen pending (all involving efficiency in data storage systems), Data Domain continues to be strong leader in developing and extending this new paradigm.

Data Domain holds a unique position in the marketplace, as the only array achieving data reduction ratios averaging 20:1 using off-the-shelf backup software. Data Domain storage protection solutions, with their Global Compression deduplication technology, bring the cost per Gigabyte down to \$0.35 per GB, and falling.

The Data Domain family of storage protection products can be used as onsite retention/local backup/restore, and, via optimized WAN Vaulting, for offsite DR, multi-site tape consolidation and remote office data protection.

"By applying the 20:1 data reduction factor over the WAN, deduplication can greatly reduce the network bandwidth requirements for offsite replication, making the transfer of large amounts of data across the WAN possible."

Building the Business Case

Although many users are moving to D2D and WAN Vaulting without conducting a full financial analysis, for those IT organizations that require TCO, ROI, Payback, or other financial analysis measures, building a business case is straightforward. (For example, in some companies, project funding approval may be based on comparative TCO numbers, or may require ROI to be above a certain percentage, or the payback period to be within some time period, e.g., < 1 year.)

Financial Analysis Measures

The financial analysis measures used in these case studies include:

- Savings - Direct, Indirect and Net Savings
- TCO
- ROI
- Payback period

Direct Savings are any direct cost reduction where cash outflow is reduced. Savings in user or IT staff time are considered Indirect Savings. Net Savings is total savings minus total costs. TCO (Total Cost of Ownership) is the cumulative, fully loaded cost of a project over time (typically 3 years for IT), and incorporates financial changes over that period such as those based on data and storage growth.

ROI is total savings minus total costs divided by total costs, expressed as a percentage. Payback period is the amount of time it takes for a project to pay for itself. (For more detailed definitions, see Appendix A.)

TCO categories used in this paper are **Hardware, Software, Support, Supplies and Services.**

Effects of D2D and WAN Vaulting on TCO

A key part of the financial analysis presented here is based on the effects of D2D and WAN Vaulting on individual TCO Components. Appendix B shows the components within each TCO category, the effect of D2D and WAN Vaulting on that component, and how the costs and savings are calculated.

Given these savings, building a financial case for D2D and WAN Vaulting is not difficult, even if you still continue to use tape for archiving, etc. This paper presents two case studies of users who have moved to D2D and WAN Vaulting, with significant cost savings and improved operations.

Key savings derived from D2D for Backup, Remote Office Protection and DR:

- **Hardware:** eliminating (any or additional) tape libraries, drives and/or media servers in local and remote offices
- **Support:** reducing tape mounts, and tape handling labor, saving IT and end-user time due to faster restores
- **Supplies:** reducing the number of tapes
- **Services:** reducing tape storage, transportation and recall costs

Case Study 1: Multi-Site Data Protection and DR

Case study #1 is based on the experience of an international investment banking company who viewed their existing tape backup situation as a “logistical nightmare.” With 62 TB of storage, 3500 tapes, multiple sites, and ongoing tape problems, there were major concerns over tape drive failures, missing backup windows, increasing risk of lost (unencrypted) tapes, and an insufficient DR plan for the very stringent criteria in the financial industry.

By moving to WAN Vaulting for data protection and DR, they eliminated their remote office tape hardware and storage contracts altogether and now vault all backups to one location. Backup data is

then vaulted to their DR site, and archived to tape (now encrypted) quarterly (see Figure 1). Instead of having to spend an additional \$242K on tape libraries and encryption hardware to meet backup windows at all their sites, they have reduced tape operations to one site and now meet their backup window consistently. The transition was so smooth, that they cutover all servers in all locations in three days. (For more detail on the financial numbers in the case studies, refer to Appendix A).

“The transition was so smooth, that we cutover all servers in all locations worldwide in three days.”

-VP Engineering Services
Case Study #1

Figure 1 - Data Domain for Multi-Site Data Protection & Offsite DR (Case Study #1)

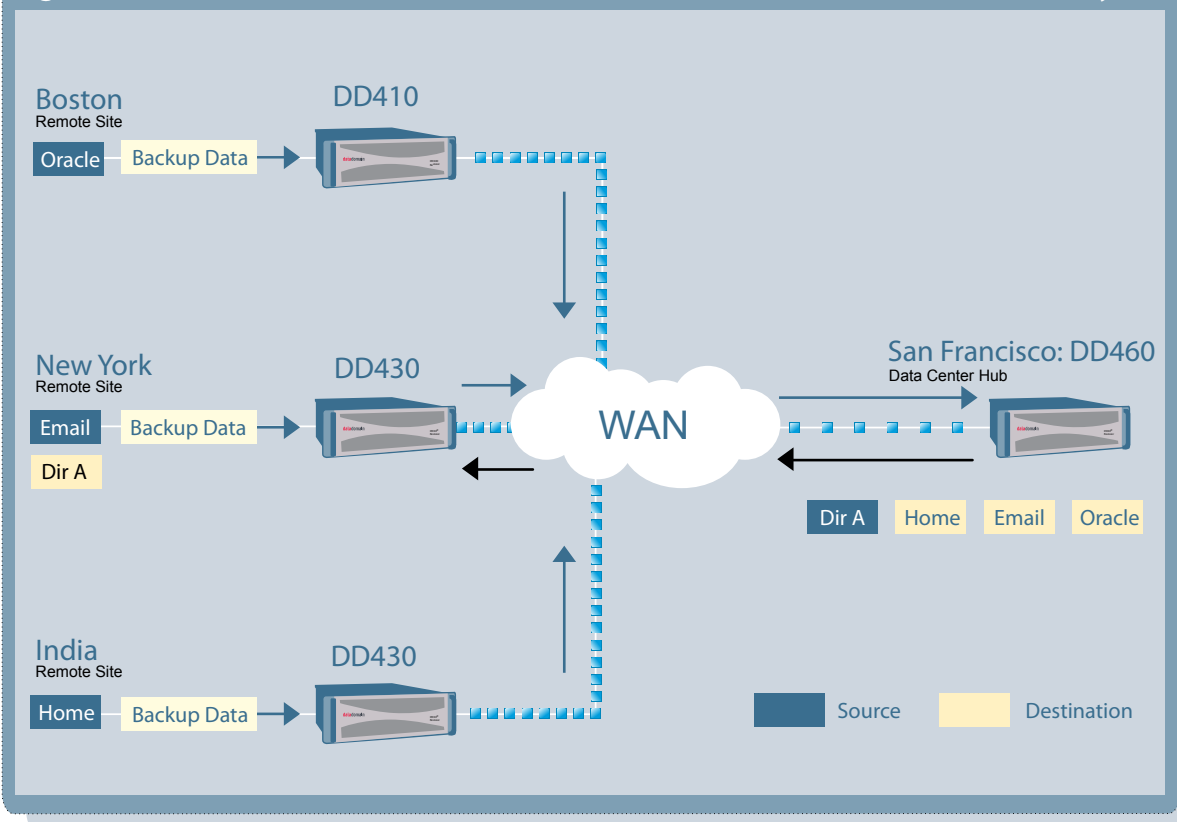


Figure 2 shows the key financial benefits of their transition to Data Domain. Over 3 years, this summary shows a total savings in TCO of \$901K, an improvement of 51%, resulting from:

- avoiding the cost of upgrading their tape hardware to meet their requirements
- reducing their tape media, transportation and tape storage costs
- eliminating thousands of hours of tape handling

Tape media costs (measured here in cost per TB per year) were reduced by 43%, with a 3-year savings of over \$75K. Offsite tape storage and transportation costs were reduced by 50% with a 3-year savings of \$75K. Backup and recovery times were also reduced by 48%.

Figure 2 - Savings and % Improvements

	Units	Tape Only	D2D Data Domain	% Improvement	Savings over 3 Years
3 Year TCO per TB	Cost / TB	\$6,855	\$3,368	51%	\$901,915
Tape Media Cost per TB	Cost / TB / Yr.	\$19,444	\$11,111	43%	\$75,000
Offsite Storage & Transportation Costs	Cost / TB	\$581	\$290	50%	\$75,105
Backup Window	Hours	56	29	48%	N/A
RTO (Recovery Time Objective)	Minutes	120	10	92%	N/A
Data Kept Online	Months	0	1 to 3	-	N/A

*Case Study 1

Figure 3 shows the relationship between costs and various savings, by year and cumulatively, as well as the total Net Savings. Avoiding the initial tape upgrade resulted in a major hardware savings in year 1, which over time is almost matched by the ongoing savings in labor. As the chart shows, the largest chunk of cumulative savings comes from the cost avoidance in labor, followed closely by the cost avoidance in hardware.

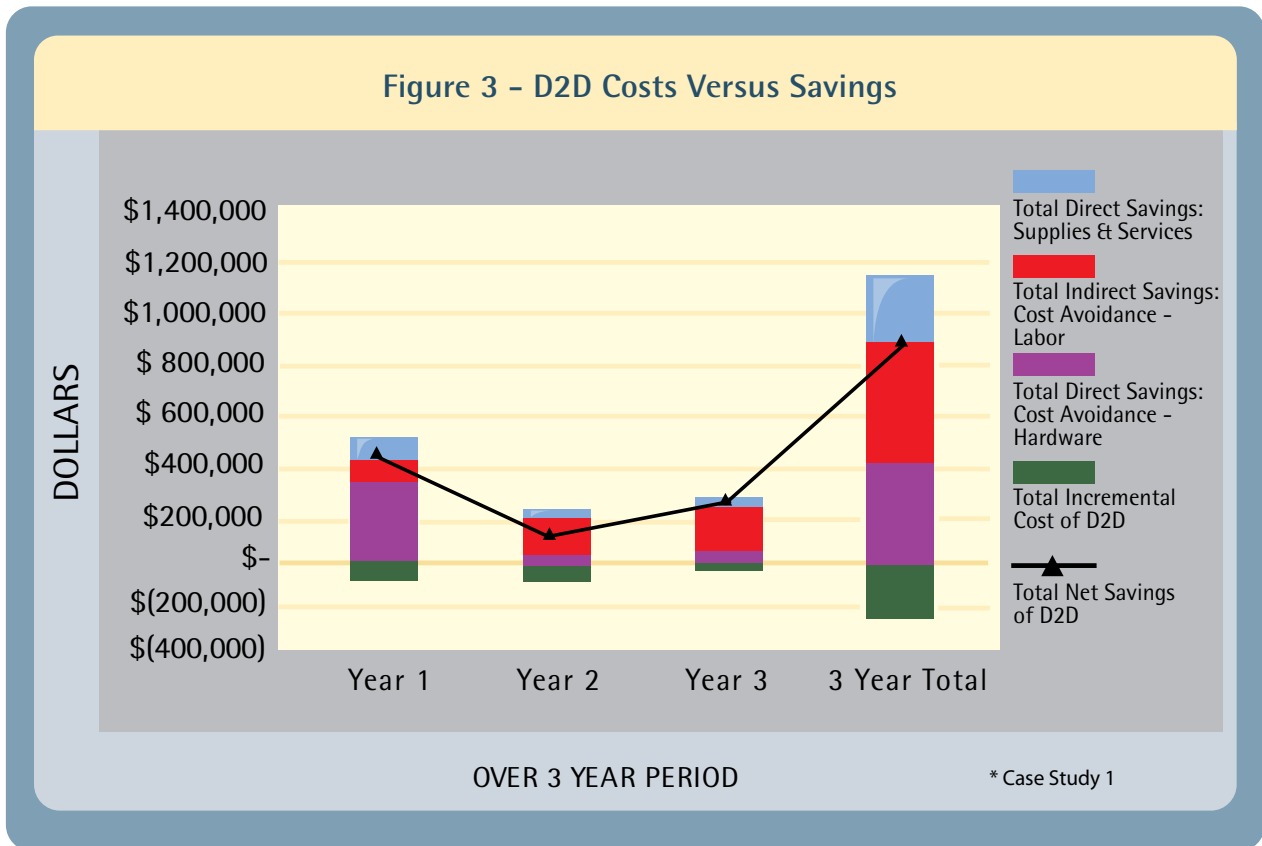


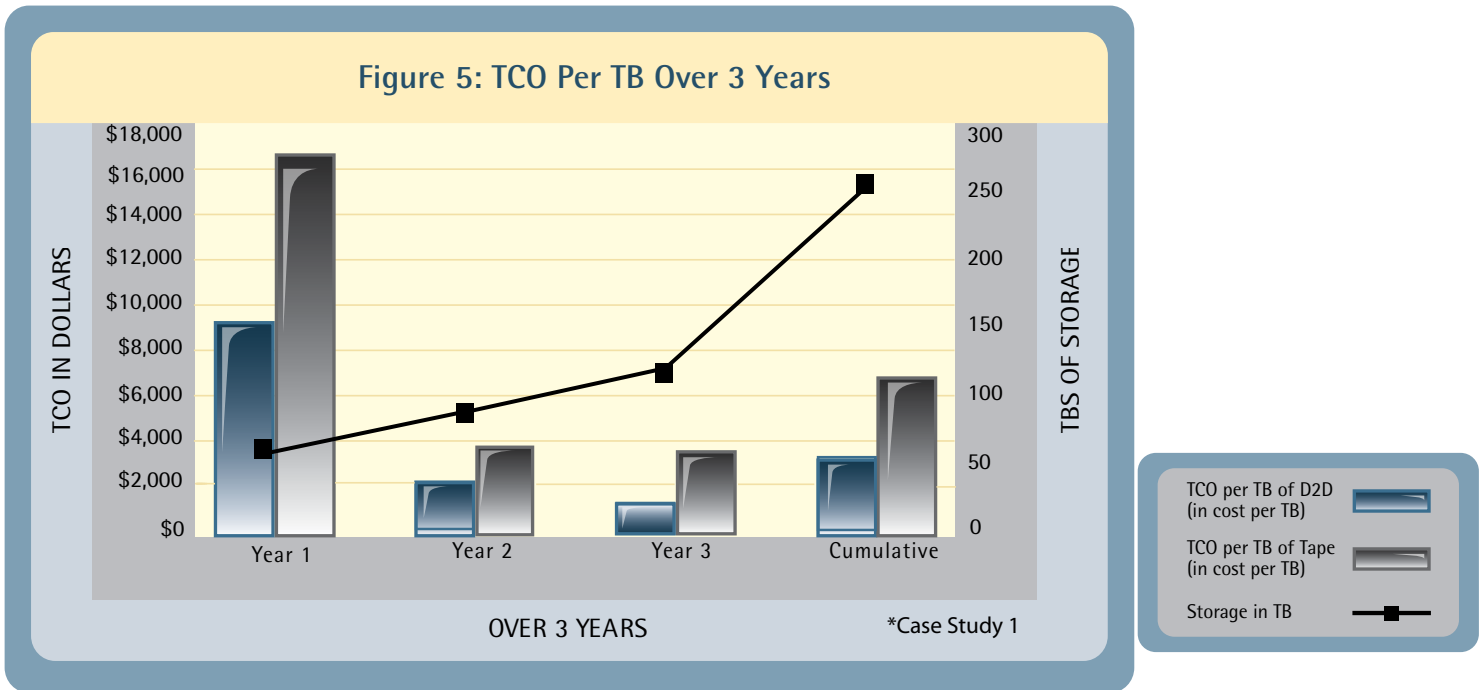
Figure 4 shows the summary for costs and savings. It also shows a payback period of 3 months, and an ROI of 350%.

Figure 4 - Financial Summary

Savings	Year 1	Year 2	Year 3	Total
Direct Savings- Supplies & Services	\$115,700	\$54,945	\$74,176	\$244,821
Cost Avoidance- HW	\$335,120	\$51,120	\$51,120	\$437,360
Cost Avoidance – Labor	\$114,400	\$154,440	\$208,494	\$477,334
Total Savings	\$565,220	\$260,505	\$333,790	\$1,159,515
Costs				
Total Incremental Cost of D2D	\$120,000	\$101,600	\$36,000	\$257,600
Summary				
Total Net Savings of D2D	\$445,220	\$158,905	\$297,790	\$901,915
Payback (in Months)				3
ROI (3 Years)				350%

*Case Study 1

Lastly, Figure 5 shows the TCO as calculated per TB, over three years, for D2D using Data Domain systems and WAN Vaulting, versus the TCO per TB for Tape only. It also shows the cost per TB decreasing over the three years, while the amount of storage increases (see secondary y-axis for TBs of storage).



Case Study Study 2: Distributed Remote Offices – Consolidating Data Protection and DR

In case study 2, a highly distributed user in the legal industry with 7 TB of email (Exchange) and other critical data, implemented Data Domain to solve a variety of problems. Tape issues included lost email data due to bad tapes, repeated tape failures, a variety of outdated tape technologies, and tape libraries coming off lease. In addition, they were not meeting their backup windows and had problems with their remote sites. With no technical staff at the eight remote offices, and no centralized management of backup or disaster recovery plans, they had a great deal of difficulty with both reliable backups and with restoring at the distributed sites. With limited bandwidth between sites, they had no way to perform any backup/restore or DR over the WAN.

Implementing Data Domain in each site provided automated and reliable backup for each site, as well as Disaster Recovery through WAN Vaulting (made possible over their limited bandwidth through Data Domain's deduplication and optimized replication).

"Data Domain solves our backup issue at all sites, and makes it possible to do the replication across the WAN within our constrained bandwidth. Our compression rates exceed the average 20:1 as advertised by Data Domain, and in fact, we're seeing up to 35:1 compression. Data Domain has allowed us to do a complete replacement of tape technology at our remote sites for both backup and DR".

- IT Manager
Case Study #2

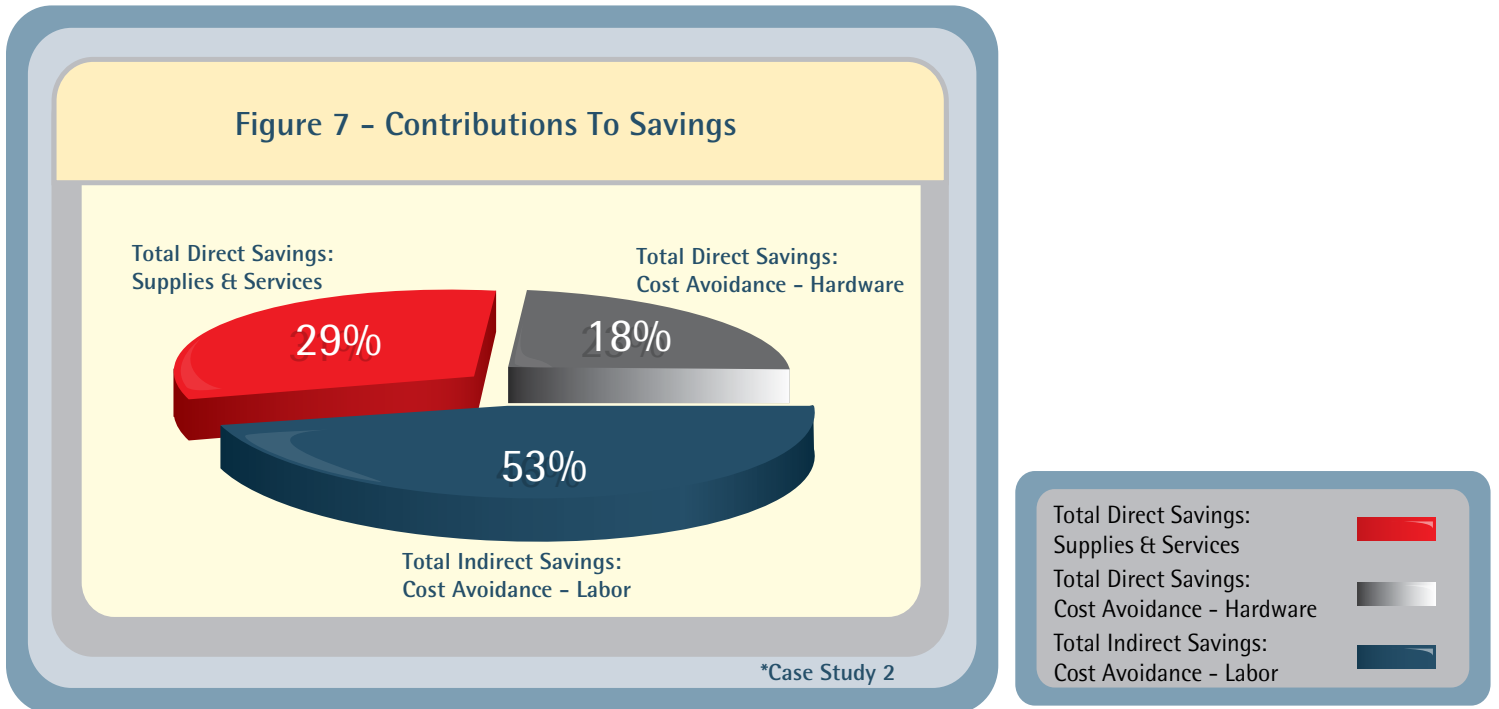
As shown in Figure 6, the savings in labor alone (\$428K) paid for the Data Domain hardware. Even with the purchase of 13 Data Domain systems with Replication to handle all the distributed sites, the payback period was only 5 months, with a net savings over 3 years of \$405K and an ROI of 100%.

Figure 6 - Financial Summary

Savings	Year 1	Year 2	Year 3	Total
Direct Savings- Supplies & Services	\$91,200	\$62,370	\$84,200	\$237,770
Cost Avoidance- HW	\$115,000	\$15,000	\$15,000	\$145,000
Cost Avoidance – Labor	\$102,648	\$138,575	\$187,076	\$428,299
Total Savings	\$308,848	\$215,945	\$286,275	\$811,068
Costs				
Total Incremental Cost of D2D	\$135,400	\$135,400	\$135,400	\$406,200
Summary				
Total Net Savings of D2D	\$173,448	\$80,545	\$150,875	\$404,868
Payback (in Months)				5
ROI (3 Years)				100%

*Case Study 2

As shown in Figure 7, over the 3-year period, labor represents the majority of the contribution to savings (at 53%), a result of the elimination of tape handling from all remote sites, and the redeployment of one Full-Time Equivalent (FTE) to other (more interesting) work.



Conclusion

This paper has presented both the direct and indirect savings possible by extending advanced deduplication technology to optimize WAN Vaulting for remote office data protection and DR. With the kind of ROI achieved by Data Domain users in these case studies (100%-350%), along with the Total Net Savings (\$400K to \$900K) and the types of payback periods they experienced (3-5 months), it is clear that Data Domain offers proven cost savings and a strong, persuasive business case for WAN Vaulting.

By leveraging their sophisticated deduplication technology, Data Domain extends the benefits of the new disk-based backup paradigm, over the WAN, and brings new possibilities to IT organizations with remote office data protection, multi-site tape consolidation and DR requirements.

Appendix A: Financial Analysis Terminology

TCO (Total Cost of Ownership)

A TCO model establishes a fully loaded, total cost of a project over time. Decisions are made by comparing the TCO of one approach to the TCO of another. TCO is a cumulative number, over some period of years (typically 3 for IT), and incorporates the changes in costs and benefits over that period (e.g., due to data and storage growth). TCO includes capital acquisitions, maintenance and operational costs, and should include both direct (e.g., hardware and software acquisition, salary costs of Full Time Employees (FTEs)) and indirect (often difficult to quantify, e.g., cost of waiting for a file to be restored) cost components. The TCO categories used in the paper are **Hardware, Software, Support, Supplies and Services**. Salaries generally are based on a 30% burden rate, to cover insurance, benefits, etc.

ROI (Return on Investment)

ROI is a measure of the financial return on an investment over a specified period of years (typically 3 for IT), represented as a percentage. A minimum ROI may be required by corporate finance departments in order to get approval on a project/acquisition.

Payback

Payback period is the amount of time it takes for a project to pay for itself or break even, such that the cash flow becomes cash positive for all aspects of the project.

Total Savings

Total Savings is the amount of both direct and indirect dollar benefit resulting from the project.

Net Savings

Net Savings is the net amount saved over a given time, calculated by subtracting the costs for that time period, from the total savings for that time period.

Direct Savings

When the project results in a direct cost reduction, where cash outflow is reduced, these reductions are direct savings. Significant direct savings described by users in this paper's case studies include:

- **Supplies & Services**

These types of direct savings involve a reduction in the total cost of tape media, and the services to transport and maintain those tapes offsite. For users with a large number of tapes, these savings alone can be staggering. Both users profiled in this paper experienced savings of over \$200K over 3 years.

- **Cost Avoidance in Hardware**

These savings are the result of eliminating the need to purchase additional tape hardware to complete backups within the available backup window, as well as for performing tape backup in remote sites. For users already up against the window, or for users eliminating tape in remote sites, this can be the largest percentage of savings. By avoiding upgrades to their tape libraries as well as avoiding extra tape encryption hardware, the user in case study #1 saved \$335K in year one.



Indirect Savings

When implementing a project can save time (for IT staff or end-users), the result is considered indirect savings.

- **Cost Avoidance in Labor**

Labor cost avoidance is time saved by backup administrators, systems administrators or end users as a result of implementing the project. This savings would allow the user the choice of either spending time on other projects, or potentially reducing headcount (of Full Time Equivalents or FTEs). For purposes of this paper, this category is calculated as a cost reduction. The users profiled here saved in excess of \$400K each over 3 years.



Appendix B: Effects of D2D & WAN Vaulting on TCO Components

TCO Category	TCO Component	Effect of D2D	Calculation of Costs/Savings
Hardware	Tape Backup HW & Maintenance	Reduction or elimination of need for any or additional tape libraries, drives or media servers in local and/or remote offices	No additional tape HW, possible elimination of current HW, avoidance of future HW
	D2D Backup HW & Maintenance	Incremental cost of D2D HW for storage and WAN Vaulting/replication	Incremental initial costs plus any add'l required over 3 yrs
Software	Backup SW Licenses & Maintenance	With D2D, no additional SW. Avoids cost of add'l backup licenses	Subtract cost of add'l licenses required by tape backup
Support	Labor (Backup Admin FTEs)	Reduced labor in tape mounting, handling and transporting from remote offices	# of hours saved per week
	Labor (Sysadmin, Backup admin FTEs)	Time saved due to faster restores	# of restores per week times # of hrs saved per restore due to data being kept online
	Labor (Sysadmin, Backup admin FTEs)	End-user time saved/yr due to faster restores	# of users affected times # of restores per week
Supplies	Tape Media	Reduction in tapes	Reduced # of tapes in inventory and added per year (after implementing D2D) times cost of tape
Services	Offsite Tape Storage & Transportation	Reduction in storage, transportation and tape recall costs. Potential elimination of service contracts at remote sites	Average reduction in invoiced costs after implementing D2D

Appendix C: Case Study Details

	#1	#2
Amount of Storage in TB	62	10
Amount of Data in TB	9	7
% Growth over 3 years	35%, 35%, 35%	35%, 35%, 35%
Number of Tapes Before D2D	3,500	1,300
Number of Tapes After Implementing D2D	200	250
Offsite Storage Costs Per Yr Before D2D	\$36,000	\$24,000
Offsite Storage Reduction w D2D (yr 1)	\$18,000	\$19,200
# FTEs for Backup and Support	.5	2
Tape handling hours saved/year	988	2080
Admin time saved/yr due to faster restores	26	52
User time saved/yr due to faster restores	130	52
Data kept online after D2D	1-3 months	3 months
Data Reduction Ratio with D2D	Range of 17 to 29:1	Range of 20 to 34:1
Backup Window before and after D2D	56 hrs to 29 hrs	11 hrs to 15 min
Recovery Time Improvement	120 min to 10 min	20 min to 2 min

Appendix D: Tape versus Disk Backup

Data protection, backup and recovery have been based on tape for the last twenty-five years, for one main reason - cost (per MB, GB, TB). With the advent of inexpensive ATA (Advanced Technology Attachment) and Serial ATA disk, as well as new compression-related technologies, times have changed. While perhaps not quite as reliable, SATA is good enough and cheap enough to have started a revolution and created a paradigm shift. Welcome to the reality of disk-based data protection, with dramatic improvements in speed and reliability.

According to an Enterprise Strategy Group study in March 2005, 18% of respondents have already replaced their tape libraries with disk-based alternatives, and another 58% would consider it. Eighty percent of respondents stated they would begin to replace some of their existing tape infrastructure with disk within 24 months, with 40% saying they would do so within 12 months.

In a Purchasing Intentions Survey done in March by Storage Magazine, 54% of the respondents were increasing their D2D spending. For the first time, ***remote replication spending surpassed offsite tape spending as the primary focus for Disaster Recovery.***

Clearly, the move to disk-based protection is well under way.

Tape Backup Problems

The shift to disk backup is in large part fueled by a variety of problems with tape backup. Many of the savings included in this analysis of Total Cost of Ownership (TCO) and Return on Investment (ROI) come from solving these problems.

The most disconcerting issue with tape backup is that you never know if a backup tape is good until you really need it. Diogenes Analytical Laboratories, an IT advisory company that performs independent product lab evaluations and advises IT buyers, estimated that between five and twenty percent of nightly tape-based backup/recovery jobs fail on average. The most common problem - media failure (e.g., lost, damaged, or corrupted tapes).

Operational errors run a close second, including operator (human) errors (storing the wrong tape) and procedural errors (backing up wrong or empty files). Any time there is human intervention, the opportunity for error increases dramatically.

With analysts generally estimating IT management costs at five to seven times the cost of capital expenditure, TCO analysis must consider operation and administrative costs (including media management and tape swapping) in addition to acquisition costs. Tape media costs (which come from the expense versus capital budget) must be included as well.

In addition to normal data growth, regulatory compliance (Sarbanes/Oxley (SOX), SEC 17a, HIPAA, Patriot act, Freedom of Information Act, etc.) is contributing exponentially to data growth, as more records are generated, more regulations are created in more industries, and as we move further into the retention periods in year/decades. Including compliance and other factors, analyst predictions for data growth range between 50% and 100% growth per year.

Growth eventually forces users into a decision on whether to spend money to upgrade tape backup equipment (additional libraries, more or faster tape drives, new tape formats) or to spend money on other alternatives. For example, the user in Case Study #1 needed to upgrade their tape library to upgrade/add more drives because they were missing their backup window. They also needed to add encryption to all their tape hardware, due to the fear of lost (unencrypted) tapes. This caused them to do a financial analysis of tape versus disk backup.

Also, with Disaster Recovery (DR) continuing to be one of the top IT priorities identified by users, Recovery Time Objectives (RTO), or the amount of time it takes to recover, may be the final driver in evaluating alternatives to tape. If your RTO is measured in minutes rather than hours, it is time to look at disk-based protection.

Since traditional backup methods create large volumes of data, often too large to be replicated across the bandwidth constrained WAN, DR strategies have traditionally relied on tape. New capabilities in disk-based protection are changing this as well, enabling the WAN to become a key component in DR, and reducing or eliminating the need for multiple site tape creation.

Appendix E: Deduplication Technology

Deduplication works somewhat like traditional compression techniques, but it goes one big step further. Traditional compression techniques identify repeating characters or simple patterns, and represent them using that character or pattern and the number of repetitions. With deduplication, a data object such as a file or a network transmission is analyzed and broken down into pieces, or chunks. Any unique chunks are identified and stored only once, along with instructions for where repetitions of those chunks are to be re-assembled into the data. Any repeated chunks (e.g., a graphic, a commonly used paragraph, a section of source code, etc.) will only be stored once, along with instructions for where it is to be re-assembled. Thus, duplicate files require nothing but instructions. In addition, when data changes, only new non-unique parts are stored, along with any new instructions (as opposed to storing an entirely new file on each backup). Since a large majority of day-to-day operations involves only small changes relative to the size of the data, this means that over time, the efficiency of deduplication increases, often dramatically.

About the Author

Barb Goldworm is the founder and President of Focus Consulting, a research, analyst and consulting firm focused on systems and storage. Barb has spent thirty years in the computer industry, in various technical, marketing, sales, senior management, and industry analyst positions with IBM, Novell, StorageTek, Enterprise Management Associates, and multiple successful startups. A frequent speaker at industry events worldwide, Barb currently chairs the Server Blade Summit conference, created and chaired the Storage component of Networld+Interop, and has been one of the top three ranked analyst/knowledge expert speakers at Storage Networking World. She has also been a regular featured analyst speaker for TechTarget and Ziff Davis, as well as a regular columnist for publications including NetworkWorld, ComputerWorld, Storage Networking World Online, and TechTarget SearchServerVirtualization. She has authored numerous business and technical white papers on systems and storage, storage networking, and enterprise management, and has just finished a book, *"Blades Servers and Virtualization: Transforming Enterprise Computing While Cutting Costs"* published by Wiley (available on Amazon.com). Barb can be reached at barbgoldworm@focusonstorage.com.

About Data Domain

Data Domain is a leading provider of Enterprise Protection Storage systems for disk backup and network-based disaster recovery. Over 750 companies worldwide have purchased Data Domain's award-winning solutions to reduce backup costs and simplify their data recovery. Data Domain's Global Compression™, data invulnerability and replication technologies offer breakthrough data reduction rates that enable new efficiencies in enterprise data protection. Data Domain delivers the performance, reliability and scalability to address the data protection needs of enterprises of all sizes. Data Domain's products and solutions integrate into a customers' existing infrastructure and are compatible with leading enterprise backup software products. To find out more about Data Domain, visit www.datadomain.com.

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