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Reexamining Tape Media Reliability: What Customers Should Know

Enterprise Computing & Networking
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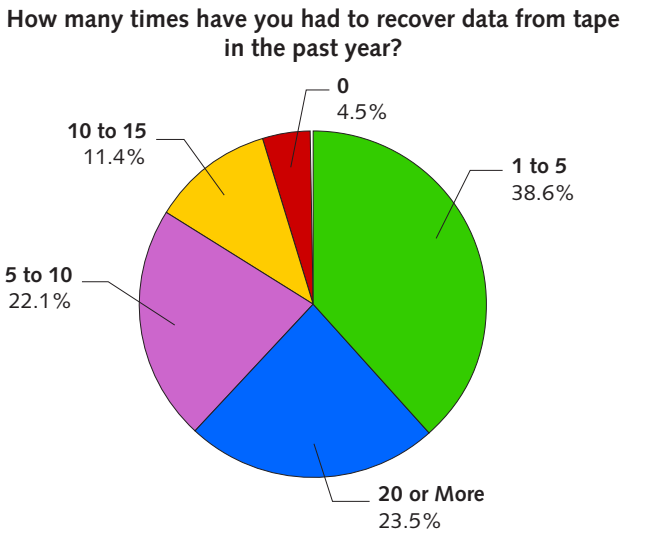
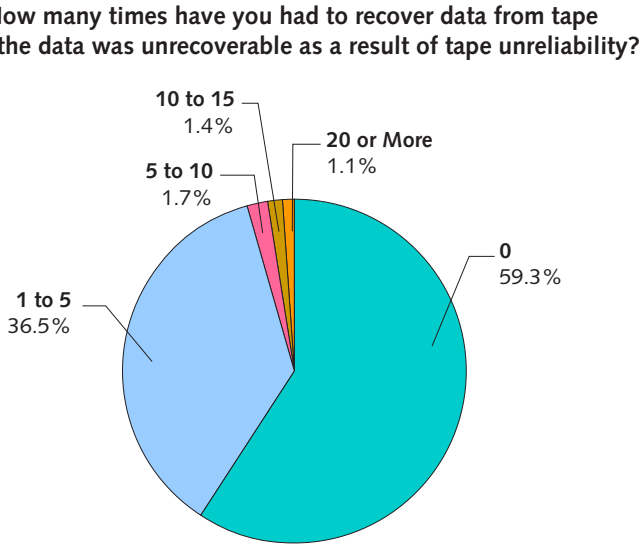
Executive Summary

Tape continues to be one of the most commonly used storage mediums for backup, archiving and remote site disaster recovery. Disk-to-disk systems are an emerging alternative that puts pressure on tape vendors to provide better platforms. In addition, new compliance regulations affect the storage operations of both enterprises and small and medium-sized businesses, leading to higher stakes in data protection. As a result, customers rank tape media reliability as a key buying criterion for tape cartridges. No doubt, one reason for this is recent customer experience. A Yankee Group/Sunbelt Software survey of 362 IT executives in March 2004 found 40.7 percent of respondents had been unable to recover data from tape in the last year as a result of tape unreliability (see Exhibit 1).

The industry challenge remains accurately measuring tape media reliability with real-world benchmarks and metrics. Many tape media manufacturers point to one or two key metrics to demonstrate their reliability without a clear context for application within real customer environments. In this custom research report, the Yankee Group examines the issues surrounding tape media reliability, tape reliability metrics customers should consider, recent customer perceptions about tape reliability, and how one tape media manufacturer—Hewlett-Packard (HP)—is addressing tape reliability.

Exhibit 1
Customer Recovery of Data from Tape
Source: Sunbelt Software and the Yankee Group, 2004





Note: Totals may not equal 100% due to rounding.

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I. Introduction

Tape media reliability is an age-old industry issue; something that customers have had varying experiences with in recent years. Growing data protection requirements from regulations such as Sarbanes-Oxley, HIPAA and SEC 17a-3 make the issue of reliable data protection much more important. Additionally, customers are deploying data retention strategies that preserve a mixture of corporate information such as intellectual property, corporate accounting ledgers, personnel records and other documents.

The importance of tape reliability has also increased based on what customers currently use tape for: a mixture of different storage operations focused on data protection. Approximately 65.2 percent of customers polled in a recent Yankee Group/Sunbelt Software survey use tape systems to support backup operations. Additionally, 61.3 percent use tape for disaster recovery, 29.8 percent for archiving and 15.2 percent for compliance/data retention requirements.

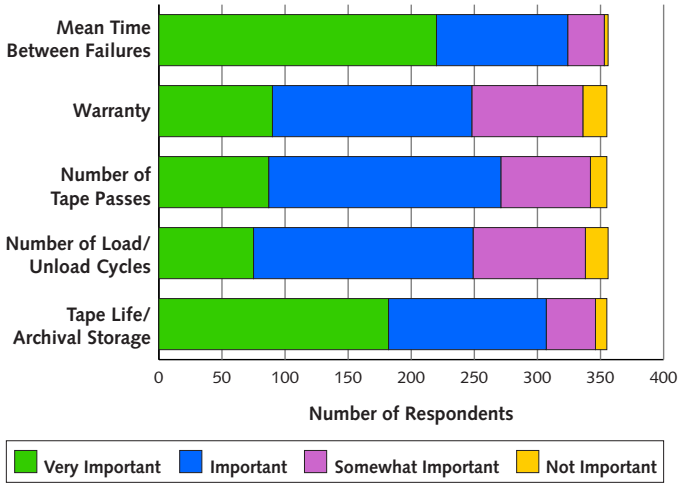
These new corporate responsibilities to improve data retention and data protection strategies shed new light on how to gauge tape reliability. When considering backup and recovery strategies, recovery takes priority in most enterprises. For some time, customers have said that backup completion rates tend to be a significant problem for many companies, affecting the recovery of important data in the event of corrupted data sets, disaster recovery during an outage, and even routine restores.

Customers suggest their dependency on tape systems to assist with data recovery has grown. Close to a quarter of customers (23.5 percent) have had to recover data from tape systems 20 times or more in the last year, with an additional 33.5 percent recovering data 5 to 15 times during the same period, according to recent survey results.

So, although tape has come under scrutiny for reliability, it is important to remember that tape media reliability is just one element of a much larger ecosystem that involves multiple layers, such as disk systems, backup software, media management software and storage networks. Often, reliability issues surrounding tape may in fact be related to a mixture of other issues that involve backup software, storage networks or the primary storage platform.

Customers' buying decisions on tape media largely have depended on a number of factors—the first being tape reliability, which ranked even more important than price. But how that reliability is defined today depends on the customer. In a survey of 362 IT executives, 220 ranked mean time between failures (MTBF) as a *very important* metric in evaluating tape reliability, followed by metrics around tape life/archival life, with 182 respondents (see Exhibit 2). Customers also view certification and qualification of tape reliability as *very important*. In this same survey, close to 76 percent of respondents ranked tape manufacturer certification as either *very important* or *important* to their buying decisions.

Exhibit 2
Customer Evaluation of Tape Reliability
Source: Sunbelt Software and the Yankee Group, 2004



However, the Yankee Group argues that these metrics are only a subset of a much larger number that customers may not be aware of. Customers must fully understand what each of these metrics means—understanding the differences between lab-based stress testing and real-world benchmarking. This custom research report provides further details about the different kinds of tests used to measure reliability. Additionally, it examines how one vendor—HP—has developed additional benchmarks and metrics on tape reliability, and examines customer perceptions about which vendors have the best tape media reliability records.

II. Tape Cartridge Manufacturer Overview

Tape format technologies such as Ultrium, SDLT and DLT are licensed to companies that manufacture tape cartridges and/or tape mechanisms according to specification. Certance (formerly Seagate Removable Storage Solutions), Hewlett-Packard and IBM collectively developed and own the Ultrium technology specification. Quantum owns the DLT and SDLT specifications. The specifications provide the technical information necessary to develop cartridges and mechanisms that interchange between products of the same format. Typically, a third-party verification test company performs compliance testing to ensure the manufactured products meet the required specification. If the verification testing is successful, the company is awarded trademark and logo rights.

The specifications are primarily concerned with format compliance and interchange among products, and do not specify standards for tape quality or reliability. Thus, cartridge and mechanism quality—even of the same format—can vary considerably from one manufacturer to another. That is why most tape manufacturers develop their own standards and testing methods to ensure the quality of their products. Products that meet their standards for quality are further branded with their own company trademark or logo.

Every manufacturer develops its own standards and testing methodologies. Therefore, it is difficult for customers to ascertain tape quality and to compare tape quality among tape manufacturers because there are no consistent industry standards. Customers must educate themselves on the standards and testing methodologies employed by the manufacturers.

Common Reliability Measurements

Although no industry standards exist for tape quality and reliability testing, manufacturers provide some common measurements as an indication of tape quality and reliability (see Exhibit 3). Customers should be aware that these tests are not performed consistently from manufacturer to manufacturer and are not necessarily conducted under the same operating conditions typical of most customer environments. In addition, some manufacturers must estimate their statistics because they lack the historical and empirical data.

Exhibit 3
Common Tape Reliability Measurements
Source: The Yankee Group, 2004

Common Measurement	Definition/ What It Measures	Issue
Tape Life/ Archival Storage	Measures the shelf life of the tape, typically 25 to 30 years.	• This is not necessarily a guarantee that you will be able to recover data from the tape after 25 to 30 years. • This measurement is adversely affected by improper handling and storing of tape cartridges, as well as excessive reuse.
Tape Passes	Measures the number of times that a point on a tape can withstand passing the head in either direction; average is 1 million passes.	• One backup does not equal one tape pass, as customers often assume. • Backups require multiple passes across the head, sometimes as many as 48. • It is not necessarily a measurement of the full length of the tape passing the head, only a small section of tape.
Load/ Unload Cycles	Measures the number of times a cartridge is inserted and ejected from the tape drive. A cycle is one complete insertion/ejection event.	• Often this test is not conducted in automated libraries or under the same stress found in customer environments.
Mean Time Between Failures (MTBF)	Measures the probable number of hours between failures.	• There is no industry standard that specifies under what conditions this measurement is determined. • This measurement is often a predicted number and only after a substantial use in the field can a manufacturer provide demonstrated or actual MTBF measurements.
Average Failure Rate (AFR)	Measures the probable number of failures per year based on the manufacturer's total number of installed units of similar type.	• Same issues as MTBF.

Other Factors Affecting Tape Reliability

All reliability metrics provided by the company are adversely affected if the tapes are not handled and stored according to the guidelines of the manufacturer or OEM. Poor handling (dropping tapes, stacking tapes too high) and improperly storing cartridges (storing or transporting cartridges in extreme temperatures or humidity) can seriously affect the writing and reading of data from the tape as well as performance and capacity.

Other Factors to Consider

Given that the technology specifications of the various tape formats do not include standards for quality and reliability, customers should consider several factors beyond price when selecting a tape media supplier. Price is a factor—but when recovery of mission- and business-critical data is at stake, price cannot be the only factor. Other factors to consider include the following:

- **Additional testing requirements:** Manufacturers and OEMs should conduct quality and reliability testing of their tapes, including environmental and dynamic stress testing. How these companies arrive at their statistics is crucial to ascertaining quality and reliability. They should conduct tests under the same or similar rigorous operating conditions as found in typical customer environments. In addition, manufacturers should conduct tests regularly so customers have the most current statistical information. Otherwise, these statistics are inaccurate and therefore of limited value.
- **Warranty:** If a manufacturer or OEM has conducted thorough qualification and reliability testing of their tapes, they should be confident to offer a limited lifetime warranty. Companies that offer anything less than a limited lifetime warranty are most likely unsure of their tapes.

  Warranty is an important factor to consider but customers should also understand that warranty does not protect customers from potential data loss. Warranties only offer protection from any manufacturer's defect that is detected in the normal working life of the tape.
- **Service:** When there is a defect in the tape cartridge, is there a service line or call center that the customer can call directly?
- **Reputation:** In an industry where no consistent industry standards exist to measure quality and reliability, a company's history and track record are often the best way of ascertaining what to expect of its tape cartridges. A company that has sold tape cartridges for years will have historical and actual field data to support its statistics. In addition, a company that has all-around experience in supplying the tape mechanisms and the media in an integrated system will be in a better position to ensure not only the reliability of the tape cartridge alone, but its reliability in concert with tape drives and library robotics.

III. Vendor Profile: Hewlett-Packard (HP)

HP provides a significant mix of different kinds of storage products ranging from high-performance disk storage systems to a broad range of tape storage offerings. HP's tape storage system business plays a crucial role in the company's broader storage strategy on Information Lifecycle Management (ILM).

A core focus of ILM is to guide data through its life cycle from creation to deletion. A significant portion of this life cycle is directly tied to tape systems. At the same time, customers are under greater pressure to ensure data is preserved for a variety of reasons, including regulatory compliance. This increases the focus on tape reliability and the support for several different kinds of tape products and technologies. HP's ILM strategy takes a holistic view of customers' requirements and applies its product portfolio to meet various customer storage tiers that match those requirements, including tape systems.

These tiers include:

- **Online storage:** HP offers its StorageWorks XP, EVA and MSA storage systems, focused on supporting 3 months of active data, mirroring and instant recovery.
- **Near-online:** HP MSA platforms use Serial ATA disk, usually for 3 to 6 months of active data, faster recovery and infrequently accessed data.
- **Nearline:** HP offers the StorageWorks tape and tape automation products for 1 year of active, file recovery and offsite recovery environments.
- **Offline:** HP provides StorageWorks tape and optical products for 5 years of active, offsite storage and disaster recovery environments.
- **Archive:** HP provides HP StorageWorks tape and optical products for 30 years or more of record retention, which is retrievable based on set policies, and offsite storage.

HP offers customers a wide range of tape mechanisms (e.g., drives, autoloaders and libraries) and tape cartridges for a number of different formats including Ultrium, DLT, SDLT, AIT, DDS and Travan. This wide spectrum of product offerings allows HP to meet the specific needs of small, medium and large enterprises with the most appropriate tape solution for their particular needs.

HP-Branded Tape Media

Tape suppliers must comply with a stringent set of qualification and testing standards in order to manufacture HP-branded tape media (see Exhibit 4). HP will disqualify manufacturers that other companies may in fact accept as suppliers. Manufacturers that earn HP qualification must submit to monthly reporting and ongoing testing to ensure they maintain HP standards indefinitely.

Company reputation is an important factor to consider when selecting tape media. HP has a 20-year history of supplying tape storage media to customers, which amounts to more than 1 billion terabytes of data that has been saved to and restored from tape. HP also has one of the lowest defect rates in the industry.

HP's experience as a manufacturer of drives, autoloaders and libraries is a major competitive advantage over suppliers or manufacturers of tape media alone. This long-time expertise and access to hardware has enabled HP to develop unique software tools and techniques that scrutinize the tape drive and cartridge together and garner incredibly detailed information. HP tests several hundred drives each week using HP-branded media.

HP conducts environmental, drop, ambient and archiving tests on both drives and media in rigorous operating conditions that can often exist in customers' environments. To support this, HP custom-built 20 test chambers designed to simulate real-world customer environments across the world. The tests are meant to ensure not only that the cartridge is not visibly damaged, but also that it still functions properly when loaded into a drive or library. The tests also ensure that performance and capacity are maintained under these same conditions.

Exhibit 4
Qualification Tests for HP-Branded Media
Source: Hewlett-Packard and the Yankee Group, 2004

Test	Standard/Methodology
Drop Testing	This test ensures reliability in daily use within a busy data center. There must be no visible damage or loss of function to the cartridge following a 0.5 meter drop onto a concrete floor. This requirement is met when the cartridge is dropped successively onto each of its 6 faces, 12 edges and 8 corners.
Environmental Interchange	This test measures the ability of multiple tapes to be written and read in a range of environmental conditions—from 10° C and 10% RH to 29° C and 80% RH. This test ensures that the tape reads and writes data reliably when used in different drives and under different conditions.
Ship/Store	This test ensures the tape will perform reliably after storage and shipping by verifying read and write at 10° C and 10% RH and 45° C and 15% RH on multiple drives and tapes.
Shuttle Mode (Tape Passes)	This test measures the media's ability to withstand repeated passes over the tape head. It is performed by passing a small section of media back and forth across the head 40,000 times at an extreme 29° C and 80% RH (the most aggressive environment). This ensures sustained high performance and reliability to reflect the fact that tapes are used many times within the library environment.
Tape Edge Durability	This test ensures the durability of the tape edge within a busy data center. It includes repeated aggressive handling and mode changes such as fast stops, rewinds and spacing for file appends.
Automation	This test measures the media's ability to withstand rigorous use in automated tape libraries. It includes repeated aggressive handling of tape cartridges by the library robotics.
Thermal Aging (Archival Life)	This test ensures the tape will still perform successfully after it has been archived for long periods of time. The test reproduces the effects of years of aging by holding the cartridge at 60° for a minimum of 100 hours then reintroducing it to day-to-day conditions for normal use.

IV. Customer Perceptions About Tape Media

In a March 2004 survey jointly completed by the Yankee Group and Sunbelt Software, 362 IT executives in charge of buying tape systems were polled on their preferences and perceptions regarding tape reliability. Tape media reliability is a primary buying criterion for customers when evaluating tape cartridges. Approximately 75 percent ranked it as one of the most important elements in the purchase of tape cartridges. Price ranked second, with 42.3 percent of respondents. Customers ranked tape life/archival storage as the third most important criterion, with 36.2 percent of respondents (see Exhibit 5).

Exhibit 5
Tape Cartridge Buying Preferences
Source: Sunbelt Software and the Yankee Group, 2004

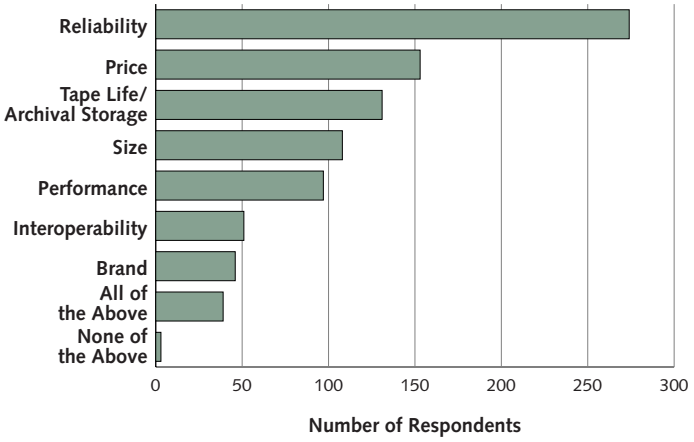
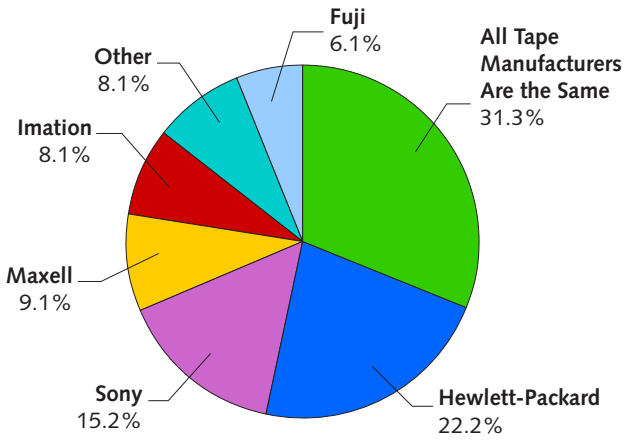


Exhibit 6
How Customers Rank Vendors for Tape Reliability
Source: Sunbelt Software and the Yankee Group, 2004



Note: Total does not equal 100% due to rounding.

Customers also have strong impressions about which vendors have the strongest track records for tape reliability. Although nearly a third of customers polled believe that all tape manufacturers have roughly the same reliability, customers ranked HP number one for its tape media reliability, with approximately 22 percent of those surveyed (see Exhibit 6). Additionally, Sony ranked second among customers with approximately 15 percent of respondents.

Customers have mixed impressions about the differences in vendors' individual tape reliability metrics. This in many ways could be considered a call to action—customers need to educate themselves more about how each vendor tests and qualifies the reliability of its tape media platforms.

How Customers Measure Tape Media Reliability: In Their Own Words

In this recent survey, customers expressed their mixed impressions of how well tape reliability has held up. Some of the 362 respondents representing a mix of small and medium-sized businesses and enterprises felt tape reliability remains a significant industry problem. One even wrote: "The most common problem is that software reports an OK backup and then when we try to recover the data no data can be recovered." Another suggested that tape reliability mileage will vary greatly, writing "It's like going to Vegas and shooting craps…you never know when the restore will work or not."

Another key issue surrounds how customers handle and store tape cartridges. Many customers had feedback on what must be done to preserve tape cartridges. 81.8 percent of respondents said they follow the guidelines from tape vendors regarding properly storing and handling tape cartridges.

A significant number of customers require a high level of tape reliability because of their backup practices. More than 50.8 percent of respondents said they do full backups to their tape systems. Another 40.6 percent conduct a mixed backup, where they do a full backup once a week and incremental backups throughout the week.

V. Conclusions

Customers should better educate themselves about what tape reliability really means and how to measure it. Given the growing requirements for better data retention, backup strategies, archiving and disaster recovery, customers need to better ensure their tape media meets stringent testing and certification requirements on reliability.

Customers already view tape reliability as an issue they must manage and mitigate. Understanding the specific ways tape manufacturers benchmark their reliability, as well as the pros and cons of each metric, will be important. Customers also must follow the requirements for proper handling to ensure the tape cartridge remains reliable.

The continued usage of tape systems for a variety of applications mandates that more formalized certification and industry-wide guidelines be established beyond what individual tape manufacturers currently offer. A crucial missing link remains testing tape cartridges in real-world environments that also take into consideration other points of failure in the backup, disaster recovery, and archiving process (such as network, server, storage array or backup software).

Because there are no industry standards, customers must take more initiative in asking tape manufacturers about their existing metrics and tests for reliability. Impressive metrics alone do not prove tape is reliable. The metrics must come from diligent testing in rigorous operating conditions. HP's continuous tape reliability program demonstrates that vendors can and do go beyond the norm with additional testing. Customers should compare HP's testing program against what other vendors have to offer.

Enterprise Recommendations

- **Be certain your tape media manufacturer or OEM meets or exceeds the specifications defined by the licensed technology.** This is often denoted by a certification or qualification logo from the licensing company or entity on the tape cartridge.
- **Understand the additional quality and reliability testing performed by your tape media supplier (manufacturer or OEM). Be certain this testing meets your reliability requirements.** Your tape media supplier often will require additional reliability tests beyond what the technology specification demands. Ensure that these tests were performed under conditions that simulate the rigors of your own environment.
- **Follow the guidelines from the manufacturer or OEM for tape media storage and handling.** All the characteristics of your tape cartridge (archival life, capacity, performance, etc.) are affected by how you store and handle your tape. Manufacturers and OEMs assume you store the cartridges in their cases at the proper temperatures and humidity.
- **Do not select your brand of tape media by price alone.** When it comes to protecting the ability to restore your mission- and business-critical data, you also must consider proven quality, warranty, service and reputation.

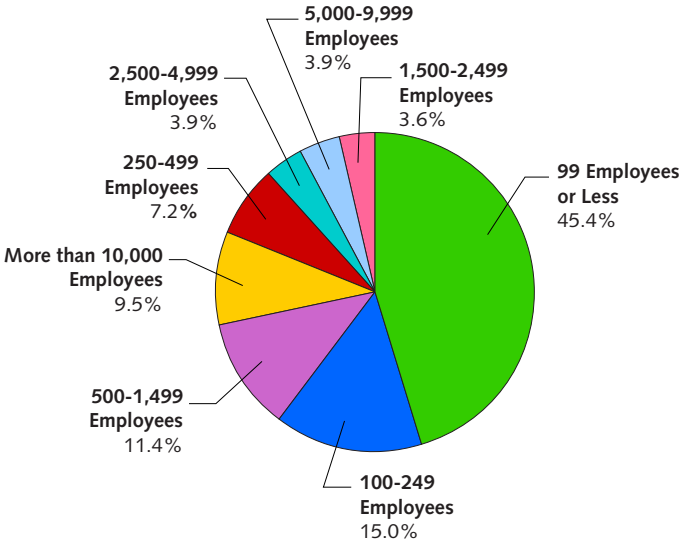
VI. Appendix

Exhibits 7, 8 and 9 present respondent demographics by company size, industry vertical and the amount of storage used.

Exhibit 7

Respondent Demographics: Company Size

Source: Sunbelt Software and the Yankee Group, 2004



Note: Total does not equal 100% due to rounding.

Exhibit 8

Respondent Demographics: Industry Verticals

Source: Sunbelt Software and the Yankee Group, 2004

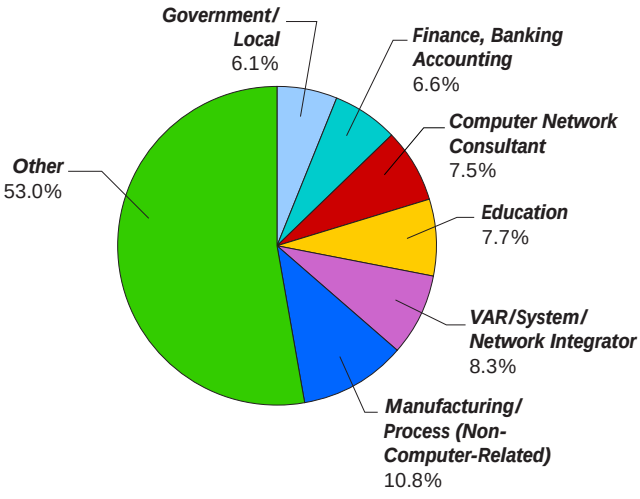
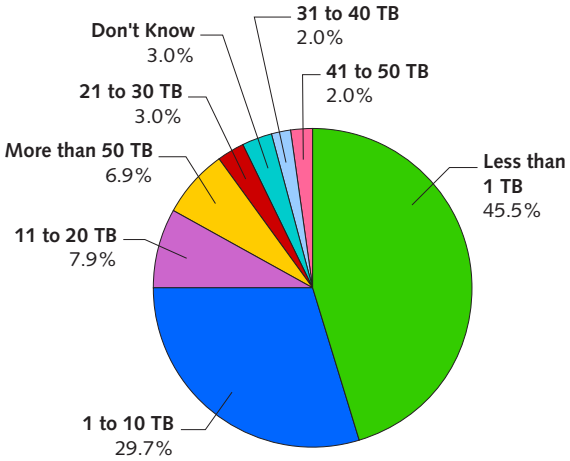


Exhibit 9

Respondent Demographics: Amount of Storage Managed

Source: Sunbelt Software and the Yankee Group, 2004



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