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WHITE PAPER

LTO Ultrium: Confirming the Value Proposition

Sponsored by: Linear Tape-Open (LTO)

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May 2003

EXECUTIVE SUMMARY

The Linear Tape-Open (LTO) program, initiated in 1997 by Certance (formerly Seagate Removable Storage Solutions), Hewlett-Packard, and IBM, is supplying open-standards tape drives and tape cartridges under the Ultrium brand to OEM customers and end users. The LTO program's approach to the tape market is in sharp contrast to incumbent suppliers, which are single-source providers of proprietary tape technologies. It is the LTO program's intention to establish a framework that ensures interoperability among Ultrium tapes and drives while encouraging competition among OEM suppliers of tape automation systems with LTO technology inside.

IDC spoke with IT managers directly responsible for the selection and deployment of LTO Ultrium tape storage systems. These managers reported improved scalability, capacity, and performance as common value propositions for choosing Ultrium technology. Some users found the LTO road map of future generations helpful, and others felt that the opportunity to purchase Ultrium products from multiple suppliers was an advantage for the LTO Ultrium format. The decision to choose the Ultrium format often reflected trust in the system supplier providing an automated tape library based on Ultrium components.

Ultrium format technology is based on a multichannel linear serpentine recording pattern. Tape is written and read in multiple passes with the drive moving from the beginning to the end of the tape on each pass. Drives have a read head immediately behind the write head so that data can be validated as it is written. A semiconductor device embedded in each tape cartridge is available to store metadata such as the cartridge ID and the number of times that the cartridge has been used. Second-generation Ultrium-based systems reached the market in late 2002 with a native capacity of 200GB and a transfer rate of 20–40MBps.

IDC believes that the LTO program's focus on open standards will increase competition in the storage system OEM market while improving economies of scale and lowering prices for those who manufacture commodity media and drives. OEMs will focus on improved tape automation, system management capabilities, and network technologies when they embed standard Ultrium drives in their products. Challenges to the LTO program include formidable incumbent competitors with road maps of their own, a continuing intrusion of magnetic disk storage systems into backup-and-recovery functions that were once entirely based on tape, and the wild-card possibility that an alternative removable read/write technology might disrupt the magnetic tape cartridge market.

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INTRODUCTION

IDC believes that data-protection products, along with tape storage technologies, are critical parts of an IT organization's overall storage strategy. While the simple costs of storing data on tape versus magnetic disk continue to converge, tape is still the lowest-cost storage medium when compared with disk. Tape storage will hold a cost advantage over the typical IT planning horizon, which is two to four years. The tape medium has several distinct advantages over disk: Tape is removable and portable for disaster tolerance applications, offers unlimited incremental increases in capacity, and can be archived or interchanged with trading partners and technology service providers. The cost advantages of tape storage are particularly pronounced for users that have large automated tape libraries.

SHIFTING REQUIREMENTS FOR TAPE STORAGE

Tape storage technologies are evolving to meet ever more challenging user requirements. IT datacenter managers need to store a greater number of larger data sets as the storage impact of new IT initiatives becomes better understood. New applications, such as customer care, sales force management, and supply chain automation, call for increased storage capacity. Greater concern about the risk of a datacenter disaster has caused many enterprises to reexamine their business continuity plans and to increase the amount of data that is replicated and stored away from the primary datacenter.

The many enterprises that are executing a storage consolidation strategy are better able to back up corporate data in a centralized manner. Networked storage solutions, whether NAS or SAN, gather the multitudes of files and datasets that were once scattered across the enterprise. Consolidated storage makes possible the appropriate backup of users' workstation files, departmental email systems, notebook computer disk replicates, and other information, which (in the opinion of many datacenter managers) has been largely underprotected for many years.

The cost of storage has always been a strength for tape solutions, and the analysis has shifted from simple, direct costs to the total cost of ownership (TCO). TCO includes indirect costs, which, in the case of tape storage, includes the need for space in the datacenter and the cost of managing storage resources. In a TCO analysis, better tape systems store more information in a smaller footprint, take less time to manage, and provide higher performance; the systems read and write data more quickly. TCO analysis of tape systems also includes an investigation of interoperability. Removable media — that is, the tape cartridges — must work properly with any and all libraries and drives regardless of the manufacturer.
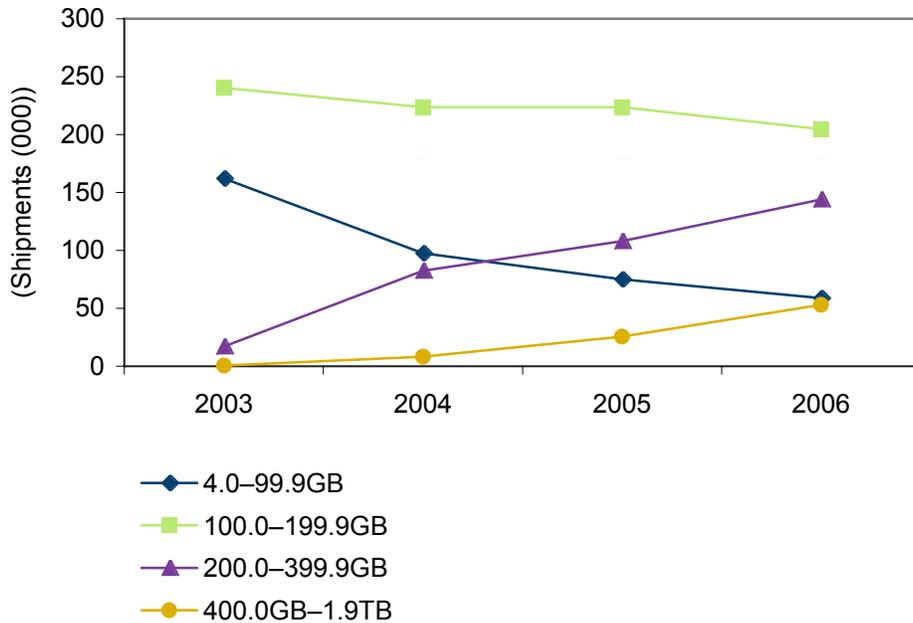
TRENDS IN TAPE TECHNOLOGIES

The tape storage industry has responded to new and more demanding requirements with steady progress on several fronts. Today's tape cartridges hold substantially more data, and improvements in capacity are expected to continue.

IDC's analysis shows increases in the midrange tape drive market for the shipment of higher-capacity drives. The midrange tape drive market includes tape technologies that are designed for direct attachment to servers and that are increasingly deployed in multiple drive libraries, such as LTO Ultrium products. As shown in Figure 1, IDC forecasts that unit shipments for smaller-capacity tape drives (i.e., drives for tapes with a capacity of less than 100.0GB) will decline over the period 2003–2006. Drives for tapes with 100.0–199.9GB dominate this market segment throughout the forecast period. IDC forecasts that drives for 200.0–399.9GB tapes will show the sharpest increase in shipments. The shipment of drives for larger-capacity tapes, which begins in 2003, will constitute about 10% of the market segment by 2006.

FIGURE 1

WORLDWIDE MIDRANGE TAPE DRIVE SHIPMENTS BY CAPACITY, 2003–2006

Source: IDC, October 2002

New high-capacity tape technologies will continue to be integrated into tape libraries and one-drive autoloaders to best exploit the economics of tape data storage. IDC believes that this trend toward shared tape resources will intensify in the next five years as deployments of SANs become much more widespread. High-capacity tape technologies integrated into libraries will best suit the growing user requirements for data protection and archiving of mission-critical data.

Furthermore, the importance of a defined technology road map has emerged across all information system technologies. This is especially true for tape products that are used for data protection and archiving of high-value, mission-critical data. As a result, customers are evaluating tape technology deployments in a three- to five-year time horizon. Customers make significant investments in tape-based data protection products, including tape drives, libraries, autoloaders, tape cartridges, storage management software, people, and practices. Therefore, customers need to understand product enhancements, road maps, and subsystem integration efforts to effectively plan for a technology transition. In most cases, transitions in tape-based data protection can be difficult and costly. Customers are becoming much more astute in evaluating "end of life" for legacy systems and the right time to invest in new tape storage technology. It is an increasingly important decision.

I D C   C A S E   S T U D Y   M E T H O D O L O G Y

IDC spoke with a sample of managers directly responsible for the selection and deployment of LTO Ultrium tape storage systems. The users were nominated by members of the LTO program and interviewed by IDC analysts. Case studies summarizing our findings are inserted in this White Paper.

LINEAR TAPE-OPEN OVERVIEW

The LTO program was announced in November 1997 by a powerful tape storage triumvirate: Certance (formerly Seagate Removable Storage Solutions), Hewlett-Packard, and IBM. The three companies created the LTO open specification to address a set of common tape storage needs that they perceived in the marketplace. A host of single-source, proprietary technologies have traditionally dominated the tape data storage market. However, as more and more tape technology was sourced and sold by large system and server OEMs, product allocation and competitive pricing became a prime concern for those OEMs. End users interviewed by IDC pointed out that open specifications supported by multiple vendors are important to them. Competition among the suppliers keeps prices down, drives quality up, and allows for a variety of tape drive feature sets that can provide choice and expand customer purchase options.

Painless Migration at a National Retailer

IDC spoke with the IT director at a national subsidiary of a global retailer. The $3 billion subsidiary migrated to LTO Ultrium tape two years ago, and in the words of the IT director, "It was painless. Two years ago we had reached end of life with two tape technologies, and when our system supplier recommended that we evaluate Ultrium, we did just that.

"The Ultrium library that we purchased promised scalability, much higher capacity, and higher throughput," the IT director explained to IDC. "We were able to obtain the first Fibre Channel drives, which made it easier to integrate the library with our SAN. In a year we successfully added more slots and drives, and today the library contains over 250 slots, 20 drives, and approximately 200TB of data. We have a second Ultrium library at our backup datacenter. We have also placed small Ultrium libraries in our warehouses.

"We used to maintain tape backup at each of our stores," the IT director continued. "Store managers were supposed to put a tape in the drive every night before leaving the store, and, of course, they didn't always remember or they overwrote a tape. Now, store data moves to the head office over our T1 network, is stored in our SAN, and is backed up daily to the Ultrium library."

This IT director abhors the high cost of maintaining multiple legacy systems. As a result, he replaced all tape systems with a single standard. Part of his confidence in Ultrium was the open standards of the LTO Ultrium format. Even though he bought his library from a trusted system provider, he also valued the idea that the technology was available from other suppliers.

"I have friends who do what I do for other companies, and I have recommended that they evaluate Ultrium tape solutions," the IT director concluded. "You don't want to recommend technology to friends unless you're certain, and I am certain that bringing this technology to my organization was a slam dunk. What am I concerned about in the coming months? Server consolidation — now that my storage subsystems are running efficiently, I can move on."

The crux of the LTO effort was to establish a framework for continuing competition among LTO licensees — competition bound by a single, open-standards specification to which all LTO tape drives and cartridges must remain compliant. This would ensure seamless interchange of tape cartridges among the manufacturers' drives. Storage system and server OEMs now have more than one choice of tape supplier for LTO tape drives and media.

By April 1998, the LTO program announced its product's format and moniker, Ultrium, and provided a technology road map for future versions. In the first year of operations, 16 companies joined the original trio, which are known as the Technology Provider Companies (TPCs). Licensing was set in place along with mechanisms for LTO participants to exchange information about LTO technologies. Processes were put in place to help ensure media and tape drive compliance. Measurement Analysis Corp., an independent verification service, is part of the process to ensure compliance to the LTO Ultrium specification. There have been only a few reported cases of problems encountered with the interchange of cartridges among the different vendor tape drives. These issues were typically resolved with the implementation of current drive firmware.

The LTO Ultrium road map, shown in Table 1, anticipated an initial release of a product with a capacity of 100GB (uncompressed). The data transfer rates for the initial release were targeted at 10–20MBps native or uncompressed, and all drive manufacturers delivered performance within this range. Second-generation Ultrium 2 drives are now available with uncompressed cartridge capacities of 200GB using Ultrium 2 data cartridges. The Ultrium 2 drives have the capability to read and write Ultrium 1-generation cartridges at Ultrium 1 capacities. Ultrium 2 native drive data rates are in the range of 20–40MBps. Subsequent generations double both capacity and transfer rates and are expected to roll out as products about every 18 to 24 months. Tape drives, libraries, and cartridges for Ultrium Generation 2 will be generally available from most major system and server suppliers in 2003.

TABLE 1

THE LTO ULTRIUM FORMAT ENHANCEMENT ROAD MAP

Ultrium Format	Generation One	Generation Two	Generation Three	Generation Four
Capacity	100GB	200GB	400GB	800GB
Transfer rate	10–20MBps	20–40MBps	40–80MBps	80–160MBps

Note: Capacities and transfer rates are native or uncompressed.
Source: LTO, 2003

Road Maps and Choices for Managed Services Provider

IDC spoke with the storage manager at a national managed services provider with two large datacenters, one on each coast in North America. The company provides the entire infrastructure necessary to support business systems that customers choose to outsource. The company shifted to Ultrium tape in June 2002, when reviewing technology to equip its second datacenter.

"We saw a road map from the Linear Tape-Open [LTO] program," the storage manager explained, "and realized that we had been waiting for a long time for next-generation technology from our current provider. LTO Ultrium was ready to go. Financial analyses showed that the solution was cost effective, and our need for extensibility could be satisfied by the OEMs working with LTO technology providers."

Road Maps and Choices for Managed Services Provider (cont'd)

The company installed a library consisting of 10 drives and 300 cartridges, which should provide sufficient capacity for a year of growth. Installation was straightforward, and the technology works as promised. Drivers worked properly when installed on servers provided by different suppliers, and the backup process was accelerated because of the higher-speed write capability of Ultrium tape drives.

"A second reason we felt comfortable with Ultrium tape was the trio of suppliers of LTO technology," the storage manager continued. "We realized that we could buy drives from Seagate [Certance], IBM, or HP, and if one vendor was late to market, we would have two additional vendors to turn to. We expect that the competition among these suppliers will be a good thing for customers."

Ultrium tape systems are now in place at both datacenters for this company, IDC learned. The drives are attached to shared storage systems and provide backup and recovery services exclusively. While the libraries currently share a common brand of drives, the company buys tape media from different suppliers and uses them interchangeably.

LTO ULTRIUM TECHNOLOGY

The Ultrium format can be divided into two components: a specification for the Ultrium tape drive and a specification for the Ultrium tape cartridge.

ULTRIUM DRIVE

The Ultrium tape drive reads and writes data to the data bands beginning in the center tracks of the tape. Data is written to the tape in multiple passes as the drive moves from the beginning of the tape (BOT) to the end of the tape (EOT) and back. On each pass, eight tracks are written simultaneously. After each round-trip, the drive's read/write head is relocated using the servo bands for reference. The resulting pattern for the data is serpentine, and, in a nutshell, the Ultrium specification is described by the LTO program as multichannel linear serpentine recording.

As the data is written to the magnetic media, a read head follows the write head to verify the data. Error checking codes constantly evaluate data integrity and correct most cross-track errors. Other error correction technology marks bad areas in the tape media or areas where servo information is weak or unreliable, further enhancing data integrity.

ULTRIUM CARTRIDGE

The Ultrium cartridge is slightly smaller than most single-reel cartridges, measuring 4.1 x 4 x .8in. The drive has a single hub to allow the cartridge to hold as much magnetic tape media as possible. When manufactured, the Ultrium generation 1 tape is formatted for 384 data tracks that are divided into four 96-track regions, called data bands. These data bands are written one at a time as the tape cartridge is filled with data. Separating each of the data bands are servo bands, which are written when the tape is manufactured and used by the drive to help provide precision alignment of its read/write head.

Built into the body of the cartridge is a semiconductor device that provides cartridge memory (CM). The LTO-CM stores 32KB of data and communicates with tape

automation devices by way of a noncontacting radio frequency (RF) interface. This on-cartridge chip is ready to store information about the cartridge that can be retrieved without inserting the cartridge in a drive. The LTO-CM can be used to store calibration data, tape usage counts, initialization parameters, and other such data used in support of tape automation.

Capacity and Speed for a Global Manufacturer

IDC spoke with the manager of storage systems at a diversified manufacturer of transportation products. The company moved to the LTO Ultrium technology in April 2002.

"We swapped out our old tape technology to gain greater capacity and speed," the manager explained to IDC. "With hundreds of servers and workstations supporting the design of our products, storage systems are critical to our business.

"We were briefed on Ultrium technology by our system supplier two years ago, and we've had our eye on it ever since," the storage manager elaborated. "My colleagues in other IT organizations were reporting trouble with other tape products, and there were no problems with LTO Ultrium. We wanted to choose one technology, and LTO Ultrium was our choice."

The company's Ultrium library consists of eight Ultrium drives and over 600 slots. Six terabytes of data are stored with incremental daily backups of about 2.2TB. Data is written to tape with 71GB/hour throughput. The library is connected by fibre and is a part of the company's SAN. Because of the success of Ultrium in the company's North American operations, the technology is now being deployed in the company's European operations as well.

"We needed that three-to-one reduction in the number of tape cartridges that Ultrium provides more than we initially realized," the storage manager added. Initially, an investment in a new ERP system triggered the need for more storage capacity. Then, a risk analysis led to a doubling of the time that tapes are retained. Taken together, demand for tape storage capacity jumped 200% since the migration to LTO Ultrium was completed.

"I recommend Ultrium tape to my colleagues," the storage manager told IDC. "My system supplier, whom I trust as a business partner, is solidly behind the technology and delivered a system that continues to meet our emerging requirements."

PRODUCTS WITH LTO ULTRIUM INSIDE

Three manufacturers supply LTO Ultrium tape drives, and tape cartridges are generally available from seven companies. However, the strong adoption from major system and server OEMs is very impressive and is extremely important in propagating the LTO Ultrium tape technology. As of April 2003, 12 major system and server OEMs are supplying LTO Ultrium-enabled tape libraries, autoloaders, or single drives (see Table 2).

IDC believes that OEMs producing end-user products will differentiate their offerings that have common drives meeting the LTO Ultrium specification. Generally, IDC has observed that standards sharpen competition by creating commodity components. Standardization of components shifts the competitive focus. In the case of products

based on LTO Ultrium technologies, tape automation technologies and management software tools are emerging as the key feature sets that differentiate OEM offerings. Evidence supporting this claim can be found in the case studies included herein. Users of Ultrium tape storage systems were also pleased with reliable and easy-to-use automation features associated with the packaging of Ultrium technology in a complete end-user product.

TABLE 2

LTO ULTRIUM MANUFACTURERS AND ORIGINAL EQUIPMENT MANUFACTURERS THAT USE ULTRIUM COMPONENTS

Manufacturers of LTO Ultrium tape drives	Certance, Hewlett-Packard, and IBM
Manufacturers of LTO Ultrium tape cartridges	Fuji, Maxell, Imation, Sony, TDK, EMTEC, and Verbatim
System and server OEMs using LTO Ultrium technology	ADIC, Dell, Exabyte, Hewlett-Packard, IBM, Overland Storage, PeAk Storage, StorageTek, Sun Microsystems, Tandberg Data, Plasmon IDE, Fujitsu Siemens, Fujitsu, NEC, Qualstar, Grau, and ATL

Source: LTO, 2003

Multivendor Standard at a Global Biotech Company

IDC spoke with the system manager at a global product and services company in the biotech industry. In 2000, the company moved to LTO Ultrium technology.

"We were seeking an alternative to our legacy tape systems, and the bottom line was that we needed to back up and restore snapshots of our data on disk in a timely fashion," the system manager told IDC.

LTO Ultrium was evaluated along with other available tape technologies.

"It seemed to us that LTO Ultrium had a better long-term future," the system manager explained, "and it didn't hurt that LTO Ultrium was less expensive as well. We were beta testers for the library, and since we write our own backup programs, we learned a lot about the technology when putting it into service.

"Ultrium 1 drives write at 30MB per second, and there is a read head following the write head that verifies the data," the system manager continued. "If there is an error in writing the data, I know it immediately. In the past, I needed to read each tape on a second pass to verify the data. I don't use the chip embedded in each cartridge, but I expect to use it in the future to monitor the number of times that the cartridge has been used and things like that."

The primary workload for the Ultrium tape library is 4TB of storage for SAP and Informix application data. Eight drives are allocated to this purpose. The secondary workload is backup for Microsoft NT servers, and now there are over 500 slots in the library. The system was deployed without incident.

"I understand that LTO Ultrium is a specification agreed to by several suppliers, and that was important to us," the manager indicated to IDC. "We prefer not to buy single-vendor technology, and when we took our tapes to our backup server provider, they worked properly on an Ultrium drive from a different supplier. We are pleased with our decision to install Ultrium technology."

IDC ANALYSIS

OPPORTUNITIES

The LTO Ultrium initiative represents a turning point for the tape storage industry, OEM customers, and end users alike. In the past, the tape industry has been dominated by single-source, proprietary tape formats. The power triumvirate of Certance (formerly Seagate Removable Storage Solutions), HP, and IBM backs the LTO Ultrium tape technology. No other midrange tape product has been developed and delivered to the market in this way. The aim is to propagate LTO Ultrium through OEM customers and major storage system suppliers.

OEM customers now have more supplier choices with regard to tape drive formats. The availability of LTO Ultrium by three manufacturers affords them flexibility and frees their reliance on a single supplier. Ultimately, more options allow OEM suppliers competitive sourcing and pricing.

The LTO Ultrium initiative benefits end users by ensuring data and cartridge interchange standards and wide availability of the technology. However, end users might not know which manufacturer actually builds the technology because the LTO Ultrium technology is integrated into their servers or tape subsystems.

CHALLENGES

The three manufacturers (Certance [formerly Seagate Removable Storage Solutions], HP, and IBM) of LTO Ultrium must continue to work together in order for the technology to remain viable and gain more momentum in the marketplace. We believe that it is critical for the three to continue to execute on the LTO Ultrium technology road map. Poorly executed or very late product introductions will jeopardize the LTO group's ability to win and, more important, hold on to customers. Competitors of the LTO Ultrium format will bring higher-capacity, higher-performance tape drives and tape cartridges to market as quickly as possible. LTO is competing in a market that is marked by leapfrogging technology improvements.

The LTO Ultrium initiative must continue to gain mindshare against more established and entrenched tape technologies by working with OEM customers and system suppliers. However, it can be very difficult for the three suppliers to differentiate their products and still adhere to a truly open standard.

The LTO Ultrium group is also vying for a limited number of OEM customers. The storage system and server marketplace has consolidated and will likely consolidate more. Not only will LTO OEM companies compete for customers, but they will have to battle formidable competitors in the tape industry. Many tape industry OEM players have aggressive development road maps and new high-performance products set for delivery.

Disk storage systems continue to intrude on traditional tape storage applications. IT planners can now employ point-in-time copy and distant replication techniques to produce replicas of files and data at a second location, for example, thus addressing some backup-and-recovery objectives without the use of tape storage at this point in the process. While the data typically ends up on tape systems due to its unique benefits and cost advantages, some enterprises are utilizing interim disks for some datacenter storage needs.

Finally, a wild-card challenge might come from unexpected improvements in an alternate removable technology. Significant advances in alternatives such as optical tape technology could disrupt not only suppliers of LTO technology but also other tape suppliers as well. While the likelihood is small in the foreseeable future, it should be nonetheless noted.

CONCLUSION

The LTO program aims to provide a combination of open standards to encourage competition among suppliers of tape storage systems. Users of first-generation Ultrium products report that their expectations for interoperability among media and drives supplied by different companies have been met. In addition, users report that the road map for future generations of LTO Ultrium is helpful for planning purposes.

IDC believes that the LTO Ultrium initiative has the opportunity to meet customer needs if LTO technology is able to gain momentum and deliver the higher capacities and transfer rates identified in its road map. IT planners are encouraged to include products with LTO Ultrium inside when evaluating data-protection strategies and new tape systems.

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