



Snatching Chaos from the Jaws of Order

The Myth of "Open" Systems in Tape Backup

by
John Szantho
Product Line Manager,
Quantum DLTtape Group

SDLT
Super DLTtape™ Technology

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The testing data referenced in this document was derived from testing performed by an independent laboratory, Percept Technology, Inc., in a controlled environment using specific systems and data sets. Actual results in other environments may vary. These results do not constitute a guarantee of performance. Testing was conducted using Linear Tape-Open (LTO) drives and media from several different LTO consortium manufacturers.

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INTRODUCTION

Recently the concept of “open” systems has been highly touted in tape backup systems for larger-scale installations. In theory, such open systems will result in a standardized media that can be written by one vendor’s system, appended to by a drive from a different supplier and successfully read by a third system from yet another manufacturer. This has the potential to be a great idea, if carefully and thoroughly implemented. Unfortunately, in its current form — as represented by the LTO products — the implementation is significantly flawed. Although the LTO Ultrium media is standardized for compatibility, the hardware that writes to this standardized tape has no such controls. The result is that you may use any Ultrium tape in any LTO backup system, but there is no assurance that a tape written by one vendor’s drive can be read or appended by another manufacturer’s drive. This defeats the purpose of an “open” environment.

Open systems are theoretically attractive. What IT manager wouldn’t want intense competition from a group of manufacturers vigorously fighting for his or her business? Especially when all the various products were totally interchangeable. In this best case, the individual products’ performance (faster, bigger, cheaper) might differ. But these differences would not be seen in their interfaces with the remainder of the system in which they are installed. Simply stated, any product would work with any system.

Unfortunately, open systems often work better in theory than in practice. Certainly, CD-ROMs burned on any machine are readable on any other. But the mess in writing DVDs on the computer is a dramatic counterexample with competing factions of drive manufacturers producing disks that may or may not be read in another manufacturer’s drive. In contrast Intel’s role in the development of the personal computer is an example of a fiercely competitive, proprietary stream of innovations from one firm that has enabled the development of a huge industry. Even though Intel advances the R&D and product improvement, few of us think (or care) whether the maker of the chip in our PC, is Intel or AMD.

There are several key issues of major concern with the LTO “open” standard for the responsible IT manager trying to select a tape backup system. Five of these issues, addressed in this paper, are:

- No organization dictates compatibility between LTO devices.
- A tape written on one drive may not be read by a drive from another vendor.
- Uncertain commitment to the business by the drive manufacturers.
- Diffused emphasis on product R&D in the LTO consortium.
- Unclear lines of responsibility if a problem exists.

Let’s look at these issues in more detail.

No One is Setting Device Standards

The first issue, referenced above, is internal to the LTO consortium, but with critical importance for the IT manager. There is no organization dictating compatibility between LTO devices. To be truly successful, any open hardware standard needs a standard-setting entity with the power to enforce compliance with its mandates. The current LTO situation means that any supplier may basically claim that its drive is compliant with the LTO cartridge

standard and no one else guarantees or validates that claim. Because, unlike Intel in the chip world, there is no acknowledged leader who sets widely accepted standards.

Good intentions are no substitute for hard data. Nominally, LTO drives would be tested to exacting standards by an independent third party. As presented by the LTO consortium, an outside third-party with the imposing title of Compliance Verification Entity (CVE) is supposed to test both drives and cartridges (tapes).

The reality, unfortunately, is quite different. LTO's Compliance Verification Entity, Measurement Analysis Corporation, was never engaged to perform the drive licensee verification process for LTO-1 drives. Measurement Analysis Corporation was only hired to perform the cartridge licensee verification process. Rather than follow the independent third party verification process, the LTO drive manufacturers decided that the drive manufacturers would do any drive-level interchange testing.

As indicated by the test data presented below, the likelihood that thorough testing was performed, given the incompatibilities between drive systems, is very slim.

Unfortunately, testing and certifying the media is only part of the solution. Without rigorous interchangeability testing of the drive devices reading and writing the media, there is no assurance that the goal of an open system is achieved.

It now looks like one of the LTO drive manufacturers will be first to market with a second generation Ultrium drive. Does this mean that the other two drive manufacturers must make their drives compatible with that produced by their arch-competitor? Or does the first vendor to market have to wait to release its drive until the other two have drives to release so compatibility testing may be done? Or is interchangeability among LTO drive vendors a concept only paid lip service, not actually implemented?

For the IT manager this means that, even when procuring a nominally "open" system with a variety of suppliers, he or she is effectively locked into one vendor.

Interchange Problems

The second issue, and a direct result of this lack of discipline in the consortium discussed above, is the raw incompatibility of the existing LTO systems. The critical issue for an IT manager who wants to use an "open" system is the level of interchangeability among the various products — both now and in the future. If the whole point of an open system is to allow more flexibility in choice of product suppliers, then the purchaser should not be locked into one manufacturer from the initial procurement. A tape written on one vendor's system should be read or successfully appended on another manufacturer's drive.

The results of actual compatibility testing on the LTO products are not encouraging. Testing by an independent third party lab, Percept Technology, Inc., uncovered the following issues:

Inconsistent Write Start Location

While performing an unrelated test suite it became necessary to determine exactly where each LTO drive began writing to tape. Testing showed HP LTO drives begin writing to tape at approximately 22 feet from beginning of tape, while Seagate LTO drives begin writing on the tape at approximately 29 feet, and IBM LTO drives begin writing at approximately 50 feet. This may be a factor in the drive incompatibility issues described below.

Incompatibility Problems Among Drives

By creating identical data sets from each LTO drive and reading/writing/appending in the other manufacturer's drives, interchangeability of LTO cartridges – written on different LTO drives – was tested.

This test showed that interchange between the LTO drives is not reliable. The HP LTO has the greatest difficulty reading a tape created by IBM or Seagate drives (although drives from all manufacturers had issues). This test was verified on two separate HP LTO drives.

Native Capacity Testing Failures

- HP hung on read on a tape written on Seagate.
- HP failed on read on tape written by Seagate.
- HP failed on append on tape written by Seagate.
- HP hung on read on tape written on HP then appended by IBM and Seagate.
- HP failed on append on tape written on IBM and appended by Seagate.
- HP failed on read on tape written on IBM and appended by Seagate.
- HP failed on append on tape written on Seagate and appended on IBM.
- IBM failed on read on tape written on HP and appended by Seagate.
- IBM failed on read on tape written on IBM and appended by Seagate.
- Seagate failed on read on tape written by IBM.
- Seagate failed on read on tape written on IBM and appended by Seagate.

LTO interchange issues have been noted by other parties.

Others have identified this lack of interchangeability as a substantial impediment to increased adoption of LTO. In one example, HA Storage Systems is one tape backup solution provider highlighting these issues on its web site:

“The LTO standard was created with the backing of three major vendors with the idea of creating a drive that was compatible between them all. To date this hasn't been the case. Not only are the transfer rates and form factors different between vendors but a tape written by one drive can't be read by another. This "open" standard was to be one of the primary advantages of LTO (SDLT is controlled by Quantum and Quantum only) but so far this hasn't come true.” – *HA Storage Systems article entitled "Tape Wars"*

<http://www.itstorageshop.com/Index.asp?WebpageID=50>

In another example the on-line publication *Enterprise Systems* had the following to say in an article by noted storage guru Jon William Toigo:

“...LTO tape sounded like a good idea in the late 1990s—a vendor consortium offering interoperable products to avoid single vendor lock-in—but this past year the problems with a technology-by-multi-vendor-consortium approach began to show. Similarly-named products from HP, IBM and Seagate have shown design differences that cut to the heart of the technology's value proposition. Tapes from one Ultrium drive won't necessarily work in another Ultrium drive. While we're told that these differences will be ironed out, monolithic SuperDLT continues to carry the day in the tape world.”

quoted from "Enterprise Storage And the Winner is ... the Best (and Worst) in Storage" by Jon William Toigo
<http://www.esj.com/Columns/print.asp?EditorialsID=95>

And to make matters even more complicated, the pending introduction of a second generation, higher capacity Ultrium brings another level of complexity on the interoperability front.

Long-Term Prospects for Selected Suppliers

One pressing issue that requires the IT manager to gaze into the crystal ball and foresee the future is selecting a vendor that will not exit the business.

Three manufacturers for LTO drives exist currently: HP, IBM, and Seagate. These three rivals are vigorously competing both against the DLTape™ standard and against one another. The installed base of LTO drives supplied by each manufacturer is small and there is no manufacturer with a clear leadership position. Furthermore, the LTO business is not core to any of the three firms. With limited market shares and a highly competitive environment (even within the small LTO niche), the prospects that one (or more) supplier(s) may exit the business are significant. Between the emphasis on software/services at both HP and IBM and the current trend in corporations to focus on a key corporate competency, guessing who isn't going to pull the plug on LTO requires careful scrutiny of that crystal ball.

Already in the LTO consortium's short life, the mortality rate (in terms of both products and suppliers) has been noteworthy. One whole family of LTO products (Accelis) announced over four years ago has yet to see the light of day. Rumors are that it has been scrapped. Fujitsu's license to produce Ultrium drives was announced with great fanfare in 1998. After the LTO introduction, Fujitsu has never brought a product to market. Currently Fujitsu is private labeling drives produced by other LTO partners.

Obviously, relying on orphaned devices from a vendor no longer in the business is a highly risky strategy for any aspect of the IT business. But, to place the data backup facility, the heart of corporate IT risk management, in the quasi-limbo of an orphaned product is, for any sane IT manager, an unacceptably high-risk strategy.

Diffusion of R&D Resources

Reinventing the wheel is inevitable with the current LTO structure. R&D effort, in any company, is a very scarce resource. Certainly there are differences of opinion on how R&D resources are most effectively used. Should it pay for the paradigm-shattering new product that changes the complexion of the industry? Or should these limited resources be applied to making incremental changes that provide near-term competitive marketing advantage? The tape situation exacerbates this dilemma: three manufacturers, nominally pledged to the LTO standard, that are competing intensely both with each other and with an entity with a far larger market share. Maybe it makes more sense to focus that scarce R&D resource on trying to advance the overall state of the product rather than having three vendors each competing by spending resources to develop products with little differentiation.

With improvements in the LTO standard requiring the participation of three competitive manufacturers, the slowest of the three to perform the necessary R&D and product development will determine the pace of the entire consortium.

Given that all three manufacturers must fund this R&D out of the proceeds of a small market share in a competitive niche market, the temptation to focus on incremental advances is intense. Only with a powerful central “standard-bearer” who puts resources in developing the next big product improvement can the situation in tape storage be expected to truly advance.

Diversity vs. Compatibility

Finally, there is the very diversity of vendors — normally a good thing — that may haunt IT managers. There are a variety of manufacturers involved in both LTO devices and LTO media as shown in the table below. Without a strong central organization managing the standard and dictating compatibility, who are you going to call when you have a problem? The vendor who sold you the drive that wrote your data, the vendor who sold you the drive used to read your data, or even the media supplier? Toss in a couple of semi-compatible generations of devices (LTO-1 and LTO-2) and the mishmash grows exponentially.

Diversity is great for competition, but diffuses the responsibility for effective operation. Think about all the decisions an IT manager has to make. And, we’ve seen these can be tough picks with long-term implications because not everything works together. Interchangeability in this “open” LTO environment is currently a dream rather than a reality.

A	B	C	D	E	F
Write Drive Type	Write Drive Manufacturer	Read Drive Type	Read Drive Manufacturer	Media Type	Media Vendor
LTO-1	HP	LTO-1	HP	LTO-1	TDK
	IBM		IBM		Verbatim
	Seagate		Seagate		EMTEC/BASF
LTO-2*	HP	LTO-2*	HP		Fuji
	IBM		IBM		Maxell
	Seagate		Seagate		Imation
				LTO-2	TDK
					Verbatim
					EMTEC/BASF
					Fuji
					Maxell
					Imation

* LTO Generation 2 units are claimed to be backward-read and write compatible with LTO Generation 1.

Given that it appears that limited (if any) read-write interchangeability testing is performed by the LTO partners, the opportunity for problems when exploiting the diversity that is the supposed hallmark of LTO is immense. As indicated in the table above the number of

combinations and permutations that arise are well over 500. Will the compatibility of a drive type from column C supplied by one manufacturer from Column D really be thoroughly tested against all the drives of Column A supplied by the vendors of Column B using media from Columns E & F? The opportunity for mutual recriminations and finger-pointing is enormous when highly competitive suppliers offer essential elements of the full system. An IT manager entrusted with creating a fail-safe backup system using LTO products is offered two equally unpalatable options: 1) being totally locked into one LTO vendor (who may or may not remain in business) or 2) having no single supplier accept responsibility for a vital mission-critical aspect of the organization's IT operation.

Conclusion

Although superficially attractive, the implementation of the "open" LTO standard in tape backup systems is fatally flawed in the details. Since the only rational decision for today's IT manager is to select a single vendor and source its products exclusively, the supposed virtues of the "open" standard are lost. The rational IT manager might prefer the clear leadership and one-stop responsibility of Super DLTtape™ rather than the phantom advantages of the "open" LTO systems. With DLT there is one organization enforcing stringent control of media/drive interfaces at the same time there is vigorous competition among multiple drive and media licensees.

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