



Tape Density Evolution? No — Revolution!

Analyst: David Reine

The Evolution of Tape

Over the past 54 years, we have seen a continual evolution of tape from its origins as a 10.5” reel of half-inch media with a capacity of two megabytes for the IBM 726 *Magnetic Tape Unit*, continual but far from linear. Today’s commodity tape architectures, such as DLT and LTO, have seen a geometric increase in both capacity and performance since their introduction at the turn of this past century. Introduced with a native capacity of 100GB and a throughput of 15 MB/s in 1999, LTO has evolved over three generations to a native capacity of 400GB per cartridge and a throughput of up to 80 MB/s of commercially available technology. LTO4 has a roadmap for an 800GB cartridge in 2006 with throughput of up to 120 MB/s. IBM has already demonstrated, in 2002, the capability to pack *one billion bits of data into one sq. inch* of tape, expanding the capability of tape storage to **one TB** of data (native) on a single cartridge, 500,000 times the capability of the IBM 726. This does not address the advantages available through compression, with ratios of 2:1 and 3:1 being common. These advancements could not have occurred at a better time.

Enterprises have implemented many processes with tape as an integral component, where sub-second response time is not a critical factor - archiving, backup and recovery, and regulatory compliance, to name a few. With the enactment of the Health Insurance Portability and Accountability Act (HIPAA) in 1996 and the Sarbanes-Oxley Act in 2002, the requirement to preserve data for long periods became mandatory rather than just good business practice. Because of the significant cost advantages that tape has over disk, especially when considering total cost of ownership (TCO) issues, the tape industry has shelved the obituary notices and has been experiencing remarkable growth over the past few years. Forecasted growth in capacity and throughput, however, requires more than just improved media; it requires the continued investment into innovation in all areas of recording technology.

Recently, we have seen a partnership between Sun (for its StorageTek tape product line) and Imation to further Sun’s capabilities with regard to their *T10000* tape drive. Now we see another, perhaps more interesting union, between IBM and Fuji Photo Film Co., for the **development of a new tape recording environment** that could change the tape recording paradigm for the next decade. Based upon a next-generation dual-coat magnetic tape, IBM and Fuji have demonstrated the capability of recording *6.67 billion bits per sq. inch*, or up to **8TB** of data on a single cartridge, another 20x that of LTO3, using a variety of innovations from IBM’s Almaden Research Center. What are these innovations?

Next-Generation Tape Recording Technology

IBM has exhibited improvements in five separate areas of tape recording technology with this high data density demonstration. Here are the details.

- **Tape Media** – Developed by Fuji, in collaboration with IBM, this next-generation *NANO-CUBIC* tape employs a new barium-ferrite nanoparticulate magnetic media to enable high-density recording without the use of expensive “metal sputtering or evaporation coating” methods;
- **Head Design** – Taking advantage of the same technology used to sense very small magnetic fields in hard disk drives, IBM adapted sensitive giant-magneto-resistive (GMR) head materials and structures to a new read-write tape head;
- **GMR Servo** – Using software and fast, precise positioning devices, the new GMR servo-reading elements provide an active feedback system with outstanding accuracy in monitoring and positioning the read-write head over a 1.5 micron-wide data track;
- **Tape Handling** – The implementation of flangeless grooved rollers to the current grooved roller data path used in IBM’s LTO and TS1120/3592 tape drives, enable a smoother, high speed transit of the media, enhancing the ability to process high density data; and
- **Signal Processing** – The development of an advanced read channel using “noise-predictive, maximum likelihood” (NPML) software enhances the ability to process captured data faster and more accurately.

Benefits to the Data Center

Having higher-capacity tape cartridges with faster-throughput drives can only improve the TCO picture of any data center. Disk-to-disk (D2D) backup will still be prevalent for the rapid restore of mission-critical files and data. However, energy costs to keep drives spinning and cool the data center from the heat generated by multi-TB disk-based storage networks and the administrative costs to manage these SANs, will see the expansion of D2D2T environments. Parallel advancements in de-duping and compression algorithms will reduce the size of the high-end library required to store petabytes of nearline data, reducing floor space and improving the data center cost structure.

The Clipper Group has used these pages before to endorse the continued value of tape to the 21st-century enterprise. Companies like IBM and Fuji are continuing to put their investment dollars where we have been investing words. This is important to the future success of enterprise IT infrastructure to keep up with the pace of data growth and archival demands.



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- *The Clipper Group can be reached at 781-235-0085 and found on the web at www.clipper.com.*

About the Author

David Reine is Director, Enterprise Systems for The Clipper Group. Mr. Reine specializes in enterprise servers, storage, and software, strategic business solutions, and trends in open systems architectures. He joined The Clipper Group after three decades in server and storage product marketing and program management for Groupe Bull, Zenith Data Systems, and Honeywell Information Systems. Mr. Reine earned a Bachelor of Arts degree from Tufts University, and an MBA from Northeastern University.

- *Reach David Reine via e-mail at dave.reine@clipper.com or at 781-235-0085 Ext. 123. (Please dial "123" when you hear the automated attendant.)*

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