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## New 5TH Generation DDS Drives Offer Major Gains Plus Compatibility With 6 Million Base

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The new 5<sup>th</sup> generation of DDS tape drives offers a major improvement in data integrity, speed and capacity while maintaining compatibility with the installed base of 6 million earlier-generation DDS drives. Until recently, the lack of a clear upgrade path for DDS drives and the fact that several leading tape drive manufacturers have developed their own proprietary standards targeting the low end server market, led some to predict that the DDS standard would die a slow death. But the market has weighed in with its own opinion; giving earlier-generation DDS drives an 87% market share in the low-cost tape drive market in 2001. Now, a new generation of DDS drives is hitting the market with capacity and performance gains over earlier-generation DDS drives. One of the most exciting improvements seen on some of these drives is an environmentally sealed chamber that provides dramatic improvements in data integrity in dusty non-IT environments. Another major gain is (fragment assembly) or the ability to read curved tracks sometimes seen on tapes written by worn older generation drives. At a suggested list price of under \$1200, new 5<sup>th</sup> generation DDS standard drives also maintain the same highly competitive pricing as their predecessors.

DDS (Digital Data Storage) is a data storage format that grew out of the DAT (Digital Audio Tape) format based on work by Hewlett-Packard and Sony. DDS was originally developed as an open standard that has been supported by many different drive manufacturers and media vendors. The main reason why this standard has achieved such overwhelming popularity in the entry server market (servers priced under \$100,000) is that these drives have delivered consistent performance and capacity increases from generation to generation while maintaining backwards compatibility with existing media. This feature offers businesses the opportunity to take advantage of technological advancements while protecting their investment in previous-generation media.

### Interchangeable drives and tapes

Another important advantage of the DDS standard is the ability to interchange tapes and drives among the many different manufacturers that support this specification. Interchangeability provides the user and reseller with an ensured product supply chain while creating competition. The average purchase price of existing DDS-4 drives is currently between \$700 and \$800, which is ideal considering that 80% of the entry-servers are sold for \$6,000 or less. DDS drives are rigorously tested for format compliance and data interchange. DDS media is put through a comprehensive set of tests designed to ensure that only data cartridges capable of meeting the exacting environmental and durability requirements of the DDS standards bear the DDS trademark.

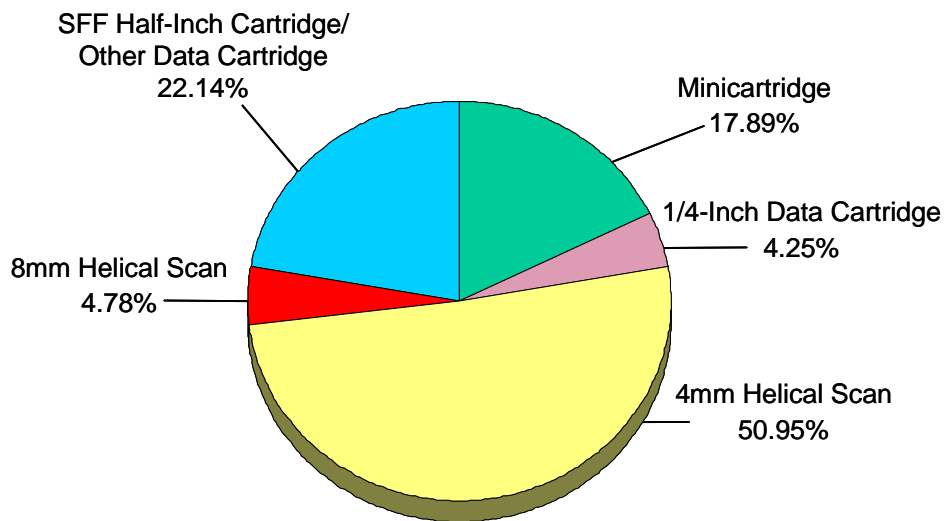
DDS-4, the most recent generation before DDS-5, became commercially available in 1999. DDS-4 drives store up to 40 Gigabytes of compressed data on a single DDS-4 cartridge and offer backup speeds of up to 6 Megabytes per second compressed and 3 megabytes per second native. Data is verified while it is being written, which eliminates the need for a

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second verification pass and cuts the backup time in half. According to Gartner Dataquest, over 50% of the 2,452,766 tape drives sold in 2001 were DDS drives. Yet, despite this success, the path to the 5<sup>th</sup> generation DDS drives has not been an easy one. Early efforts at development of a 5<sup>th</sup> Generation specification were aborted when Sony made the decision to develop their proprietary AIT-1 specification. Several other manufacturers also came out with their own proprietary specifications.

### Time to bury DDS?

DDS drives (4 mm helical scan) have maintained their dominant market share. (Source Gartner Dataquest.)



**Total = 2,452,766 Units**

With the original developers of the DDS specification as well as other leading drive manufacturers busily developing their own proprietary formats, it looked like time to bury the DDS standard. But the market refused to abandon the cost effectiveness, interchangeability and backwards compatibility of the DDS drives and none of the new proprietary formats had the same success in the marketplace. For example, Sony's AIT format gained only a 4% market share of the low-end drive market in 2001. One important reason is that DDS-3 and DDS-4 data cartridge prices from commercial distribution to the reseller range from \$0.54 to \$0.65 per gigabyte compared to \$0.95 per Gigabyte for Sony AIT1. DDS drive pricing, in this case list prices from the reseller to the user, is also lower, at \$997 for AIT-1 drives compared to \$889 for DDS-4 and \$729 for DDS-3 drives.

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With the marketplace providing strong signals that it wanted to see the DDS standard continue to advance, Hewlett-Packard reversed their previous decision and began developing the 5<sup>th</sup> generation DDS specification in earnest. Certance (Seagate), one of the leading suppliers of DDS-4 drives, weighed in by contributing technology that they had originally developed for a proprietary DDS replacement that never reached the market. The new 5<sup>th</sup> generation DDS specification offers several significant improvements over DDS-4 while maintaining the key advantages that have made DDS so popular up to now. An increase in the length of the media will raise the storage capacity of 5<sup>th</sup> generation DDS tapes to 36 Gigabytes native and 72 Gigabytes compressed. The data transfer rate at launch will be 3 megabytes per second native and 6 megabytes per second compressed with substantial growth potential. Just as important, drives that meet 5<sup>th</sup> generation DDS specifications must be able to read the last three generations of DDS media. Fifth generation DDS drives are also expected to hit the same pricing sweet-spot as previous generations at launch and then are expected to follow the same pricing curve as earlier generations during their product cycle.

### Preventing dust buildup

While other tape drive manufacturers could eventually license the 5<sup>th</sup> generation DDS specification, Hewlett-Packard and Certance (Seagate) are the only drive manufacturers that have announced 5<sup>th</sup> generation DDS products to date. Some of the most interesting aspects of the new generation drives revolve around improvements that these manufacturers have made outside the specification to improve data reliability and backwards compatibility. One of the most interesting improvements is designed to eliminate the possibility of data errors or drive failures over time when dust and debris enters the drive. The photos above show an example of a drive without a sealed mechanism after two years in the field. Dust buildup can be seen around the media entrance and in critical areas such as the capstan. In particular, if contamination reaches roller guide tracks and the capstan shaft, stiction can occur during load and unload, causing the media to jam up in the drive.

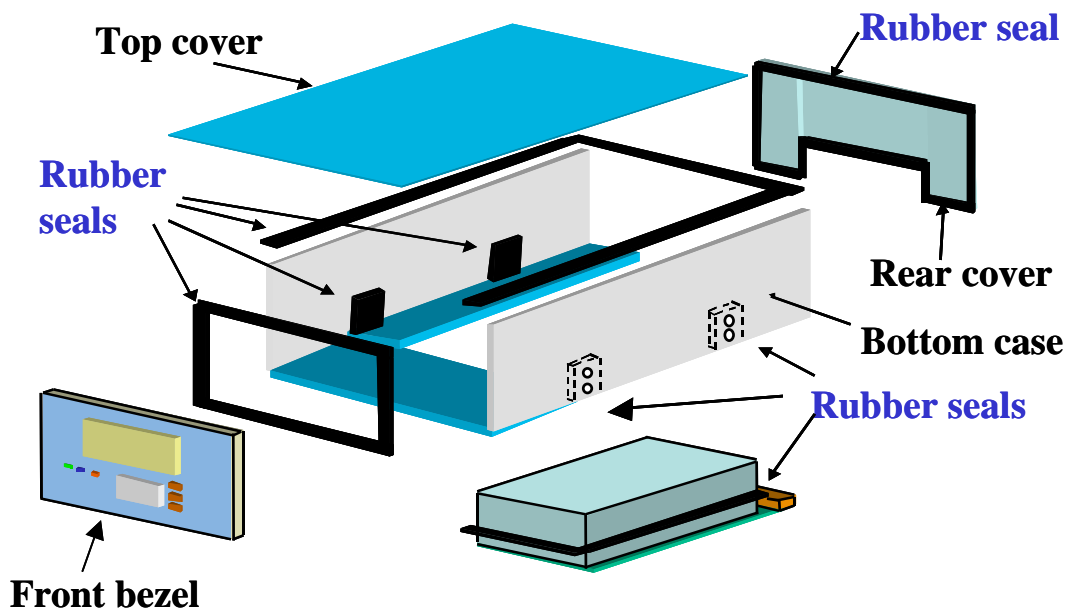
To eliminate this possibility Certance (Seagate) 5<sup>th</sup> generation DDS drives offer an environmentally sealed chamber consisting of a two-piece case with rubber seals at all joints to enclose the drive tape path and block out airborne contamination, which in previous drives may have found their way into the head-to-tape interface and onto the tape path. Certance (Seagate) also redesigned the drive bezel so that as soon as the tape door closes, the drive is completely sealed.

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### Reduction in operating temperature

Initially there was some concern that the environmentally sealed chamber would cause the drive to run too hot. However, temperature measurements at the most critical point in the drive, the tape-to-head interface, have shown that the drive actually runs cooler than previous generation DDS-drives. These tests showed that, in a 23°C environment, the new drives operated at 24°C while traditional drives with unsealed chambers operated at between 24°C and 27°C. This decrease in operating temperature is due to Certance's effort to separate the heat generating sources in the drive's electronics from the sealed media-head interface chamber. The printed circuit board spans the full length of the drive and is separated from the sealed cartridge chamber to allow for continuous airflow between the PCB and the drive case. The new 5<sup>th</sup> generation DDS drive also uses 3.3 volts everywhere inside the chamber, reducing current draw.

*Environmentally sealed chamber.*



Certance (Seagate) drives with a sealed environmental chamber that have been in the field for years have shown a complete lack of contamination. Dust tank testing demonstrates the value of this approach. The density in the dust tank is 90 grams of particulate per cubic meter, about 750 times the density of the normal office environment. Conventional drives

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started producing errors after 1 to 2 hours of operation while the Certance (Seagate) drive with the environmentally sealed chamber ran for 26 days without any errors. These tests should translate directly into longer life and higher reliability for drives built with the new environmentally sealed chambers.

While the environmentally sealed chamber fights airborne contaminants, the media can also contaminate the drive. That's because even a brand new DDS cartridge is likely to contain some debris left over from the manufacturing process. Typically tape media particles deposit themselves on the tape head, then are redeposited on other points along the tape path. In a worst-case situation, the particles could build up on the head-to-tape interface and cause read and write errors. This possibility is eliminated by a new ceramic cleaning blade, located at the beginning of the tape path, that wipes the tape clean of debris. The debris remains localized on or near the blade and is prevented from migrating to the head-to-tape interface.

Capstan from environmentally sealed drive shows no contamination after years in field.

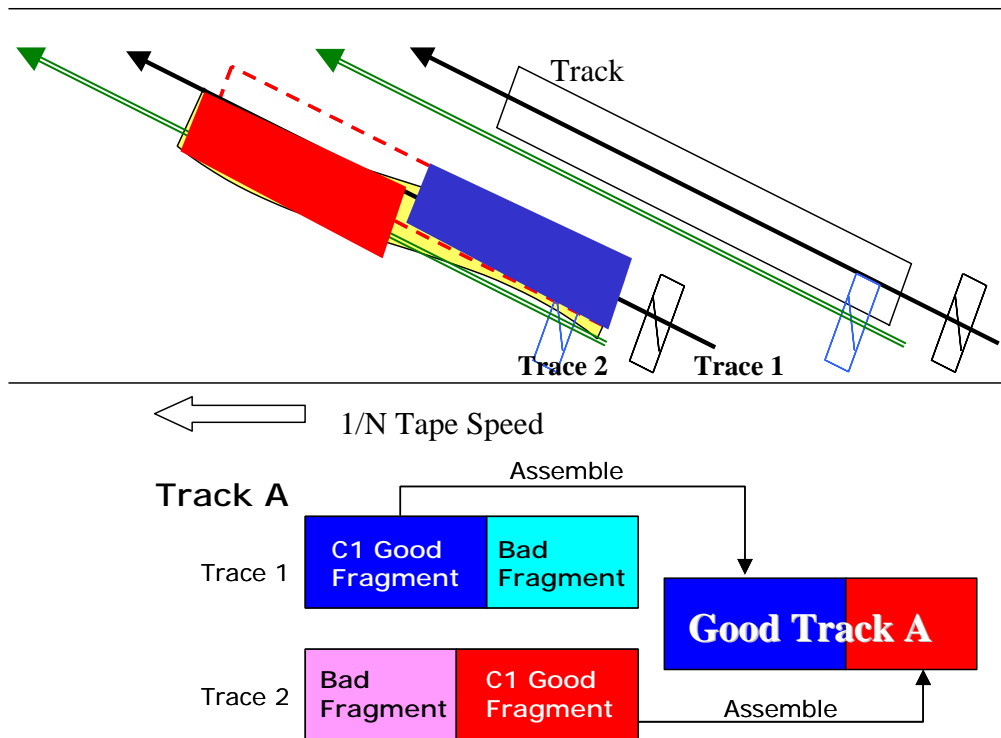


### Fragment assembly

Another major improvement that will first be offered in Certance (Seagate) 5<sup>th</sup> generation DDS drives is fragment assembly which makes it possible to read tapes that were written in earlier generation DDS drives that suffered from contamination problems. All DAT products use the helical scan recording method that has been used in professional video tape

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recorders (VTRs) since 1956 and in home video cartridge recorders (VCRs) since 1974. In helical scan recording, both the read and write heads are located on a rapidly rotating cylinder or drum. The cylinder is tilted at an angle in relation to the vertical axis of the tape. As the tape moves horizontally, it wraps around the part of the circumference of the cylinder so that the head enters at one edge of the tape and exits at the other edge before the tape unwraps. The horizontal movement of the tape in combination with the angular movement of the cylinder causes the track to be recorded diagonally across the tape, rather than straight down its length. The resulting recorded track is approximately eight times longer than the width of the tape.



*How new drives read curved tracks.*

Normally, helical scan drives keep very close control of the tape in the tape path. But, as the earlier generation of unsealed drives age, buildup of contamination on critical components can cause vertical tape motion to occur. The result is a curved track written to tape. As the read head follows immediately behind the write head, there is no way for the drive to detect the problem as it happens. During the read, the tape path is stable so the vertical motion

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seen during the write operation is absent. The read head follows a path to read a straight track and actually reads across multiple tracks. The tape is likely to be either marginal or unreadable. A new feature in Certance (Seagate) 5<sup>th</sup> generation DDS drives, called fragment assembly, corrects this problem. When the head cannot read the complete track, it saves the data that it can read, then backs up and makes several incremental passes along the tape, looking for additional fragments of data that are part of that track. Once it collects all the data, it assembles it in the correct order and proceeds to the next track.

It doesn't require going out on a limb to predict that 5<sup>th</sup> generation DDS drives will not only be successful, but will probably maintain and even expand upon the dominant position established by their predecessors in the low-cost market. Even when it appeared that there would be no successor, the market demonstrated that it preferred the low cost, backwards compatibility and multiple sources of supply of DDS. Now, that a successor is in place that offers all these features while continuing the performance improvements that DDS has been known for over the years, it seems clear that 5<sup>th</sup> generation DDS will be a success. And with innovative features such as the environmentally sealed chamber, ceramic cleaning blade and fragment assembly to enhance an already highly reliable product, Certance (Seagate) 5<sup>th</sup> generation DDS will be a winner by design. ♦

For more information on the company and its products, go to <http://www.certance.com>.