Migration From Hierarchal Storage Management to ASM™ Storage Server: A Case Study

Donald Baune and Geoffrey Bookman

The Department of Radiology at the University of Utah Hospitals and Clinics had to make a change from its current hierarchical storage management (HSM) system. The HSM software is the heart of any near-line data storage system and any change in this software affects all near-line and on-line data storage. In this case, over a terabyte of data had been migrated in more than 2 million files. The traditional method of reading in the old data and then writing it out to the new system was calculated to take more than 60 years. Here, we will examine the reasons for making such a radical change in the HSM used. We will also discuss why ASM™ (the new HSM software) was selected, and the performance improvements seen. A second, less difficult transition was made a few months later, of upgrading to a newer faster tape technology. The two types of tapes were incompatible, but the storage software and robotics used allowed for a peaceful coexistence during the transition. The transition from HSM to ASM was not a trivial task. It required a reasonable implementation/migration plan, which involved finding the correct resources and thinking outside the norm for solutions. All sites that have any amount of data stored in near-line devices will face similar conversions. This presentation should help in the event that a data conversion plan is not already in place.

Copyright © 1999 by W.B. Saunders Company

THE SELECTION of any computer technology is generally made with a great deal of study and evaluation. It has been our experience at the University of Utah that any technology selection, no matter how state-of-the-art, will be made obsolete by the next generation of technology. Whatever solution is selected must have an exit strategy planned/designed into the original implementation. This plan does not necessarily have to be the wholesale replacement of the original purchase, it may simply be an evolutionary growth to a newer, faster, and bigger storage medium (eg, from DLT4000 to DLT7000 tapes and drives). Some thought must be given to the controlling software as well. Will the company that made the archive software today be around next year? While no one can predict the future, one thing you can count on is change.

BACKGROUND

The Department of Radiology built their own near-line storage server with standard components.

It was built to meet the very specific needs of the department, that being the ability to store both Digital Imaging and Communications in Medicine (DICOM) and non-DICOM data in the same archive. A SUN (Mountain View, CA) Enterprise 5000 server with a StorageTek (Louisville, CO) Clarion RAID disk subsystem and a StorageTek 9710 Tape Robotics Library were selected as the hardware configuration. The software to run on this hardware was the more difficult part to find of the total archive server solution. After working with many archive vendors, it became apparent that each vendor had a propriety solution to the archive and was not able/willing to allow the archive to be shared with non-DICOM data. The search for the "right" DICOM archive software took much longer than originally expected. It became critical for us to start storing the non-DICOM data into the archive, even though a DICOM software solution had not yet been found. To meet this immediate need, we selected the Veritas (Mountain View, CA) hierarchal storage management (HSM) tape management system.

Data was stored on the RAID disk subsystem; as the disk filled, the data was migrated to the StorageTek 9710 Tape Library. This migration was done with HSM software; in this case, we used the Veritas HSM software. The file structure of the control data, the information that was left on the disk, and the format in which the data was stored to tape are all propriety to Veritas. While being propriety is not necessarily bad, it does make it difficult to get at the inner workings of the disk and tape system to be able to move large amounts of data quickly. With any HSM system, a requested file is restored from the tape to the requesting/controlling disk. For a small number of file retriev-

From the Department of Radiology, Center for Advanced Medical Technologies, University of Utah Medical Center; and Corporate Medical Solutions, Storage Technology Corporation, Salt Lake City, UT.

Address reprint requests to Geoffrey Bookman, Senior Medical Applications Consultant, Corporate Medical Solutions, Storage Technology Corp, 349 S 200 East, Suite 540, Salt Lake City, UT 84111.

*Copyright © 1999 by W.B. Saunders Company
0897-1889/99/1202-1021\$10.00/0*

als this is adequate. However, when trying to move all of the data on the HSM system to another file system, the preferred method is to read the tapes directly to the new file system without the intermediate step of staging the data to a local disk. It was determined (after approximately a year) that the Veritas system was not the best choice available for the type of data that we have in our system. The data that we were storing is many, many small image files. Additionally, the DICOM archive software to store the DICOM images was not compatible with the Veritas HSM software. This left us with the rather monumental task of moving from the Veritas HSM to the StorageTek ASM™ system.

PROCESS

The process of moving to the new HSM software was long, difficult, and unsupported by all parties involved. Being unsupported does not mean unhelpful. We received a great deal of advice and understanding as to how the system worked, but no guarantees that the process we were undertaking would be successful. The first step was to move the tapes out of the StorageTek 9710 Tape Library and the Veritas HSM software off the SUN Enterprise 5000 server. This was necessary as we needed to reuse the Tape Library and the SUN Server in the new configuration. The current data had to remain available during the conversion process so it was necessary to move it to another server in such a manner as to look transparent to the installed base. This was accomplished with a small (1-Tbyte capacity) loaner StorageTek 9730 Tape Library from Datalink and a SUN Sparc 20 desktop. We installed a generic version of the Veritas HSM software on the new SUN Sparc 20 with the loaned StorageTek 9730 Tape Library. All of the HSM tapes in the StorageTek 9710 Tape Library were exported and placed in an off-line state. Once the Veritas HSM software was installed, configured, and tested with the loaner tape library, the RAID5 disks that were under Veritas HSM control were physically disconnected from the SUN 5000 and connected to the SUN Sparc 20. It seemed a bit of a waste to have 200 Gbyte of disks on a SUN Sparc 20. The HSM software was configured to manage these disks. The tapes were then imported and placed in a near-line state in the new StorageTek 9730 Tape Library. The ability to use the same disks on the temporary system allowed us to move all the control data and file handles to the new

system without the difficult steps of backing them up to tape and then restoring from tape into the new environment. Once the transfer was accomplished, we waited several days to make sure that all was functioning correctly. The move was done in such a manner as to allow us to return to the original configuration quickly if it became necessary.

After the temporary home for the accumulated data was established, we were able to completely reinstall the permanent archive with the newest version of the SUN operating system, HSM software and new StorageTek 9145 Fiber Channel RAID disks. The ASM™ software is from LSC, Inc (Eden Prairie, MN) and is called SAM-FS (Storage and Archive Manager File System). Once the new ASM™ system was installed with the new disks, we were able to begin testing the new migration software to verify that it did not suffer the same shortfalls that we experienced with the Veritas HSM system. After system burn in with the new disks, we installed the Oracle Database (Redwood Shores, CA) software and the Image Devices DICOM archive software distributed by Picker, International (Cleveland, OH). The archive was then allowed to store exclusively DICOM images for several months as a test of how the archive would perform under normal clinical load. The length of the test was necessary to allow the read-ahead cache, and the disk write cache's to fill. The difference between a new archive versus one that has several months of real data can be enormous. We did not really discover some of the problems with the Veritas HSM system until it had been in real-world use for 6 months.

After we were satisfied that the archive was performing as designed, we began to slowly add our non-DICOM data back into the permanent archive. This was done with a great deal of care to avoid any conflicts with the clinical DICOM data. The process was done in steps; first, new data was introduced to the archive. Then, as old data was needed from the temporary archive, the data was restored and used as needed and then written to the new archive. After verification that these data was successfully stored, the data was deleted from the temporary system. This allowed the most used data to be on the new system first. This process is continuing today and it is anticipated that at some point in the future we will begin an effort to move any remaining data on the temporary archive to the main archive in one large process.

EVALUATION

We chose the ASMTM system as a replacement of the Veritas HSM due mainly to the migration method. Veritas HSM waited until the disks reached the high-water mark to begin selecting files for migration to tape. This selection and migration would typically take more than 40 hours, during which the ability to retrieve data from older tapes was also severely restricted. This was due to a design where individual files were written to tape and a confirmation was received for each file. With this method of file writes to tape the DLT tape drives were never given sufficient data to go into a streaming mode and file transfers were extremely slow. The confirmation of writes to tape is critical to the verification that data were successfully written to tape. With ASMTM it can be done in much larger units, which allow the tape drives to reach their designed transfer capacity. A second issue that was discovered is the massive number of files that were being generated. The Veritas HSM was designed to handle a relatively small number of large files. Real radiology image data contain a very large number of relatively small files; for example, in 1 month, our department stored just over 200,000 images with a total disk use of 180 Gbytes.

How does ASMTM treat data, tapes and migration differently? Data migration begins as soon as data is written to the disk and is there for a sufficient amount of time to be sure that no additional images will be received for that series (≈ 1 hour). After the data has aged for this time period, the information is copied to tape as a full series (lowest level directory) with verification of the series write as

one event. This allows the tape to achieve its rated transfer capacity and then verify that it was successfully written to tape.

CONCLUSION

The migration process described here is not the way in which we would have preferred to do it. As hinted earlier, the ideal method would have been to have known the file formats on the tapes and simply read the data from the near-line storage directly into the new archive system. We had just over 40 tapes and we calculated that we would have been able to read all of these data in less than 30 days. This was not possible with the way that the data were stored and indexed in our system. As it worked out, the migration is taking many months.

While not every conversion will go this smoothly, the key items to a successful conversion include a great deal of planning, very detailed understandings of the internal workings of the archive software and its near-line data, creative design; and the willingness to take a limited amount of risk. While taking some risk with valid clinical data is not something that I would enter into willingly, in some cases, it is the only option. The real key is planning with vendors at the time of sale, getting some assurances and planning with their help and blessings that there is a feasible plan for moving to the next generation of archives, whether it is their product or that of a competitor. One important point to remember is that the vendor that sells the archive today may not be around or with the same vendor 2 years from now, so local expertise and understanding of the inner workings of the archive is essential.