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Storing Diagnostic Images

West Virginia University Hospitals examined its enterprise storage practices and found 'a large tail wagging a small dog.' Here's how the hospital changed its approach.

By Michael T. Balassone, CPHIMS, FHIMSS, and George H. Bowers, FHIMSS

Storing non-textual data has become an issue in health care organizations as more data applications such as picture archiving and communications systems (PACS) and document image management systems have become increasingly popular.

Traditionally, storage requirements for a specific application were handled on an individual basis. An organization typically purchased PACS with a PACS archive. Planning for diagnostic image storage was part of the overall project implementation. If storage capacity began to run low upon activation of the application, the upon activation of the application, the organization usually purchased more of the same storage media. Data storage was considered part of the application. If an application's data storage could be shared with a new application, that was a plus; however, it was not the rule. When installing a new application, the organization usually did not revisit its storage requirements or storage architecture. If an application worked, it stayed "below the radar."

In today's environment, PACS and other applications that store diagnostic images have clearly put storage on the list of top-priority issues for health care organizations. This article describes our organization's adjustment to that reality.

Upgrading storage requirements

West Virginia University Hospitals (WVUH) is an academic medical center that serves a large rural region in North Central West Virginia. In spite of being in an economically deprived section of the country, WVUH had managed to keep up with most health care organizations in having the current state of information technology. Our technology environment included PACS for radiology and another PACS for cardiology.

In 2004, administrative responsibility for the radiology and cardiology PACS was transferred from the individual departments to the CIO. Within a few weeks, the CIO received a request from the PACS administrator for a significant upgrade to the storage requirements for PACS, stating that the systems would be totally out of storage space for images within a few weeks without action. The request specified a multi-terabyte storage area network (SAN) with a high price tag and emphasized the need for storage planning.

Global storage

At the same time, several other factors indicated that WVUH should look at storage from a global perspective.

WVUH was considering proposals for vendors for an enterprise-wide clinical information management system that would support inpatient and outpatient services while addressing issues in patient safety and workflow efficiency. The data storage requirements were not known. Meanwhile, the looming HIPAA security rule deadline challenged the organization to not only guarantee the privacy of patient information but to safeguard it and ensure that it could be recreated and retrieved on a timely basis.

In the short term, WVUH was being driven to new storage technology based on specific application requirements. What would be the implications on the organization's storage requirements with all of the other events happening and at what cost to the organization?

WVUH engaged the assistance of Health Care Information Consultants to focus on the aforementioned issues. First, we gathered information about data-storage usage among all applications at WVUH. This included an inventory of the applications, their storage media, current storage size, their methods for backup and historical growth rates. Because of the diversity of the applications, we calculated growth on an application-by-application basis. For some applications where historic data on storage was not available, we interpolated growth rates based on other indicators such as transaction volume. For some applications, such as the radiology PACS, we factored in growth in the number of diagnostic images per study in addition to growth in the number of actual studies. We gathered additional information regarding the procedures for data retention and disaster recovery. We then analyzed and compiled the information into an enterprise-wide picture of data storage usage at WVUH.

The findings

We measured more than 22 terabytes of data storage among all WVUH applications, an amount significantly higher than originally estimated. The cardiology and radiology PACS combined for over 18 terabytes of the total storage. Both applications had storage growth rates greater than 12 percent per year. We calculated this percentage before factoring in the impact of new imaging modalities projected for inclusion in the WVUH capital budgets for the next few years.

WVUH is also planning to acquire three new multi-detector CT scanners within four years and will begin implementing digital mammography in the near future. The application driving the initial storage network decision was optical imaging. Document image management, a new application for WVUH, showed a growth rate of more than 150 percent, which was greater than originally anticipated. With the implementation of a new enterprise-wide clinical information management system incorporating the new imaging modalities, WVUH could need an additional 10 terabytes of storage over the next 5 years.

In analyzing the organization's disaster recovery procedures, we discovered that WVUH's disaster recovery plan with an outside vendor had been partially tested. However, a full-blown test to simulate a real disaster had not been performed; restoring all data from all applications is beyond the current contractual provisions.

For other applications, WVUH identified more than eight different tape back-up systems using various generations and types of tapes and drives. This was another example of systems having been built one piece at a time with reliance on individual vendor solutions instead of an enterprise back-up strategy. Not all of this equipment is covered under the third-party disaster recovery contract. In the event of a disaster, purchasing replacement equipment and then configuring it would be a major effort and require significant time.

In addition, some of the tape back-up equipment is no longer manufactured, which would pose a challenge in the event of a total disaster. We identified additional risks in trying to restore critical files from tape. For example, the amount of time required to restore databases from tape would have been unacceptably long. We also determined that the recovery methodology for some databases was not applicable for some critical patient data.

The projected growth models also showed that storage capacity was unevenly allocated among applications. The models were designed to calculate critical dates. The first trigger would be 18 months prior to the projected "out-of-storage" date in order to plan for the additional storage in the capital budget process. The second trigger date would be nine months before the out-of-storage date, coinciding with a normal purchasing cycle for new equipment. The models indicated that our mainframe applications would not run out of storage until 2024. Two other applications, document image management and the desktop user network backup, were already past their first trigger dates.

Lessons learned

The key lesson learned from our analysis was that data storage can no longer be driven on an application-by-application basis. Managing it at an application level creates pockets of risks in terms of disaster recovery and potential crises if the organization were forced to purchase additional storage because of depletion of storage for a particular application.

Storage management needs to be performed at an enterprise-wide level. While imaging applications such as radiology and cardiology PACS can consume the largest portion of the enterprise's storage requirements, continuously feeding their voracious appetite for storage does not necessarily yield the best solution. When new

storage technology is introduced, it must be considered in light of the needs of the entire enterprise. For example, our Tivoli tape management system, a sophisticated tape back-up system previously used at WVUH solely with one application, could instead be used on a broader basis and provide benefits to multiple applications.

Our organization also learned that disaster recovery plans need to be continuously evaluated, tested and revised based on changes in the environment. What might have been an acceptable plan five years ago may no longer meet HIPAA requirements or the organization's operational requirements. Taking several days to recover from a disaster is not acceptable, particularly for an institution such as WVUH that has a special relationship with the citizens of West Virginia. Finding adequate solutions takes creative thinking, careful planning and the realization that storage is a component of infrastructure that must be continuously addressed.

Enterprise storage management

WVUH is finalizing an enterprise-wide storage management plan that will provide a multi-year roadmap toward a standard SAN solution using data vaulting as a back-up and recovery technique.

In between the implementation steps will be reductions in the number of tape back-up systems. We also plan to take advantage of the current Tivoli tape management system for more applications.

A new position reporting to the CIO is also being considered; the position would have responsibility for implementing this plan as well as monitoring storage growth and maintaining the organization's disaster recovery plans. The data growth models will continue to be used in such analyses and will be regularly updated and evaluated.

A major obstacle to implementing this plan will be cost. While the final costs are still being calculated, it will be a multimillion-dollar capital expense. Because this is an infrastructure project, it lacks the appeal of other projects that are visible to end users. The long-term benefits will include some cost savings from eliminating multiple storage systems. However, the major benefit to the organization will be assurances that critical patient information will always be available in a timely fashion.

Like other major technology projects, creating an enterprise storage solution will start with an organizational awareness process. Selling the concept will start with the education of senior management on the need and the technology. Besides dealing with costs, the issues of network connectivity, space and availability will need to be considered, too.

As advanced clinical systems become more prevalent, so will the need for redundant and highly available storage. Storage vendors will become an integral part of hardware configuration planning, as storage technology will have a life cycle like other hardware components.

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Memorial Hermann Speeds Access to Patient Information

Memorial Hermann Healthcare System, a network of 12 hospitals, nursing homes and other health care organizations, had previously relied on an optical storage and retrieval (OSAR) system that could not keep up with the health system's rapidly growing active archive needs.

Consequently, record retrieval was slow with numerous backlogged requests to access the system when the OSAR solution was taken offline.

Based in Houston, Memorial Hermann now uses a tiered storage approach to support its long-term paperless patient record system and archive data across FileNet's document-imaging solution, Heartlab's cardiovascular imaging system and GE's Healthcare PACS. Because the value of medical information changes over a patient's lifetime, Memorial Hermann moves PACS and other images from EMC Corp.'s CLARiiON networked storage to EMC Centera content-addressed storage for long-term archiving. The tiered systems provide multi-application support, lower storage acquisition and ongoing management costs, and improve management of retention periods and expiration dates.

"Each day, our systems generate thousands of documents and images that must be instantaneously available to our 4,500 doctors, nurses and administrators," said Robert Weeks, Memorial Hermann's director of information technology. "By archiving and retrieving patient records faster, we are able to further comply with federal and state regulations governing the retention and security of medical records and automate our records management processes. As a result, our users get their jobs done faster and more efficiently, which leads to higher-quality patient care."

Roberta Katz
Director and Global Solutions Leader
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