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Server Consolidation & Virtualization

Category

Improving State Operations

State of Illinois
Central Management Services
Bureau of Communication & Computer Services
120 W. Jefferson
Springfield, IL 62702-5172

B. Executive Summary

In 2003, the State of Illinois faced a \$5 billion budget deficit and searched for opportunities to reduce costs. Legislation was written and passed by the General Assembly with a goal of creating efficiency and reducing costs through the use of shared services.

The Bureau of Communication and Computer Services (BCCS) within the Illinois Department of Central Management Services (CMS) conducted an analysis to determine several potential areas of cost savings and efficiencies. It was determined that duplicate efforts throughout various state agencies could be eliminated and savings realized by sharing and consolidating IT services. Data center operation and server management were identified as areas for significant potential savings. Data center server consolidation and virtualization would enable the state to reduce the number and size of data centers scattered throughout Illinois among disparate agencies.

The goal of the data center consolidation was to physically consolidate servers into two primary data centers: one in the State capital located in Springfield, IL and the other in Chicago. Begun in 2006, the project resulted in the decommissioning of 22 substandard data center/computer rooms, which resulted in a reduction of 22,800 sq. ft. of data center floor space. The move resulted in: significant cost reductions, improved service and availability, and significantly better operational efficiencies.

Server virtualization began in January 2008 after the initial physical consolidations were completed in the primary data center in Springfield. Most of the servers were over ten years old and in desperate need of upgrading/refreshing. There was also a need to better utilize power, cooling, and floor space. A decision was made to install redundant/clustered virtualized server systems utilizing blade server technology, SAN attached storage, as well as, water-cooled racks. The consolidation was designed to be fault-tolerant and scalable with the capability of full, off-site disaster recovery.

The project resulted in the virtualization of 854 aging physical servers and the installation of 190 new virtual servers for a total of 1044 virtual servers managed today.

The project also resulted in more efficient operations at reduced costs, improved service measured by higher server uptime and reduced server/storage provisioning times. Completion of the project has resulted in a significant Return on Investment (ROI) totaling over **\$10,798,000** between July 2006 and May of 2010.

C. Description of the Project

Prior to IT consolidation, each agency managed and maintained its own IT environment including data center operations and server management. Raised floor data centers at these locations ranged in size from approximately 500 square feet to 30,000 square feet and contained anywhere from 10 to more than 350 servers. A study was completed to determine the current state of 12 primary data centers. The study determined that the existing data centers were in various states of disrepair and suffering from a combination of the following conditions:

- UPS system batteries beyond life and failing
- Regular maintenance and testing of emergency equipment was not performed
- The agencies were managing disparate contracts for emergency equipment
- Servers were aged and prone to failure
- Server environments lacked redundancy
- Existing server hardware was underutilized

There were two viable choices: 1) upgrade the existing data centers and continue the decentralized data center and server management approach, or 2) consolidate both the data centers and the servers within them. Due to cost and availability considerations, the decision was made to consolidate the data centers and centrally manage these systems. The existing twelve agency data centers and ten smaller computer rooms were consolidated into the two best existing data centers, one in Springfield, IL and the other in Chicago, IL. To address the problem of aged and failure prone server hardware, analysis was completed to determine the cost and benefit of simply upgrading all the existing server hardware, or utilizing virtualization technology as an upgrade/replacement strategy. The virtualization solution was selected due to lower hardware costs, higher utilization, lower power/cooling needs, increased uptime/availability and overall lower overall management cost. A combination of blade server technology utilizing water cooled-rack and 3-phase power was utilized to increase server density, minimize power and cooling consumption, and lower overall cost.

A separate project manager was assigned to the project and each of the phases and sub-projects. Traditional project management methodologies were utilized throughout the project. A scope was defined for both the development of the systems and migration of agencies. Milestones were tracked and reported. The project manager reported metrics of progress, risks, and issues via weekly status reports to the Enterprise Project Management office. Any major issues were escalated to the management team for assistance and resolution. Numerous meetings and other communications were initiated with customers, especially during conversion. Additionally, the project manager's implementation of a dashboard showed stakeholders the current status of a subproject in one page documents. This kept the team focused

on any issues and problems. The team discussed lessons learned at the end of each subproject.

The plan developed for the data center consolidation was basically a three phase project. The first phase addressed Springfield based agency data center consolidation, the second phase addressed Chicago-loop based data centers, and the third phase addressed the virtualization of the server environment.

Solution - Data Center Server Consolidation

The discovery phase of the project began in July 2006, and agency consolidations immediately followed. A dedicated project manager was assigned and meetings were conducted with agency CIOs. Initially, we were met with resistance from the agencies who anticipated a “loss of control”. Additional meetings were held, agency input was accepted into the project plan and resistance began to fade. The entire plan was eventually accepted and the level of trust increased as we absorbed the agency infrastructure support personnel. The same staff with the legacy knowledge of the agency equipment would continue to manage and maintain the equipment. The agencies were confident that their service levels would not be diminished. Following each agency consolidation, follow-up meetings were held, and lessons learned were incorporated into the project plan before the next move.

Phase I was completed in December 2007 with the consolidation of 1237 servers from ten agency data centers.

Phase II, the Chicago-based data center consolidation, began in June 2008. This phase involved one single agency’s primary data center, and servers in numerous small computer rooms and closets throughout the Chicago Loop Area. The Chicago-area data center consolidation moved 127 servers and was completed in November 2009.

The entire data center consolidation effort decommissioned 22 data centers and computer rooms resulting in a reduction of 22,800 sq ft. of data center floor space.

Phase III, the server virtualization immediately followed data center consolidation. This effort was planned to address the aged and failing hardware that we had recently acquired. Based on research and cost-benefit analysis, it was decided to implement a virtual environment rather than perform physical upgrades of the hardware. New hardware technologies were researched, and Hewlett Packard (HP) blade server technology was selected as the physical platform. HP water-cooled racks were used to increase cooling efficiency and reduce space requirements. A redundant Storage Area Network (SAN) system from EMC was used for shared storage. This technology utilizes a smaller footprint, less power and reduced cooling requirements. The server virtualization software technology was based on VMware ESX which includes clustering and failover. Off-site disaster recovery was included in the design and implementation.

The server virtualization phase of the project was developed and implemented in 2008. As part of this phase, we contracted with HP/Vmware consultants to perform analysis,

provide recommendations for virtualization candidates, and assist with initial virtualization efforts. Documentation of the virtualization process and a knowledge transfer from vendor staff to state staff was a significant portion of this initial phase. The virtualization of 850 servers was completed by the end of November 2009.

In addition to the virtualization of existing devices, this environment is the foundation for all new projects and systems. As server systems are requested for new projects, they are implemented in the virtual environment whenever possible. A total of 1,044 servers exist in the virtual environment today.

D. Significance

The Data Center Server Consolidation and Virtualization project has provided numerous benefits to our varied customer set comprised of consolidated state agencies and the citizens of Illinois/ served through the Departments of Public Health, Human Services, Healthcare and Family Services, Agriculture, Environmental Protection, Finance and Professional Regulation and Employment Security to name only a few. We have been able to reduce the overall costs of running multiple data centers required to provide necessary services by eliminating many of the duplicate “back office” or “back data center” efforts. Processes have become more efficient, and we have been able to maximize our people and hardware resources by sharing talent and servers under two roofs. Additionally, the newer technology has allowed us to take advantage of its greater reliability and built-in failover capabilities. We have eliminated the costs associated with server and application downtime. Virtual servers are provisioned and configured in a fraction of the time it took to install the older physical technology. The difference is minutes versus months. Additional resources such as memory, CPUs, and disk space can be provisioned very quickly, as well. We now have the flexibility and capability of responding to our customers’ needs in a more timely fashion. Our resources are less frequently over-committed.

E. Benefit of the Project

The State of Illinois has realized many operational and financial benefits as a result of completing the consolidation:

- We have reduced the number of data centers by nearly 85% and have thereby avoided \$4,300,000 in annual operating costs by eliminating environmental, lease space and required facility upgrade costs.
- We are also now able to support and monitor our entire IT environment 24x7 through our Command Center. This has resulted in reduced down-time and increased system availability to the Agencies and their constituents.
- Reliability and availability have greatly increased, due to newer hardware and software technologies implemented. The virtual environment provides automatic failover, which translates into increased customer satisfaction, from both our

internal agency customers, as well as, Illinois citizens needing to access resources.

- Server consolidation and virtualization has enabled us to more efficiently use our rack space and has reduced the amount of server floor space required. **Server virtualization has reduced by 92% the amount of floor space** required as compared to physical servers.
- Our **server processor utilization has increased by over 700%** on average since consolidation and virtualization. This has allowed us to allocate resources more efficiently and lower the overall cost.
- Server virtualization has allowed us to greatly increase our energy and cooling efficiencies. Virtualization and blade server technology enable us to **reduce our power consumption by 77%**. The project has also allowed us to indefinitely postpone approximately \$1.5 million in power and HVAC upgrades to the State's primary data center.
- By moving to a virtual environment instead of procuring new hardware, we have been able to save \$1,958,544, or \$1,876 per server for regular hardware lifecycle replacements.
- A side benefit of bringing many agencies beneath one roof has been improved inter-agency relations. The affected agencies were included as partners in the planning and implementation phases. Their insight into legacy operations was critical, and their input and involvement was vital to the success of the projects. In the end, both trust and respect were developed as part of the projects.
- Overall, the project has allowed for more efficient operations. During this time, server operation staff has been reduced by 16%, mostly through attrition. The consolidation and virtualization project has allowed us to operate much more efficiently. Standard patching methodologies have been implemented, standard server build processes have been created, and standard anti-virus detection across the server environments utilized.

Return on Investment

- Our Breakeven Return on Investment (ROI) for the virtual server environment in phase III was realized in just thirteen (13) months.
- An average of \$2,159,600 annual ROI has been realized since the project began in 2006.
- A total of over **\$10,798,000 (260%) ROI** has been realized over the life of the project.

The project has been a great success. From a reduced number of data centers to the implementation of more modern technologies and improved efficiency, the state has been able to realize significant financial and operational benefits. The end result is higher service levels at a reduced cost for all of our agency customers and the tax payers of the State of Illinois.