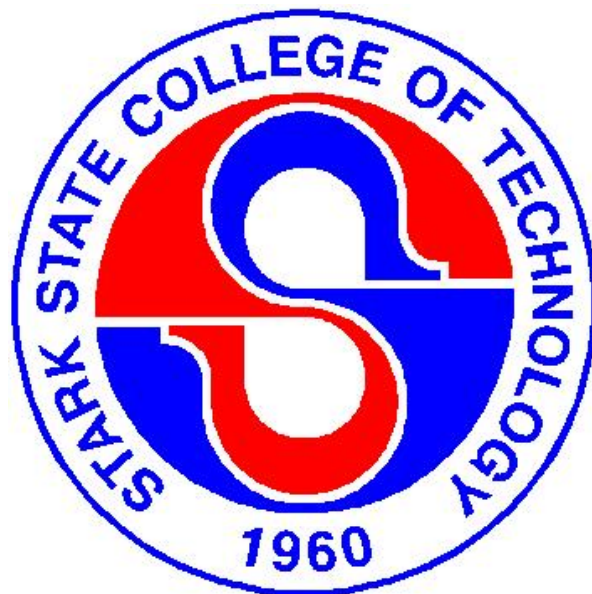


Information Technology White Paper

Virtualization

Building an Adaptive, Cost Effective Infrastructure at SSCT



October 5, 2009

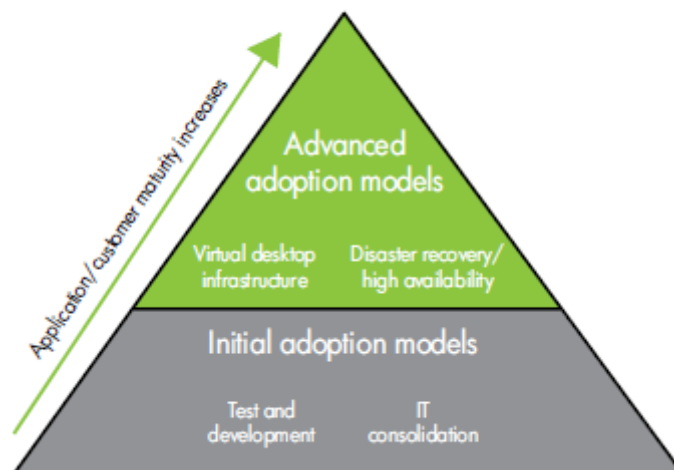
As the College grows the College needs to be poised to respond faster to market changes, stakeholder demands, growth opportunities and new technology. To do this, we need an agile and cost effective IT infrastructure. Some components of the solution are to increase the utilization of IT assets, reduce operating costs and improve the flexibility and adaptability of our server and storage systems.

Virtualization addresses these challenges by enabling us to pool and share computing resources. From a business perspective, the pooling and sharing of IT resources allows computing capability and capacity to keep pace with new developments and demand for services. A virtualized environment increases flexibility because a diverse range of resources can be added, changed, and moved as needed, to meet shifts in requirements and demand. Virtualization techniques also improve resiliency by simplifying backup, failover, and disaster recovery solutions.

From a cost perspective, pooling and sharing helps increase the utilization of IT assets and pack more computing and storage capacity into the same physical space. Virtualization helps reduce the total cost of ownership of IT assets—in terms of both capital expenses and operating expenses—by enabling greater use of our physical resources. For instance, typically only 50 percent of Storage area network (SAN) storage is utilized in a non-virtualized environment. That increases to 80 percent in a virtualized environment.

To capitalize on our virtualization opportunities, an integrated virtualization solution has been implemented at SSCT in the last several years for selected administrative systems and this year for selected academic systems with more capabilities planned as outlined in our IT Strategic Plan and our IT Implementation Plan. Figure1 represents the virtualization adoption model. We are currently in the green area moving to the top of the pyramid.

Figure 1: Virtualization adoption model



Progress to date

- We have built a next-generation data center using state of the art servers and storage systems, which integrate compute, network, storage, and management resources into platforms designed for virtualization.

- We have consolidated our storage using shared SAN storage solutions with storage management software.
- Virtualization has allowed us to reduce power usage and costs by server consolidation. With virtualization we have consolidated many physical servers and storage units into virtual server or storage pools. This has resulted in approximately 13 virtual servers running on each physical server. This helps us stop physical server and storage sprawl and solve the problem of devices that are under-utilized, consume too much space, and cost too much to power, cool, and maintain.
- Virtualization has allowed us to create a high availability IT infrastructure based on virtual machine environments. Normally the virtual servers cooperate and distribute applications across machines for best performance. If a server fails then the other servers in the cluster automatically take over running the applications that were running on the failed server. Also since virtual machines can be easily replicated, backed up, and moved from one machine to another, virtualization greatly simplifies recovery in the event of system failure and even reduces planned downtime.
- Virtualization has also improved the efficiency of your test and development environment. With virtualization, we can run multiple operating systems and versions on fewer servers and workstations. This helps us support complex dedicated development and testing environments with limited resources.
- Virtualization and the use of SANs will assist in the maintenance and failover to our proposed DR site in the event of a disaster.
- We are monitoring and will be investigating the application of virtual desktop infrastructure (VDI) to office, lab and E-learning environments. This capability allows hosting of desktop environments, including applications in some cases, on a virtual machine running on a centralized server. VDI may provide students, faculty and staff with all the functionality of a stand-alone desktop plus features that increase mobility, access, security, decrease cost and provide high reliability. In addition to user features, VDI can reduce the cost of equipment through the use of thin clients as opposed to PCs. Thin clients cost less than PCs, use less power and have a longer life. These cost savings may however be mostly offset by the cost of servers running the VDI environment. We are following developments in this area including some tests and pilot projects recently started at a few sister schools. We have planned to do a pilot of our own next year.

Our virtualization results

For administrative systems, we have replaced 20 physical dedicated servers with 3 virtual machines and 2 SANs. Also we have avoided the addition of approximately 20 more servers needed to support new applications added over the last few years. We have just started our virtualization program this year for academic systems. So far we have replaced 5 physical dedicated servers with 2 virtual machines and 1 SAN. Since there is unused capacity on the existing virtual machines, new servers will be added and other servers will be migrated to a virtual environment over time without significant additional cost.

Table 1 compares two simplified scenarios for our 40-server administrative environment. The first scenario (Base) assumes 40 physical servers with no virtualization. Using our 13:1 (40/3) consolidation ratio, the second scenario shows what happens when those 40 servers were virtualized onto 3 servers and 2 SANs. Both scenarios assume a four-year replacement cycle. For the virtualization scenario this yields savings of approximately 46 percent over a four-year period, excluding networking and potential real estate savings.

**Table 1: Virtualization Savings
For Administrative Systems**

	Base (\$)	Virtualized Infrastructure (\$)	Savings (\$)
Initial Server, SAN and Software Cost	260,000	150,000	110,000
Capital (Hardware Replacement) Cost over 4 Years	220,000	140,000	80,000
Operating Costs over 4 Years (estimate)	127,000	35,000	92,000
Total 4-Year Costs and Savings	\$607,000	\$325,000	\$282,000

Savings

Capital cost savings come in the form of reduced expenses for hardware acquisition and maintenance and potential savings for data center real estate. The following breaks down the capital cost savings as illustrated in the virtualization scenario.

- **Server hardware:** Moving to a virtual environment helps us cut capital costs by reducing the number of physical servers necessary to support our infrastructure. With virtualization, server consolidation ratios are typically in the range of 8:1 to 15:1. In our case we have a 13:1 consolidation ratio. This leads to a significant reduction in expenditures. The virtualization solution achieves these sorts of gains by consolidating workloads onto fewer servers. In addition, our new servers pack more computing power into the same physical space.
- **Storage hardware:** With a virtualized environment, we have reduced our capital expenditures for storage devices by consolidating data storage. As part of a VMware implementation, we have installed SANs which deliver pools of shared storage that enable greater server consolidation. When you combine SANs with servers running VMware, you can increase storage utilization from as low as 25% to as high as 80 percent.
- **VMware software:** There are costs for the virtualization software. The state has negotiated very advantageous pricing for this software which we are taking advantage of.
- **Management software:** Management software is part of the VMware suite enabling significant operational cost savings in the daily management and provisioning of the environment while also helping to reduce costs associated with unplanned downtime.
- **Data center expansion:** In addition to the capital cost savings detailed above, virtualization also helps to avoid the high costs of data center expansion. With data center building cost estimates ranging from \$800 to \$5,000 per square foot, this is an important area for cost savings. This is especially true when you consider that each rack of servers requires approximately 6.5 square feet and needs three times that for adequate cabling and airflow. If we had not implemented virtualization we would be at or near the point of having to expand our data center.

Operational cost savings are also substantial in a virtualized environment. These savings stem from reductions in power and cooling costs, management costs and the costs associated with server downtime. The following breaks down the operational cost savings as illustrated in the virtualization scenario.

- Power and cooling costs: Virtualization can help us hold the line on rising power and cooling costs. These savings stem from reductions in the number of physical servers in our environment. The total power and cooling savings from removing just one server from our environment is estimated at \$655 per year. Replacing 40 physical servers with 3 virtual servers and 2 SANs results in a savings of over \$20,000 per year.
- Server provisioning costs and time savings: Virtualization allows us to provision servers (set up new servers) in less time—a minimum of 70 percent less time—which, in turn, leads to reduced infrastructure management costs. For example, adding 10 servers to the environment as part of a physical server refresh requires 100 hours of provisioning at an average of ten hours per server. In the virtualized scenario, this is reduced to 29 hours, allowing us to spend an additional 71 hours on more strategic IT projects. Virtualization has also reduced the time to respond to requests to host new applications since we can usually host them on an existing virtual machine avoiding the equipment procurement and deployment time and thereby getting the application running in a few hours as opposed to weeks or months.
- Server downtime: In addition to the costs detailed in the Table 1, there are significant cost reductions attributable to virtualization's ability to reduce planned and unplanned downtime. Virtualization can help us keep systems up and running during hardware failures, disasters and other disruptive events, and the reduced number of servers resulting from virtualization shortens recovery times and reduces losses associated with downed servers in the event of a disaster. Furthermore, the cost of planned downtime is reduced by allowing for host servers to be maintained without disruption to end users via movement of virtual machines to other virtual servers.

Server virtualization often leads to total savings across capital and operating costs of 50 percent or more over a four-year period. We can also expect a fast return on our investment. Total payback time for virtualization projects is typically less than one year due to the significant capital and operational savings. We intend to continue our virtualization plan as a way of providing enhanced IT services at less cost.

Acknowledgement: Portions of this document based on - The Business Case for Virtualization. Building an Adaptive Infrastructure with HP and VMware virtualization solutions - Hewlett-Packard