

Optimizing the Data Center

Oakland Unified School District embraces virtualization, blade server and SAN technology

Enterprise Technology Manager Kelvin Chan was recently tasked with a challenging but unique opportunity: replace Oakland Unified School District's aging IT infrastructure and build a new data center from scratch.

In recent years, the district, which is located in Oakland, Calif., suffered from a textbook case of server sprawl. The data center was packed with 120 physical servers and running out of room. Managing data with direct-attached storage was inefficient. When server hard drives reached near capacity, the IT staff purchased new servers with bigger drives and migrated applications and data over, a time-consuming and costly task. Bandwidth at the network core was also a problem. The district's 1Gbps network was no longer fast enough. The data backup process was also too slow, taking two to three days to complete.

"Before we started the new project, we had a lot of problems. Our current data center didn't have space for any new equipment," recalls Chan, who had begun to deploy server virtualization to ease space constraints and meet the demand for new applications. "The data center was slow for everything. Performance was not good at all."

That changed during the past year. The school district in early 2010 began construction on a new \$75 million Downtown Education Complex that includes space for a new data center and new buildings for four new schools. And while the new data center space won't be ready until 2012, the district's Governing Board gave the IT department the green light last summer to immediately upgrade its IT infrastructure.

That gave Chan the chance to build a new, reliable, fast data center that takes advantage of the latest technologies, such as server virtualization, blade servers, networked storage and 10 Gigabit Ethernet networking equipment, and allowed him to pursue industry best practices, such as server and storage consolidation. This past fall, he deployed those technologies around a new concept called "unified computing."

Unified computing is a new data center architecture, supported by the likes of Cisco and Hewlett-Packard, which integrates blade servers, storage, networking and virtualization. It's essentially the convergence of data center equipment and allows for centralized management and the ability to provision resources – such as virtual servers – on the fly. The technology requires less rack space, reduces power and cooling needs and cuts down the number of devices an IT department needs to manage, resulting in lower total cost of ownership.

This past fall, the district focused its purchasing efforts on equipment that standardizes on Cisco's Unified Computing System (UCS), including four Cisco UCS B250 blade servers, one Cisco Nexus 7000 Series 10 Gigabit Ethernet switch and a 65TB NetApp FAS3160 Universal Storage System. For server virtualization, the district upgraded from VMware ESX 3.5 to VMware vSphere 4. And to protect all the equipment from power outages, the district purchased APC's MGE Galaxy 5000 series Uninterruptible Power Supply (UPS).

The district is reaping immediate benefits. The network core has plenty of bandwidth. The blades with their small form factor, combined with virtualization software, have allowed the district to consolidate its servers. The NetApp Storage Area Network (SAN) centralizes storage, allowing the IT department to better utilize storage capacity and more easily manage and back up data. Combined, the technologies have consolidated the amount of hardware used, freeing up space in the data center, reducing power consumption and making the data center simpler to manage.

"Centralization is important. Everything is easier to manage and we're a much greener data center," Chan says.

GETTING STARTED

In late 2009 and early 2010, Chan spent several months doing research on what to buy. The IT department supports many educational and administrative applications for the district's nearly 39,000 students and 4,900 employees at 109 schools and other administrative locations. Before the data center project, the existing 1Gbps networking equipment and some of the servers were eight years old. It was time to upgrade.

Server virtualization, which allows individual servers to run multiple applications, was a priority. Before the project, Chan had begun virtualizing applications, but most of the district's servers still housed one application each. Consolidating the IT infrastructure was critical because the district was moving from a 2,500-square-foot data center to a new space with only 700 square feet.

For months, Chan talked to IT consultants and manufacturers. He sought the advice of other school district IT administrators in Northern California and even made site visits.

"It took a few months to completely understand what I was going to get," he says. "I needed ideas and wanted to see what I should be buying or not buying."

Chan ultimately chose Cisco's Unified Computing System architecture as previously mentioned. Key components include a blade server chassis and blade servers based on Intel Xeon processors and 384GB of memory. As for networking, it supports 10Gbps speeds and unifies what are historically separate networks, such as LANs and storage area networks. It also reduces the number of network adapters, switches and cabling that is needed. As for storage, Cisco's system provides consolidated access to storage networks over Ethernet, Fibre Channel, Fibre Channel over Ethernet and iSCSI connections. All of it can be managed and configured with Cisco UCS Manager software.

When he decided what equipment to purchase, he bought all the equipment from CDW·G. The reason was two-fold: CDW·G not only had relationships with the manufacturers and sold the hardware that he wanted, but the company also provided the consulting and implementation services that he needed.

INSTALLATION PROCESS

Oakland Unified School District's Governing Board approved the IT department's recommendations for new IT equipment last summer. And for several months this past fall, a team of CDW·G, Cisco and NetApp engineers – managed by a CDW·G project manager – installed the new equipment at the current data center, just a block from the new data center site.

The implementation process went smoothly. The installation team consolidated about 95 percent of the district's applications onto the four blade servers. A few applications must run on their own stand-alone servers and can't be virtualized, Chan says.

The team also migrated the district's 35TB of data from direct-attached storage onto the NetApp SAN. To ensure high availability, they deployed two SAN controllers. That way, if one goes down, the other keeps storage operations running.

The new high-end Cisco Nexus 7000 Series Switch, featuring 10Gbps speeds, provides plenty of bandwidth. The installation team deployed Cisco's EtherChannel technology, which bundles Ethernet links together to create one logical link. The district combined two 10 Gigabit links and now has 20 Gigabit speeds at the network core, which speeds the delivery of applications to users.

"We've built a good foundation," Chan says. "Before, our network backbone was not strong enough."

The unified computing architecture also simplifies network and cable management. Previously, servers and other equipment were swamped with network cables and network interface cards. But the unified computing architecture reduces the spaghetti of interfaces and cables down to one, which results in significant power savings and makes it easier for the IT staff to troubleshoot problems. "From the UCS blade server to the Nexus 7000 switch to the SAN, we have just one 10 Gigabit Ethernet cable," he says. "Before we had a lot more."

In addition, the data backup process is faster, thanks to the faster network and the SAN. In the past, each server was backed up to a tape drive. Now, the data is first backed up to the SAN and then to tape. A full backup, which used to take two to three days, now takes one day to back up to disk.

Finally, to protect the data center from power outages and power surges, the district consolidated multiple, small UPSes with one large, high-end APC UPS. Having one device is easier to manage and more energy-efficient, Chan says.

VIRTUALIZATION BENEFITS

Virtualization has freed up space in the current data center. Overall, the new infrastructure requires just eight racks of equipment. But besides consolidating servers, virtualization provides several other benefits, including the ability to deploy applications quickly, reduced hardware requirements and improved reliability, Chan says.

Before virtualization, when a department requested a new server for an application, the IT department

had to order a new server and wait for it to be delivered. Then the IT staff had to install the application and configure the new hardware onto the network – a process that took several days to a week, Chan says. Now, with virtualization and server images at the ready, they can spin up a new VM in about 10 minutes. "It's a big difference and a huge improvement," Chan says.

Doing so also saves money. While the district had to pay an upfront cost for the new infrastructure, the IT staff will save money in the long run by not having to purchase new servers every time they need to implement new applications, he says.

Another important benefit is reliability and ease of management, Chan notes. If one blade goes down, VMware's VMotion software will automatically move the VMs to the other three blades to keep the applications up and running, he says.

Gee Kin Chou, Oakland Unified School District's information technology officer, explains that the virtualization project was a necessary investment and positions the district to build an internal cloud infrastructure in future years.

"It's a long-term benefit and the right direction to go," Chou says. "Before, we had all these little servers all over the place and every application had its own server. Some servers were old and we were running out of space, so virtualization is something we had to do. It's good we got it done."

GETTING THE JOB DONE

Chan says he couldn't have implemented the new IT infrastructure without the help and expertise provided by CDW·G. In the project's early stages, Angela Halsey, a local CDW·G account executive, put Chan in touch with CDW·G's solution architects and engineers to educate him on different technologies and make recommendations. Halsey also put Chan in touch with several manufacturers, including Cisco.

"Angela did a great job and really made me comfortable. I trusted her ideas and whenever I needed, she found the right experts to talk to me," Chan says.

Halsey recalls the initial meetings, where CDW·G's technical experts came onsite and helped Chan map out a technology strategy for his new data center. "The district needed a glue that combined the different elements and manufacturers into one cohesive solution. That's where we stepped in," she says.

The installation team from CDW·G and the other manufacturers worked well with Chan and the rest of the district's IT staff. "The teamwork has been perfect," he says.

FUTURE PLANS

With the new IT infrastructure in place, Chan plans to move the previous servers to school sites and donate the older ones to charity. He is also gearing up to move to the new data center in June 2012.

The district runs many critical applications, including the district's own police department's applications and communications systems, so it can't afford downtime. To move the equipment, the IT staff may temporarily migrate applications and data to a cloud computing provider or to a secondary data center that the district plans to build for disaster recovery purposes.

The new state-of-the-art infrastructure also allows the IT department to provide students, faculty and staff new IT services. For example, the district is looking into deploying desktop virtualization to provide students with more computer access at their schools, he says.

Overall, Chan says he is happy with the new infrastructure. Servers, storage and even network cabling is consolidated. And the district is well-positioned for the future.

"The improvement is that we are more centralized," he says. "With virtualization and a 10 Gigabit Ethernet backbone, we don't have limitations, and we're now a green data center. We're saving a lot of energy."

Virtualization Benefits Beyond Consolidation

The biggest driver of server virtualization is consolidating underutilized servers to reduce hardware, power

and cooling, and data center space costs. But IT organizations can gain other operational efficiencies, such as easier maintenance and improved continuity of operations, analysts say.

"Everyone goes after the low hanging fruit of consolidation, but the bigger benefit going forward is agility, flexibility and ease of use," says Greg Schulz, analyst and founder of analyst firm StorageIO in Stillwater, Minn.

For example, if the IT department needs to bring a server down for maintenance, they can easily migrate virtual machines (VMs) to another server, perform the maintenance and then move the VMs back without downtime, he says.

Another benefit is load balancing, which is the ability to distribute the workload evenly to prevent one server from overloading. If one application gets busy, the IT staff can move other applications off the server temporarily, so the one busy application can have the processing power and memory it needs to run optimally, Schulz says.

Virtualization also aids in continuity of operations. The mobility of VMs simplifies the failover process to a secondary data center, he says. IT departments can use virtualization management software to define rules to automate tasks such as continuity of operations and load balancing.

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