Intel IT Center

JOURNEY TO DESKTOP VIRTUALIZATION

Virtualizing for Video-Rich Education

New York City iSchool uses desktop virtualization to bridge the digital divide

For the largest U.S. school system, innovation is a way of life. So when the New York City (NYC) Department of Education (DOE) created a model public high school—the NYC iSchool—in 2008, it turned to the DOE Division of Informational Instructional Technology (DIIT) to help establish its technology infrastructure. The Solution Design and Engineering (SD&E) group, headed by Dr. Katherine Tsamasiros, researches new technologies for the 1.1 million-student system and creates software images for its 1,700 schools. SD&E is part of the DIIT, which provides technology services and support for the massive school system.

Nick Schepis, director of school technology and standards within SD&E, worked with iSchool and DOE leaders to understand the vision and identify an approach to giving students equal and ubiquitous access to technology: client virtualization. He asked Damian Maslinski, a senior engineer with over a decade of experience at DOE, to head the design and implementation effort.

The SD&E team aced its assignment. Today, the NYC iSchool uses virtual desktop infrastructure (VDI) to give students immediate access to technology throughout the day. But two problems persist:

- The VDI solution can't handle high-quality video, and the demand for video is growing.
- Even with robust back-end infrastructure and lower-quality video, the solution produces significant performance spikes.

This year, SD&E is piloting a virtual client approach that uses Intel® vPro™ technology and Citrix XenClient* with HDX* technology to deliver high-quality video in a virtualized environment. Maslinski says the team likes the solution's promise and is exploring options for expanding its use within the school system.

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Senior Engineer,
Solution Design and Engineering, NYC DOE

At a Glance

Project

- Provide high school students with anytime, anywhere access to educational tools and content.

Accomplishments

- Implemented a robust virtual desktop environment for the New York City iSchool.
- Piloted a scalable virtual client architecture to run high-quality video locally on the PC.

Lessons Learned

- Invest time to understand user needs. Ensure the deployed solution meets them, and adjust if necessary.
- Analyze the implications for server, networking, and storage infrastructure.
- If you choose a server-based model, identify how skill sets will need to change to support the data center.
- Ensure endpoint devices have local performance so instruction isn't interrupted by problems with data center infrastructure, networks, or virtualization software. Use virtual client approaches implemented with Intel® vPro™ technology to limit back-end build-out.
- Develop collaborative relationships with vendors. Adopt new software versions to get the benefits of feature advances, bug fixes, and increased integration. Make sure you understand any software limitations, release dates, and gaps in software capabilities.

User Needs: Equal and Ubiquitous Access

Maslinski holds both Bachelor's and Master's Degrees in Computer Science from Queens College and has managed plenty of complex and innovative projects. He and his team approached the NYC iSchool virtualization effort as they would any such project: by drilling down on user requirements.

DOE created the iSchool to demonstrate what a next-generation high school education would look like. The school emphasizes project-based learning and 21st-century skills, and the "i" stands for innovation, influence, inspiration, and individualization. Technology is an essential enabler.

"Technology enables us to provide each student with an individualized education that allows each child to move forward from wherever they are," says Alisa Berger, principal of the iSchool. "Technology also supports our students in learning 21st-century skills. It allows us to teach big content ideas in a more interesting and authentic way and simultaneously teach our kids basic skills."

The iSchool has a diverse student body drawn from across New York City's five boroughs. Nearly half its students receive free or reduced-price lunches, a common indicator of financial need, so providing equal access to technology was a high priority. The issue was less one of students having no access to a computer, but rather the disparity between those with the latest high-end laptops and others using antiquated low-end models. "It was a moral issue," Berger says. "How do we start a technology school without making some kids feel disadvantaged?"

The planning team decided on a virtual desktop environment to provide flexibility in the school environment and allow students to access school and Internet resources without carrying school-issued laptops between school and home. With applications running on the server, the team felt desktop virtualization would be the great equalizer.

Choosing Technologies

The iSchool is partially supported by private funds, so SD&E had more leeway to choose technologies than it might have otherwise. While SD&E had plenty of experience with server virtualization, desktop virtualization presented unique challenges. The team researched the subject, attended conferences, talked with vendors, and decided on Citrix XenDesktop*. SD&E worked with IBM to set up the initial iSchool environment.

The iSchool established a wireless network in its space in a 100-year-old building in lower Manhattan, and chose full-function PCs and laptops. "No one wanted to go out on a limb and get thin clients," says Maslinski. "We wanted to have the fully functioning laptop or PC if the technology failed or the network went down." The team chose Dell systems with an Intel® Core™ vPro™ processor to deliver local performance with the potential to activate remove management capabilities in the future.

The iSchool purchased enough clients to have them everywhere students would need them—and in sufficient quantities that students wouldn't have to wait for a turn. The school has around 580 PCs for its current enrollment of approximately 380 students, giving it more than a one-to-one environment. Students can

With virtual client technologies, iSchool students get a higher-quality, full-screen video experience.

install a Citrix Receiver* software client on their home computers, and the iSchool support team offers advice on how to connect to the school's resources.

Usage Patterns vs. Expectations

The iSchool opened with a freshman class of 100 students in September 2008 and has added a new class of freshmen each year. Technology is integrated throughout the curriculum.

The virtualized environment is widely used—but it wasn't always. In the months after deployment, SD&E monitored usage patterns and found they didn't match expectations. After discussions with school personnel, the team decided the problem lay in the virtualization solution's front end, which was oriented toward corporate users rather than educators and students. They found a solution in ClassLink LaunchPad* instructional desktop software, and were so impressed with ClassLink that they asked the company to provide ongoing support for the virtual environment.

Video Limitations

Video performance in the server-based VDI environment hasn't proven as easy to address. In addition, the rising demand for higher-quality video increases the disparity between what students and teachers need and what the VDI environment can handle.

"We have settled for what I think of as YouTube-quality video," Maslinski explains. "It streams well enough that you're not distracted by stops and starts and pauses, but it's not highly graphical and it only runs in a small window on your PC. Even that level of quality comes at a cost. We have seen a lot of spikes in the processor performance on the servers, although the iSchool has very robust server infrastructure and is probably average or below average in terms of virtual machines (VMs) per core saturation." Back-end servers use the Intel® Xeon® processor 5500 and 5600 series and support an average of 17 VMs per core compared to the DOE's average of 25 per core.

To improve the user experience, SD&E has adopted new versions of XenDesktop as they've come to market and worked with Citrix to identify and remove bottlenecks. For example, the team discovered that keeping Citrix provisioning on a physical server rather than putting it in the virtualized environment could speed the provisioning process.

"We did a lot of troubleshooting and learning along with Citrix," Maslinski recalls. "We kept improving our performance and the user experience as Citrix was progressively improving their XenDesktop infrastructure. But there's a certain wall when it comes to video that we have not been able to overcome."

Meanwhile, the iSchool has increased its use of video, offering opportunities that might not otherwise be possible in a small school. Students use instructional video and teleconference-based distance learning to take advanced placement courses and delve deeply into subjects that interest them.

SD&E could see that video performance would continue to be an issue, particularly if DOE wanted to scale virtualization beyond the iSchool. So the team decided to explore client-side virtualization.

Phase 2: Piloting a Solution for Higher-Quality Video

In the 2010/2011 school year, SD&E worked with Intel to set up a pilot at the iSchool using Citrix XenClient, a client hypervisor that uses Intel vPro technology to help balance the virtualization workload between servers and clients and execute virtualized programs on the PC. The solution aims to combine the management benefits of server-side application delivery with the performance benefits of local client execution. The pilot also uses Citrix HDX* technology to give users a high-definition virtualization experience. Dell provided resources and equipment used in the iSchool pilot.

The SD&E team says its pilot shows that client-side virtualization can give students a great experience. Students enjoy faster, higher-quality video and a full-screen experience. They do not feel that they're in a server-based environment, and they don't have to do anything special to get a VM from XenDesktop or from the XenClient Synchronizer*.

The team also identified institutional benefits to the client-side model, including greater flexibility. Schools can run several operating systems on one client, create school and personal partitions, and allow students to "check out" a VM and take it with them when they leave the school.

Key Technologies

- Dell Latitude* laptops with Intel® Core™ vPro® processors and Microsoft Windows*
- Dell OptiPlex* servers based on the Intel® Xeon® processor 5500 and 5600 series and VMware vSphere* ESX 4.0
- Citrix XenClient* with HDX* technology, Citrix XenDesktop*
- ClassLink LaunchPad* instructional desktop
- Moodle* learning management system

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Costs can also be lower. "Local resources are cheaper than server resources to provide and manage," Maslinski says. "Having the flexibility to shift between centralized server compute and distributed client compute without end users knowing there is a difference will make it easier to scale without adding thousands of servers."

The pilot was not without its headaches, however. "It's been harder than we anticipated, but not untypical for projects of this nature," Maslinski says. The SD&E team has successfully addressed a number of technical challenges, such as mapping IP addresses across DOE's strict firewall and security infrastructure, and making configuration tweaks without disrupting DOE's network of over 65,000 wireless access points. Prerelease software created ongoing problems as the team worked to achieve its goals while integrating Citrix Synchronizer, XenClient, and XenDesktop. Finally, the team has had to work around the school calendar to avoid disrupting classroom activities as it develops and deploys new solutions.

Advice from the Front Lines: Think Through the Support Implications

For school districts looking at virtualizing their client infrastructure, Maslinski recommends thinking through the support implications and making sure you have local compute capabilities to fall back on. "I think support is the biggest lesson we've learned—thinking about what happens when the lights go off," he says. "If you have local client performance and a locally based operating system, then instruction doesn't have to stop just because the technology is down."

IT planners should also keep in mind that large-scale VDI will shift support requirements from PCs to servers and networks. It will also affect costs. "Processing has to be done somewhere," Maslinski says. "If you move computing from the client to the data center, you are moving the skill requirements from supporting PCs in the local schools to supporting a data center. That data center has to be properly cooled, properly supported, and properly powered. Equipment has to be purchased and maintained, and data has to be properly stored. The support requirements and costs are very different."

SD&E is still in the data mining stage of investigation, but the team suspects the size of New York City's school system and the complexity of its IT environment will rule out large-scale VDI deployment. The client-based virtualization model is more attractive, and the team's work in the pilot is a step toward a fundamental architecture with the potential to scale to hundreds of thousands of students.

But much work remains, including exploring the potential impact on DOE's highly efficient PC support operations. "Right now, we have between 400,000 and 500,000 endpoint devices and 60 technicians," Maslinski says. "The ratio is crazy. How would virtualization change it? That's an open question."

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