

## Going on a Desktop Diet

An urban school district in Pawtucket, Rhode Island, focuses on **servers** and **services** and **saves money!**

**R**eductions in state aid to cities and towns. Level funding to education from cities and towns. Increasing mandates. Class sizes pushed to capacity and beyond, positions eliminated, programs cut back. These are some of the pressures many educators are wrestling with as we maneuver to not only meet current and future demands, but in some cases, to actually survive.

With no specific state or federal mandates to districts to maintain comprehensive technology infrastructure, how do we, in the face of mounting financial pressures, continue to build and maintain our networks, integrate our systems, and expand our resources in a way that is reasonably “budget-proof?”

This is not as impossible as it appears! Here in Pawtucket, Rhode Island, an urban district of 16 schools with 9,000 students, we have nearly achieved this goal. However, it did not happen overnight.

Like many districts, we were stuck in a continuous cycle of desktop computer upgrades and replacements we couldn't afford. Desktop computers locked us into high costs monetarily, stressed our old buildings electrically, and barely fit in our small elementary classrooms. Additionally, as they aged, desktops consumed our minimal staff with continuous repair duties. We found we no longer could afford, sustain, or grow technology in the district while we watched our equipment get older, slower, and less able to meet evolving curricular and administrative demands.

Our solution was to get out of the desktop computer business. That's right, a technology department that stopped buying traditional computers! Instead, we began buying and building terminal servers and converting our desktop computers into thin clients. Terminal servers are specialized servers that host applications and communicate remotely with multiple computers and other devices. Thin clients are specialized devices that exchange keyboard strokes, mouse clicks, and video with a terminal server. Together, a terminal server and thin client emulate a local

computer and desktop experience for multiple users. We did not convert overnight. Rather, we did it in stages and after many trials.

Six years ago, driven by the need to centralize our student information system and data, we installed our first terminal server. We brought the SIS application itself, along with each school's student data, to a central terminal server housed at the district's administration building. The school office personnel accessed the student information application and data across the WAN while the administration personnel accessed the same data locally. We also opened this server to home access for guidance and administration to work on live student data, scheduling, grading, and discipline from home.

From a management, stability, security, and support standpoint, this administrative solution worked out so well that we were confident in deploying our next terminal servers to address a curricular issue. Our business departments in each of our two high schools decided it was time to switch office suites. What these departments did not consider was that their lab computers were too old to actually run the new program. Because we could not afford to replace their computers, we did what we could afford: We used the Windows Remote Desktop Client to offload the increased memory and processing requirements of the new office suite from their old desktop computers to new terminal servers.

With two successful terminal server solutions in production, we did something radically different with our third trial, which changed our concept of the desktop computer. We began testing PXES Linux, a highly specialized Linux distribution spe-

cifically designed to connect an older computer to a network and access a Windows Terminal Server. With this, we no longer needed Windows on the desktop machines. In fact, we no longer needed a hard drive, as the PXES client delivered itself from a central server direct to memory on workstation startup.

Initially, we tested this new client in a high school lab without telling

Windows 95—as thin clients with PXES Linux. The justification to the School Committee over this budgeted project was that spending \$90,000 on new terminal servers and licensing would save us \$800,000 to \$1 million on immediate computer replacements. Along with this substantial cost savings by recycling desktops we realized additional savings through eliminating desktop operating system

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anyone about the switch. The only difference the students and teachers noticed was that their machines no longer took three minutes to start up and load the operating system and management and security software before it was ready to log in to the network. Even after logging in, applications launched and ran slowly. With the PXES client and a terminal server, the same computer started and was ready to log in after approximately 20 seconds. Afterward, launching an application was nearly instantaneous.

Through this trial, we learned that we could successfully move not only applications, but the entire student and teacher desktop to the terminal server.

The following year we got out of the desktop business. We retrofitted more than 1,000 old desktop computers—originally purchased to run

upgrades and annual desktop antivirus licensing fees. Most important for the thousands of users we support, this change was invisible to them as they continued to work in a familiar desktop environment using familiar applications.

Today most of the old, retrofitted computers in our schools are replaced by dedicated HP Linux-embedded thin clients. Our district currently deploys 1,800 thin clients across all schools, classrooms, labs, and offices. These workstations are supported by 40 terminal servers. Converting from traditional desktop computers to thin clients has allowed us to rapidly modernize our network, expand the district's overall resources and capabilities, and redirect our staff's focus from maintenance to improvement. All this was done with minimal hardware costs and

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no addition of staff. Along the way we learned several lessons:

## Lesson 1: Infrastructure is Key!

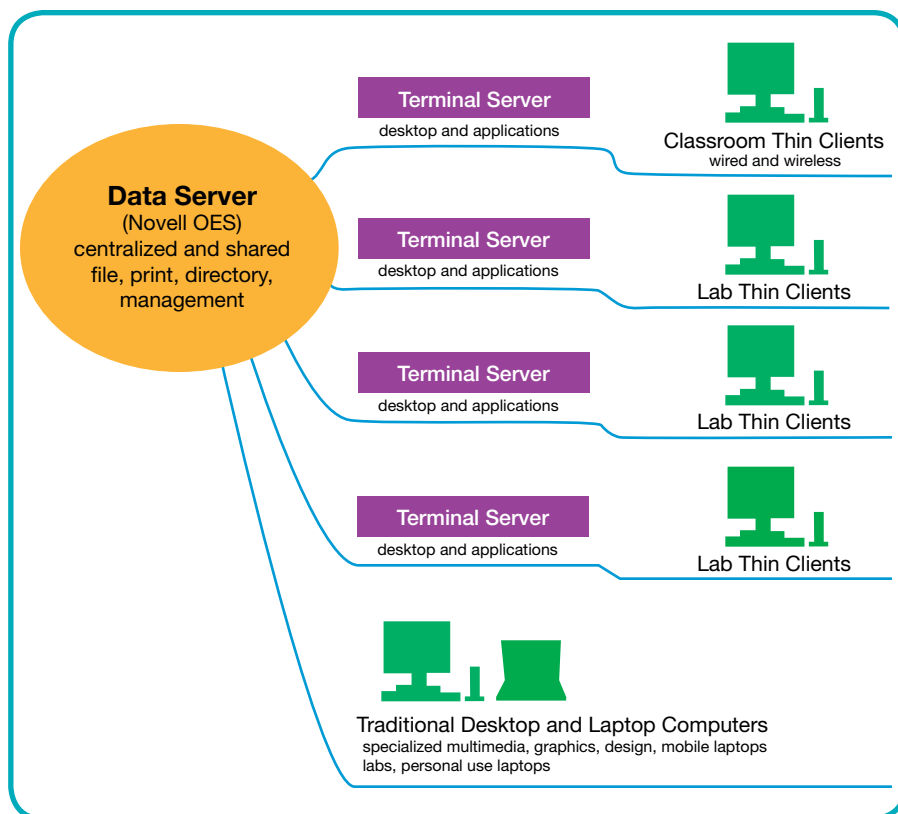
Invest in good, stable wiring, wireless, and switches. Your infrastructure is what makes automation, application delivery, management, and centralization possible. In our case E-Rate helped immensely, but prior to E-Rate we campaigned heavily for city and school committee support for a major rewiring of all our schools. During periods of investments and grant funding we have always set infrastructure as a priority and not compromised the integrity of the network. Put simply, it is not possible to travel a highway at top speed when you are weaving around potholes in the road.

## Lesson 2: Go on a Desktop Diet!

Thin clients are inexpensive and can be purchased for under \$200 each.

Thin clients are easy to set up, are secure with no moving parts, and are highly resistant to viruses, with no system files exposed to users. It is not unreasonable to plan on a 10-year duty cycle before you have to think about replacing a thin client. In a thin client environment the only thing you have to periodically upgrade is the supporting terminal server. The terminal server is the application delivery platform—refresh the server, patch, upgrade, or install an application to the terminal server and all attached thin clients are instantly refreshed, patched, upgraded, and can access the new application.

Today's thin clients are versatile and able to stream audio and video and use USB key drives, local printers, external CD-ROMs and card readers, and digital cameras. With the current level of terminal server and thin client technologies there is very little, other than intensive



School Terminal and Thin Client Model



graphics and multimedia (high-end CADD, imaging, and gaming) that actually requires a traditional desktop computer. We found that thin clients easily handled more than 95% of our student, teacher, and administrative requirements. For the remaining 5% of functions where thin clients are not the best fit, we deploy traditional desktop computers and laptops.

The cost of a single, tier-one terminal server is approximately the cost of 5 to 10 traditional desktop computers. In our environment we have settled on the following thin client to terminal server ratio: For secondary labs with 30 thin clients, where students often perform the same tasks within the same applications simultaneously, we dedicate a terminal server. For elementary and secondary classrooms, where the applications used, and when the applications are used varies, we dedicate a terminal server to handle 50 to more than 100 thin clients.



## Glossary of Terms

**Linux**—a free, open-source operating system based on Unix. Linux is used extensively to run servers (Web, data, workgroup, etc.) services, applications, and desktops.

**Multi-Core Servers**—servers with an integrated circuit to which two or more processors have been attached for enhanced performance, reduced power consumption, and more efficient simultaneous processing of multiple tasks.

**Remote Desktop Client**—a program that allows access to a desktop or applications residing on a terminal server in addition to applications on the local computer.

**Terminal Server**—a central computer that serves desktop and applications to thin clients and other remote computers via a Web browser or remote client access software.

**Thin Client**—a network computer without a hard disk drive, designed to be especially small so that the bulk of the data processing occurs on the terminal server.

**Virtualization**—Running multiple, different operating systems or services from a single physical server, resulting in greater hardware utilization and cost savings through consolidation. Multiple virtual servers can run on a single physical server.

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## Lesson 3: Focus on Servers, Expand Services, and Spend Less!

Having a stable infrastructure and offloading workstation demands onto low-maintenance thin clients allows us to focus our time and efforts on servers and services.

Our servers are the core of the network, providing centralized security, centralized management, and centralized application hosting and delivery. Our terminal servers deliver our core desktop applications to students, teachers, and administrative personnel. Our Web servers deliver content, student information, and assessment systems, and provide employee e-mail, collaboration, and home access to files and directories stored on our data servers.

We can offer an improved level of support as well. Instead of spending hours driving between buildings and visiting offices and classrooms, our staff provides direct and immediate visual assistance to users no matter what their, or our, location using the remote session management capabilities of the terminal server. In other words, their computer monitor, mouse, and keyboard become our computer monitor, mouse, and keyboard. This feature greatly facilitates trouble shooting and instruction.

Further leveraging the benefits of our server-centric focus, we are able to use our time and talents on research and development. Our staff has deployed open source code to build and customize server and Web-based

management systems; task automation routines; a high school e-portfolio system; a district-wide Personal Literacy Plan tracking system; and supplement information management, communication, and collaboration. In the process of offering more, we have saved the district tens of thousands of dollars otherwise spent on annual commercial per-student licensing fees.

Our low desktop computer cost outlays, efficiencies gained through server-based computing, and leveraging open source code where viable have all allowed us to allocate limited funds to purchase commercial licenses where necessary. We spend strategically on licensing, use multiple vendors and platforms, and look for economies of scale. For example, RISTE, Rhode Island's ISTE affiliate, has negotiated consortium pricing with key vendors. Through RISTE, our pricing for Windows Terminal Server Client Access licenses is based not on our district's number of workstations alone, but rather on the total number of workstations among all participating Rhode Island schools and districts.

In addition to the consortium Microsoft licensing model, we leverage Novell's School License Agreement providing bundled directory, server, communication, and management services. Novell's SLA is our gateway to additional savings by leveraging additional open source Linux hosting and delivery. Rounding out our commercial licenses are server-based antivirus and anti-spam programs.

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#### Lesson 4: Plan for Problems

The primary issue with reliance on terminal servers is having “too many eggs in one basket.” If a terminal server goes down so does an entire lab. If a terminal server goes down in an elementary school, so does every classroom. Anticipating this eventuality, we have built our servers to be nearly identical to one another. Our staff can image and replace a terminal server within several hours’ time. Where we have multiple servers, we temporarily point a lab’s terminal access to another server, doubling the load, but remaining operational while the problem server is dealt with.

Even though thin clients can stream audio and video, too much streaming places a tremendous load on the terminal server itself. We find the newer, multi-core terminal servers deal admirably with these demands versus the original single-core servers.

Finally, where thin clients have dramatically reduced the electrical requirements of our labs, offices, and classrooms, having so many terminal, data, and Web servers has us outgrowing the electrical and cooling capacity of our school’s server closets. To address this “server sprawl,” we have completed some very successful

tests consolidating and virtualizing Windows Terminal Servers and Linux servers using Virtual Iron Enterprise.

#### Lesson 5: It Works!

We learned that where the desktop and applications reside is immaterial as long as access is fast, reliable, secure, and familiar. We learned that we can expand services and increase efficiencies while saving money. And although we are not quite budget-proof, we learned to push forward using our knowledge and talents and to work with zero- and low-cost resources, offsetting ongoing financial constraints.

#### Resources

HP Thin Clients: <http://www.hp.com>  
 Novell: <http://www.novell.com>  
 Pawtucket School Department: <http://www.psdri.net>  
 PXES Linux: <http://www.2x.com/pxes/>  
 Rhode Island Society of Technology Educators (ISTE Affiliate): <http://www.ri-iste.org>  
 Virtual Iron: <http://www.virtualiron.com>  
 Windows Terminal Services: <http://www.microsoft.com>



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