



White Paper

Convergence of 1to1 and Client Virtualization: Maximizing Instructional Technology



In a world driven by technology, today's education environment is a study in contrasts; and a complicated one at that. It is an environment where educational technology choices seem to expand faster than a school's technology budget; where students can have instant access to information, yet limited access to the school-based software designed to help them succeed. An environment in which educators increasingly believe technology is an essential component of today's classroom, yet find themselves grappling with how to insure the technology investment truly improves student learning.

Over the past few years virtualization has presented itself as a promising solution. From the ability to run multiple operating systems on a single machine, to server farms that can emulate dozens of machines on a single box, many see the potential of virtualization as nothing short of remarkable, with benefits that include extended hardware life, decreased licensing costs, reduced power consumption and carbon emissions, and 24/7 anywhere access. However, there are a variety of issues to consider, ranging from total cost of ownership to feasibility and longevity of the system.

This whitepaper will answer key questions about virtualization and discuss the many benefits it can bring to education. The four key areas:

- **An overview of client virtualization**
- **The varying approaches to implementing a client virtualization solution**
- **The benefits and drawbacks of each approach**
- **And finally, additional considerations when selecting a client virtualization solution for instructional delivery**

Defining Client Virtualization

In very plain language, client virtualization is almost any technology that breaks the age-old computer rule of one computer = one operating system = one user. Typically, client virtualization is achieved through software, and provides both operational flexibility, as well as the opportunity to utilize more of the underlying hardware's available resources by sharing these resources across multiple users.

Where as traditional computing runs a single instance of an operating system and associated applications on a physical computer, a virtual solution takes that same physical computer and, through virtualization software, runs one or more "virtual machines," these virtual machines may each have their own operating system or they may share a single operating system. All of a sudden, a single, computer becomes multiple, portable "virtual workstations," with a range of practical uses.

Virtualization in the Marketplace

In instructional technology we refer to “desktop virtualization,” as the process of emulating an individual PC desktop environment so that a user can access instructional software away from the physical hardware.

Desktop virtualization has four main variations, each with its own unique characteristics. One telltale indicator of how to categorize a particular solution is the type of ‘host’ and ‘node’ computers the solution requires. The variations and their respective host and node computers are as follows:

Virtualization Type	Back-End (Host)	Workstation (Client)
Remote Desktop	PC	PC or thin client
PC Blade Desktops	PC Blade	PC or thin client
Virtual Machine Desktops aka VDI	Server	PC or thin client
Shared Desktops aka Terminal Server	Server	Any computer

All of these applications provide the benefit of remote access to technology resources. Users can log in from a remote location and access their individual desktop environment with little more than a network connection, gaining access to all of their files, folders, and installed applications. And that’s great. But that is where the similarities rather abruptly end, and the critical differences—most especially for education—begin.

Remote Desktop refers to the remote access of a single PC through the use of PC access software, such as GoToMyPC, PCAnywhere, NComputing and Windows Remote Desktop. Users simply log in to their physical machine remotely through a Web or desktop client interface and all applications and files stored on the physical PC are visible from the remote access point.

Remote desktop technology does requires each remote user to be connected to a physical host PC somewhere else. The host PC can only accommodate one user at a time (with the exception of NComputing). This model, primarily designed for business workers to remotely access their workplace PCs, offers no efficiency in terms of multiple users leveraging a host computer. Where education is concerned, the costs associated with both hardware and software purchases, as well as the physical support needs of a decentralized environment, make this solution less efficient than other virtualization types discussed herein.

PC Blade desktops use individual “client blade” PCs to provide independent operating systems to users logging in through a network. The PC blades are housed in a central location, with each physical machine assigned to an individual user. The user then has the ability to log onto their machine from any location with network access.

Similar to the Remote Desktop approach, the PC Blade Desktop also carries a ratio requirement of 1 to 1. Each PC blade can only accommodate one user at a time and requires individual licenses for all necessary software. Though performance is enhanced by the 1 to 1 user/hardware ratio and support costs are reduced by the central location of the machines, the total cost of ownership (due to 1 to 1 hardware AND software needs, as well as power consumption) extends beyond the reach of most school districts.

Virtual Machine Desktops, also referred to as Virtual Desktop Infrastructure (VDI), use virtual machine technology (such as VMware and Citrix) to host multiple instances of a standard, single-user desktop PC operating system (such as Windows XP or Vista) on an individual server.

Virtual Machine Desktops get a leg up on the previous 1 to 1 solutions with their ability to accommodate multiple users on a single host computer/server while running separate instances of the standard PC operating system. This dramatically reduces hardware and management costs. However, VDI carries with it an expensive per-seat cost, requiring each user to have a licensed copy of the operating system as well as all software licenses. VDI also has a limited capacity per physical PC, rated at approximately 30 users per machine. Consequently, a school with 1500 students will require a minimum of 50 servers to deliver this solution. Coupled with increased power consumption and administrative needs, virtual machine desktops have a high cost potential. The main drawback of this solution is its inability to effectively support processor-intensive applications, such as video-editing and 3D rendering software.

Shared Desktops refer to a multi-user server operating system that can host many remote users simultaneously. Unlike the VDI solution, shared desktop systems use a single instance of an operating system to support all users on the server.

The Shared Desktop approach builds on the benefits of the Virtual Machine, with some very significant improvements. Unlike the Virtual Machine solution, the Shared Desktop can support multiple users through a single instance of an operating system. This setup brings several advantages over the previous three options, including dramatically reduced cost-per-seat, improved reliability of the overall system, as well as allowing for greater numbers of users per physical server. In a shared desktop environment, each server is rated at approximately 50 users per machine. Using our same school of 1,500 students, the hardware requirements drop from 50 servers to around 30, with power consumption, technical support, and licensing needs dropping in kind. Like Virtual Machine Desktops, the main drawback of this solution is its inability to effectively support processor-intensive applications, such as video-editing and 3D rendering software.

The Topic of Home Access

Of increasing importance in education technology is access to resources out of school and on a 24/7 basis. The movement of 1to1 computing is entrenched and growing in classrooms across the nation and world. How do these four types of virtualization compare in delivering home access?

Virtualization Type	Home Access?
Remote Desktop	Available only to very limited users
PC Blade Desktops	Home access Not available
Virtual Machine Desktops	Home access Not available
Shared Desktops	Total home access 24/7

Other Considerations

Which virtualization solution is best suited for the unique needs of education, ensuring that the total cost of ownership doesn't undermine the overall learning goals? The case for Shared Desktop solutions is compelling from the outset. With reduced infrastructure needs, decreased per-seat licensing costs, and increased reliability. Coupled with anywhere/anytime access to the personal instructional desktop, the shared desktop appears to have the advantage in addressing many of education's needs.

Even so, not all shared desktop solutions are created equal, and there are additional considerations that should be addressed when choosing a specific solution, including:

Technology requirements of the remote machine:

Each virtualization solution relies on a remote computer to actually "display" the virtualized desktop. It is important to consider the needs of that machine when opting for a solution. With education environments being heterogeneous in terms of their technology, it is important that any chosen solution provide an equalized user experience, whether the machine is 7 days or 7 years old.

Inherent scalability of the system:

Schools don't stop taking students just because they've reached their theoretical capacity. And when schools grow, so do their technology needs. It is important that any virtualization solution accounts for the inevitable growth of a school, and provides a solution for dealing with said growth that is both manageable and affordable.

Management requirements of the system:

Technology needs to be managed. And management costs districts money. Virtualization should help mitigate the costs associated with system management, not only through

consolidation of equipment, but also through the use of intuitive, user-friendly interfaces that minimize the IT staff's time on the system.

The security of the chosen virtualization solution:

Network and data security is a top issue among school districts around the globe. Because of this, the implementation of any additional infrastructure, virtual or otherwise, can always be cause for concern. With a solution that relies on the remote delivery of resources, it is critical, that the chosen system integrates with a district's existing security policies, and minimizes the creation of any additional data stores that then require backup and oversight.

Expertise of the solution provider:

Districts should never underestimate the value of market expertise. Technology is a dynamic, rapidly-evolving organism. And virtualization, while not new, is at the bleeding edge of application delivery. Districts must seek out experts in the field with a track-record of successful implementations under a variety of conditions. They must be committed to doing things right the first time, in order to avoid the costly process of doing them over.

Conclusion

As technology advances by quantum leaps, the ability of educators to deliver relevant, effective learning solutions becomes more and more critical. Virtualization technology is rapidly proving an effective solution to education's need for 1to1 Everywhere™ computing. But, as we have seen, the solution itself is far from simple.

Schools need to carefully weigh the available options and seek out a solution that will provide ubiquitous access to instructional technology. A solution that offers an inherently heterogeneous computing environment, will help reduce management and infrastructure costs, and can be easily maintained and scaled as their needs evolve. Certainly, it sounds like a tall order; but if districts are to truly maximize their instructional technology investments, aligning those resources with specific learning objectives, demanding the right solution is not a luxury; it is a necessity.

About ClassLink

Since 1998 ClassLink has been helping school districts deliver 24/7 access to software and files from any computer, anywhere. Engineered for students and teachers, our award winning solutions increase the learning return on technology while lowering the cost of ownership.