TAG-IT | TAG INTEGRATED TECHNOLOGIES, LLC
PART OF THE ASBURY GROUP

Introduction to Desktop Virtualization

Brian Nelson
January 2009

Table of Contents

Summary

Modern high powered desktop hardware gave birth to a distributed desktop computing model which created a productivity boon for businesses but at the same time created an unintended maintenance workload for IT departments. This paper will discuss two different technology approaches to desktop virtualization--Terminal Services and Virtual Desktops—which enable IT departments to bring the desktop computing infrastructure back into the datacenter. This will include an analysis of common benefits between the two technologies and a discussion of the strengths and weaknesses of each approach, addressing infrastructure requirements, maintenance, and end user functionality.

The information in this paper is based on our internal deployments of Terminal Services and VDI for our parent company, deployments for our external clients, and our status as a reseller for all of the major virtualization platforms and connection brokers.

History

The original computing environments deployed by enterprises were “big iron” solutions, involving mainframe computers. These devices were proprietary in nature and very costly, but the productivity increases experienced by organizations that could afford them more than offset these disadvantages.

These centralized computing systems were accessed by dumb terminals, appliances requiring little or no maintenance with little chance that they could be damaged or disrupted by end users. The disadvantage of these environments was that it didn’t allow for any flexibility in the functionality presented to the end user, making it a technology solution directed primarily at task workers.

In the late 1980’s, personal computers began to appear on the desks of many workers, and when coupled with productivity software, the distributed desktop computing model exploded as these devices became responsible for much of the productivity growth experienced by our economy over the past two decades. An unintended consequence of this technology was a larger and larger portion of the IT departments budget was taken up by maintaining this model. Departments originally organized to maintain a centralized computing model had to adapt to a deployment model that put increased computing power and maintenance requirements outside the datacenter.

At the same time as this decentralization of desktop computing was occurring, client server applications running on Intel servers became more and more prevalent, causing performance bottlenecks as the processor resources began to move further away from the data they were trying to access and manipulate.

The increased maintenance burden and the performance issues forced IT departments to search for a solution that would allow them to bring these resources back into the datacenter where they could establish a higher level of control over both data and computing resources.

This need brought about, initially, the return of server-based computing with what is delivered today by Microsoft as Terminal Services and, within the last few years, brought the introduction of virtual desktops (VDI).

Benefits of Server-based Computing

The advent of distributed desktop computing put an enormous amount of computing power on the desktop of everyone in the organization from shipping clerks to design engineers, whether or not they needed those resources. This became necessary as operating system and application vendors upgraded their software to require higher processor speeds and increasingly large amounts of RAM to run even the most basic applications. Often IT departments would avoid upgrades just to prevent the mass replacement of hardware. This scenario was most recently experienced with the introduction of Microsoft Vista.

Server-based computing was not a new idea; rather, it was a return to the mainframe concept of computing and was introduced to the Intel and Windows environment by Citrix as WinFrame and is now delivered by Microsoft as Terminal Services. This technology used a single operating system that created individual computing sessions for each end user. A newer iteration of server-based computing, virtual desktops (VDI), has become available in the last few years and is based on the virtualization technology which was initially introduced by VMware but is now available through several different vendors and allows multiple discrete instances of an operating system to be run on a single piece of hardware. No matter which version of server-based computing is deployed, there are a number of benefits that accrue to the organization which deploys either of them.

In today's economic climate, the first benefit that should be addressed is cost reduction. By centralizing desktop functionality in the datacenter, existing PC's can be leveraged as input and display devices, providing the mouse clicks and keystrokes necessary to run the applications which now exist in the datacenter, and output of those applications is then displayed on the monitor. Resource requirements at the endpoint are minimized to the point that legacy PC's can be run until a hardware failure occurs, greatly extending their useful life. At that time, the legacy PC can be replaced by a thin client with an expected lifetime two times longer than a traditional PC, at a cost 30-50% lower and with dramatically reduced maintenance requirements.

While harder to measure, reduced downtime of end users cannot be discounted, as failure of endpoints will become relatively rare compared to current failure rates. New endpoints can now be treated as appliances, whose failures will most often be resolved through replacement, no longer requiring complex troubleshooting to resolve issues. Actual problems with the desktop functionality are confined to the datacenter where they can be addressed by your IT professionals without having to travel to the end user. Problems that involve end user training issues can be resolved by your desktop support team who can shadow your end users remotely.

Gartner Research feels that most enterprises can reduce the total cost of ownership of their desktop infrastructure by 30% through the deployment of server-based computing with the largest cost reduction occurring in end user management and administration and smaller, but significant, benefits accruing to operations and hardware acquisition.

Another area of benefit is enhanced security. When using server-based computing, your data no longer needs to leave the datacenter, since the workstation functionality is now located in the datacenter with your data. An example of this benefit is the Veteran's Administration employee who a few years ago took his laptop home to put in a little extra work. Unfortunately, his laptop as well as the personal data of 26.5 million veterans was stolen from his home. Had the VA been using desktop virtualization, the data analyst would have been able to work from home while the data remained secure in the datacenter.

Security policies are increasingly difficult to manage on the desktop with the evolution of viruses, trojans, worms and other malware. A distributed desktop infrastructure is particularly vulnerable as lockdown of the end points has to be balanced with the flexibility required by much of the workforce. By centralizing the desktop computing function in the datacenter, a higher degree of control can be enforced over the systems.

The deployment of server-based computing by its very nature also helps organizations address several other critical business issues. Due to the low bandwidth requirements of the communication protocols used by these types of solutions, remote access is another benefit of the solution, which can be achieved with a minimal investment. The remote access can be used to support teleworkers, satellite offices, and reduce downtime due to inclement weather or family illnesses.

While many organizations have done a good job of securing their data and server hardware in response to setting up business continuity and disaster recovery (BC/DR) plans, the desktop infrastructure has often been overlooked or ignored due to the cost of providing a redundant architecture. By moving that functionality to the datacenter and incorporating the remote access functionality inherent in server-based computing, much of the job for establishing a BC/DR plan for the desktop infrastructure is completed just by deploying the original solution. Loss of physical access to a desktop which has been virtualized is no longer an issue as it can be accessed from wherever your end users can obtain Internet connectivity. Desktops are now easily portable and can easily be replicated to a remote datacenter where they can be accessed in the event of an emergency.

It should be noted that there are several situations which are often not compatible with server-based computing. End users, who must be able to work when disconnected from the network, are not good candidates for this solution as you must be able to connect back to the datacenter where your desktop functionality is deployed. A second scenario that would often prevent the use of desktop virtualization is the use of graphics intensive applications. These types of applications can require large amounts of bandwidth and the communication protocols used by most solutions are not optimized for this type of traffic. Finally, resource intensive applications often do not function well in this environment as very few users run simultaneously on a server, making the deployment cost prohibitive.

There are emerging technologies that address each of these situations, but the situations noted above should be approached with caution and are best addressed through thorough testing of the technology before committing to a production deployment.

Terminal Services

As previously stated, Terminal Services is the technology which first started to bring mainframe functionality into the Windows desktop environment. Terminal Services functions by taking a single operating system installation and single installations of applications and creating individual sessions for multiple end users on a single piece of hardware.

Due to its shared operating system, Terminal Services is a very efficient platform, typically allowing 15-25 end users per processor on a dual processor system to run their applications with an acceptable level of performance. Since the underlying technology is the Microsoft operating system, this approach does not take good advantage of the current multi-core chipsets, with a typical fall off in efficiency of 50% with the addition of a third and fourth processor, and little to no gain with any processors beyond the fourth. One potential workaround to this problem is to use a bare metal hypervisor like VMware ESX or VirtualIron to manage processor resource utilization, which would allow a dual processor, quad-core server to support between four and six virtual Terminal Servers.

An advantage to Terminal Services over VDI is its relatively simple hardware infrastructure. In an appropriately designed environment, only the operating system and applications reside on the server, with profile and data stored somewhere else on the network; therefore, there is normally little advantage to attaching them to a Storage Area Network (SAN). Even if the server images are stored on a SAN, their footprint is relatively small due to the single operating system and application installs. A typical configuration for the server would be a dual processor server with enough local storage configured in a RAID1 for the operating system and applications, 4G of RAM and 2 NIC's.

As a mature technology, there is little risk to bringing in Terminal Services to take care of your desktop virtualization needs, but there are few organizations where Terminal Services will be a fit for the majority of the workforce. Worldwide, the technology only accounts for less than 15% of total desktop deployments, relegating it to the status of a tactical solution in most environments.

Several factors are responsible for this—all of which are inherently tied to the shared operating system. Often, applications are not written in a manner that allows them to run in a multi-user environment, preventing them from running in a Terminal Services environment. While workarounds and third-party software solutions can "fix" these applications, getting these software packages to run is not always possible.

The necessity of locking down the server also prevents broad deployment of Terminal Services. To ensure a robust and reliable environment, it is normal to take away the ability of the end user to modify the environment, as it is not uncommon for something as simple as the installation of a browser plug-in

to break a Terminal Server. While this is not a problem for task workers, the majority of most workforces today are made up of knowledge workers who need more flexibility if they are to perform their jobs effectively.

Finally, since the Windows operating system was never designed to be a multi-user environment, maintenance of the system requires specialized training that is not possessed by the average systems administrator.

Virtual Desktops

The relatively recent introduction of virtualization software for the Windows environment has opened up a new form of server-based computing, virtual desktop infrastructure (VDI). VDI is most easily thought of as a single user Terminal Server, where each user has an encapsulated operating system and application set. Since there is no interaction between users' operating systems, unlike a Terminal Server environment, if an end user has a problem with their desktop session, no other users are impacted. This allows system administrators the ability to grant a higher level of freedom without concern for how other users will be impacted.

Maintenance of desktops can be approached in a completely different manner when using VDI instead of a traditional desktop as in most cases, it is easier to replace rather than repair a dysfunctional desktop system.

When a discussion of VDI begins, most people immediately think of an approach using a bare metal hypervisor like VMware's ESX, but there is a second approach available using operating system virtualization with Parallel's Virtuozzo, and both environments will be addressed here.

VDI Using a Bare Metal Hypervisor

Initial deployments of VDI used a hypervisor to virtualize, or schedule the resources of a physical host server for a number of discrete desktop operating systems, each with their own set of applications. The components that typically make up this type of deployment include physical host servers, virtualization software, a connection broker, and storage.

Typically we recommend the use of servers with dual quad core processors, loaded with enough RAM to support your standard desktop image to maximize user density. For instance, if your normal desktop configuration calls for 512M of RAM, the physical host server should have 512M of RAM available for each virtual desktop that can be effectively run on the physical host. Densities of end users on these systems typically vary between 5 and 10 virtual desktops per logical processor, depending on your application set and how intensively the virtual desktops are used.

There are many choices available for the virtualization software, the primary areas to focus on when deciding which solution is the best fit for your organization include maturity of the technology, the skill set of your technical staff, cost of the software, and availability of third party solutions to enhance the management of your environment.

While a connection broker is not a requirement for a VDI deployment, without one, individual endpoints have to be hard coded to specific virtual machines, and a one to one assignment quickly becomes a management headache. Additionally, connection brokers can provide additional enhancements like web portals for secure remote access and technologies for improving the end user experience like multimedia redirection and graphics acceleration. Without these types of technologies, many of your end users would find the virtual desktop computing experience a poor substitute for their traditional desktop.

Connection broker solutions can also automate a number of the tasks associated with managing your desktop infrastructure. The provisioning and decommissioning of desktops can be scheduled, as well as the deployment of MSI packages, further reducing the amount of time your staff spends managing the desktop environment.

An item often overlooked when evaluating a VDI deployment is the requirement for SAN storage. To gain full advantage of the technology, the files which make up the virtual machines should be stored on some type of shared storage, either Fibre or iSCSI SAN or NAS. When virtualizing servers, this is not as large a consideration due to the relatively low number of servers in most environments, but when looking at desktops, back end storage becomes a much larger consideration. If a standard desktop image takes up 20GB for the operating system and the applications, a total of 2TB of back end storage would be required to support 100 desktops. This is one of the primary factors when looking at deployment costs associated with a VDI deployment.

Linked clone technology, where a number of desktops run from a single, central image, and then utilize a differential file for end user data and personalization, can greatly reduce the amount of required back end storage, but does increase the complexity of the environment.

VDI Using Operating System Virtualization

Another approach to desktop virtualization is to use operating system virtualization, where a single operating system installation is virtualized and shares multiple sessions which are encapsulated. This approach is very similar to Terminal Services, but the encapsulation of each user's session prevents them from adversely impacting one another.

There are several advantages to this approach. First, since the operating system is shared amongst multiple users, this is a much more efficient approach in regards to server density and storage requirements. End user densities on a given server are 3-5 times that of a VDI deployment that utilizes a

bare metal hypervisor as only one instance of the operating system has to be run. Additionally, each application is also installed once, again enhancing the efficiency of the server hardware.

A second benefit is the reduction in requirements for storage, due to the single installation of the operating system and end user applications. This can translate into a 90% savings in storage. To put this in perspective, if you are deploying 100 virtual desktops using a bare metal hypervisor and your desktop image is 20GB, you would require a 2TB SAN to support the deployment. Using operating system virtualization, that requirement could be as low as 200GB to support the same 100 virtual desktops.

The single operating system and end user application installation leads to another benefit, simplified administration. Rather than having to patch or update multiple virtual machines, a patch to the operating system of a server applies to all of the end users accessing virtual desktops, and similarly, an application need only be upgraded once per server.

While much more efficient, there are some drawbacks to this approach which should be noted. End users have substantially less flexibility with these virtual desktops, making them less than ideal for developers and end users who need the ability to install applications on their own. Also, due to the way the system is configured, this type of solution fits best in an environment with only a few desktop images. If there is substantial variation in the desktop image used by the majority of your end users, you will find a VDI deployment utilizing a bare metal hypervisor substantially more manageable.

Deployment Costs

The deployment costs below are approximated based on a number of different deployments performed by TAG-IT and include costs for software and hardware, but do not include integration services and represent the average cost per user.

	Terminal Services	Bare metal VDI	OS Virtualization VDI
Deployment Costs per user	$450	$950	$650

Additional Resources

For an ROI Calculator, go to www.provisionnetworks.com

Bare metal hypervisors:

http://vmware.com/products/vi/
http://www.virtualiron.com/
http://www.citrix.com/English/ps2/products/product.asp?contentID=683148
http://www.microsoft.com/windowsserver2008/en/us/hyperv.aspx

Operating system virtualization:

http://www.parallels.com/solutions/vdi/

Connection Brokers:

www.provisionnetworks.com
http://vmware.com/products/view/
http://citrix.com/English/ps2/products/product.asp?contentID=163057&ntref=hp_nav_US