Understanding the Performance of an X550 11-User Environment

Overview

NComputing's desktop virtualization technology enables significantly lower computing costs by letting multiple users share a single PC. With the X550 products up to 11 users can share and simultaneously access a single PC.

The concept of shared computing is not new, in fact if you go back to the early days of mainframe computing, multiple users shared a single system using basic access terminals. PCs forever changed the economics of computing – allowing people to have the power of the mainframe on their desk. As technology has progressed, the PC has become so powerful that most users are now only using a fraction of the capability of the machine, resulting in wasted resources and wasted power.

NComputing takes this excess power and shares it among multiple users, resulting in more efficient usage of resources and hence lower costs, easier set-up and management and a far superior environmental footprint.

NComputing manages the shared PC resources with the vSpace™ desktop virtualization software and distributes those resources to each access device. NComputing vSpace software efficiently accesses the features and functions inherent in the host PC's operating system to distribute its capabilities among users with minimal overhead. Therefore every X550 station can see operating system responsiveness and application performance that is nearly the same or equal to that of the host PC.

Determining Your X550 Configuration

Each X550 kit contains one PCI card and five XD2 access devices that add five new users to a shared PC. With two cards installed the environment can support 11 users on a single host PC. The X550 combined with a modern low cost dual core PC with 2 GB of memory provides the most affordable and powerful shared computing environment in the market today. The following diagram and image shows an example X550 installation configured for 11 users:

Of course, as with any PC, the performance for each user depends upon the host configuration and application needs of the users. Specifically, performance is dependent upon the individual host hardware, memory, CPU, applications being used, operating system, and other factors. There is almost no discernable difference between virtual and real desktop environments as long as the two key resources of processor utilization and memory use do not exceed 100%. As long as these two key parameters are appropriately sized for the application, the performance for each X550 user should be comparable to that of the host PC.

It is easy to check CPU utilization by using the Windows Task Manager in Windows or 'Top' in Linux. These tools give clear and constant feedback on the percent of processing power consumed making it easy to evaluate your environment to determine if the amount of processing power needed for a given set of applications is available. For the majority of productivity applications and many multi-media applications, most dual core processors provide more than enough performance to handle 6 or even 11 users at one time. NComputing recommends you test your actual application set prior to wider deployments.

NComputing's operating system testing with our vSpace software has demonstrated excellent "fair share" processor utilization that enables all tasks to be serviced equally. This means that even if the CPU usage spikes to 100%, vSpace and the operating system evenly distribute the available CPU capacity across all the stations. So in the cases where the CPU hits 100%, each individual station's performance slows on a sliding scale. For example, a user's perceived

performance may move from 2.5 GHz to 2.0 GHz to 1.5 GHz and then spring back once the demanding task is completed. Additionally, those times when the actual processing requests exceed what was anticipated are usually very brief, and user performance normally returns to near the host PC's native speed very quickly.

The second PC resource to check is memory utilization and it can easily be checked via the same performance tab within the Windows Task Manager. NComputing generally recommends provisioning the host PC with 2-4 GBytes* of memory. Note that in the example below, 11 users are actively running 10 applications while consuming less than 1 GByte of memory.

The X550 PCI card runs NComputing's own protocol from the host PC to the access device and uses standard Category 5e UTP or Category 6 STP cables to do so. Because the X550 PCI card in a host system shares approximately 100 MBytes of delivered throughput on the PCI bus, our efficient protocol ensures that there are typically no bottlenecks between the X550 stations and the host.

Normal PC network performance rules apply to the host PC, and the most common limit is the connection bandwidth to your Internet service provider. However, this bandwidth is a shared resource for all users, whether using individual PCs or using a shared environment.

When setting up a multi-user environment, testing of your applications in a typical usage model should be conducted to determine that the configured PC's resources (CPU and memory) are sufficient to meet performance expectations. Any dual core system from 2008 and beyond should more than meet the vast majority of application performance needs for most educational or business users. The following data show how well 11 users can run on one modest business PC available in the market today.

If your testing indicates that a system's dual core processor does not meet your performance needs, then the option is to improve the resources in the host PC by going to a faster processor or using one with more processing cores.

X550 11-User Environment

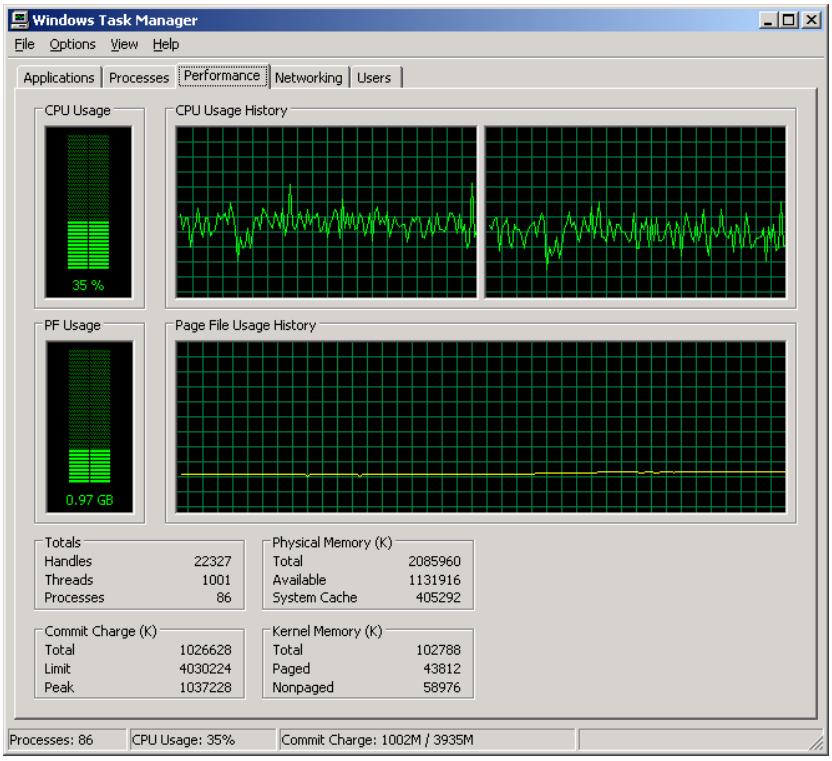
In our 11-user example configuration, we used an off the shelf Dell Vostro 200 that sold for $364*. And we added two X550 PCI cards, 10 access devices, eleven 15" LCD monitors, and Windows Server 2003 Standard Edition as the OS.

For the purpose of this exercise, NComputing ran 11 active users and a variety of different applications to determine performance. The hardware configuration and setup details are described in Appendix A. For office productivity, we ran 10 active applications comprising 25 separate instances across a total of 11 users. The applications are listed in Table 1.

Table 1: Active Applications

Application List
Microsoft Paint
Adobe Reader
Microsoft PowerPoint
Microsoft Internet Explorer
Google Earth Plug-in (in Explorer)
VLC Media Player
Mozilla Firefox
Thunderbird Mail
RoboWorks
Microsoft Excel

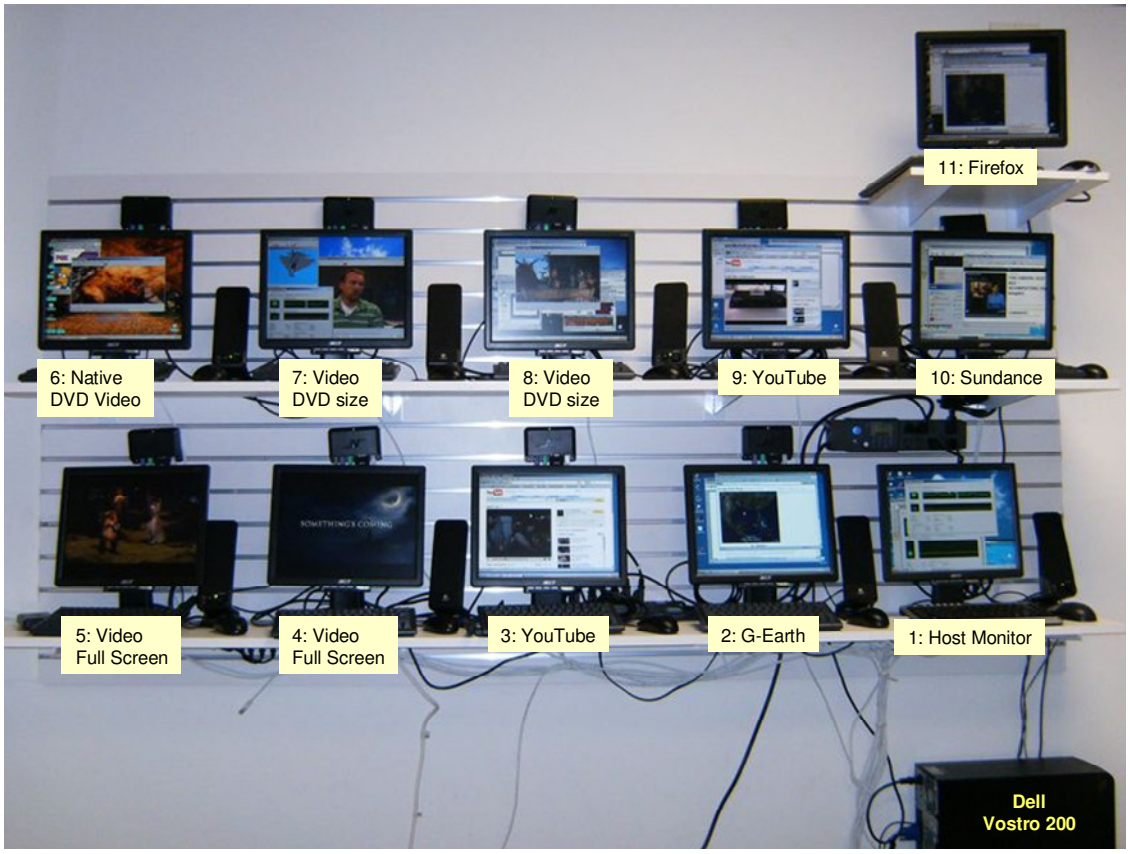
With all 11 stations (or unique users) active, 10 productivity applications running, and a total of five multi-media video clips playing at native resolution (~720 x 480), the environment provided excellent interactive performance with no discernable dropped video frames.



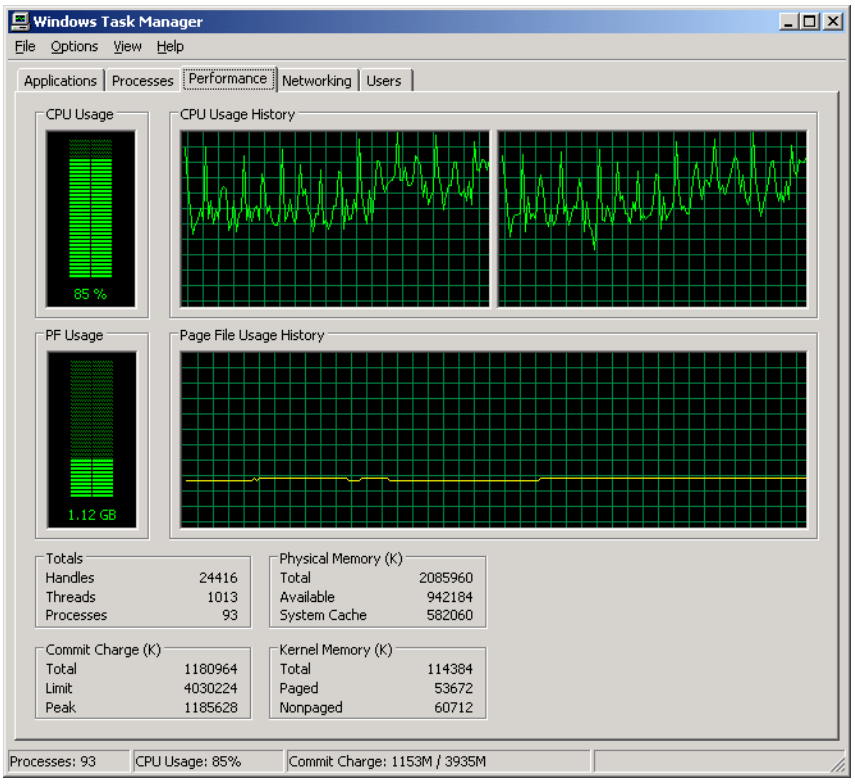
As you can see in the Task Manager screen capture, processor utilization was well below 40% and the available memory was 1.1 GB of the 2 GB installed. This clearly shows that the Dell system had plenty of performance to handle this configuration.

Additional applications were opened in this 11-user system to have a total of eight multimedia applications running with video clips of various sizes, including multiple stations running full screen video. The total set of applications and video clips playing are captured in the matrix below:

	App 1	App 2	App 3	Multi Media Clip
User 1 (Host)	Windows Task Manager			
User 2	Explorer (Google Earth)	Excel	Paint	
User 3	Mozilla Firefox			YouTube Spinal Tap "11"
User 4	VLC Media Player	Paint		Shrek 3 Full Screen (10 x 7)
User 5	Explorer	VLC media player		Shrek 3 Full Screen (10 x 7)
User 6	Explorer	Excel	Adobe Reader	Sundance Channel (web)
User 7	Explorer	VLC media player		YouTube Video Electronics Show
User 8	Explorer (2)	VLC Media Player	Excel & PwrPt	Shrek 3 (~720 x 480)
User 9	Explorer (Google Earth)	PowerPoint		Testimal Video (~720 x 480)
User 10	VLC Media Player	RoboWorks - F-18		Troy (~720 x 480)
User 11	Mozilla Firefox	Excel	Thunderbird Mail	



With all of these applications and clips playing, the processor and memory allocation still has room for more.



In this expanded application environment, average processor utilization is about 85% and the available memory was still 0.9 GB of the 2 GB installed.

Another benefit of using an NComputing environment is the power savings. This entire 11-user environment, including monitors, is running on just 229 Watts or less than 21 Watts per user.

Summary

The test results from this 11-user scenario confirm what users of our award-winning X-series products have been seeing every day – individuals utilize a small fraction of the processing and memory performance provided in today's PCs, leaving available capacity that can be used for shared computing and virtual desktops. Even a basic host PC can power up to 11-users simultaneously executing productivity, office and multimedia applications with CPU and memory resources to spare.

This environment demonstrates how NComputing vSpace desktop virtualization technology utilizes this excess capacity and distributes it to many users resulting in significantly lower computing costs. In addition, the NComputing solution provides on-going management and power savings that is many times better than the traditional PC model.

Appendix A – Setup Details

The tested hardware configuration consisted of:

- Host[1] PC: Dell® Vostro™ 200 with 2.53 Intel Core2 Duo Processor
- 2GB of DDR memory
- Two X550 cards plus 10 XD2 NComputing access devices
- Eleven 15" monitors at 1024x768 resolution and 16-bit color depth
- Eleven Keyboards and mice
- P3 International Kill A Watt™ PS power meter device

Setting up this demonstration is very easy. You simply connect each access device to a keyboard, monitor, mouse and host PC (via Category 5e cable); then install NComputing vSpace on the host PC.

[1] Host System Configuration: Intel® Core2 Duo™ E7200 @ 2.53 MHz, Intel graphics Media Accelerator 3100, 2GB DDR 800 Memory, Microsoft® Windows® Server 2003 R2 SP2 Standard Edition and Office 2003 (system hardware cost was $364, excluding software and taxes).

This is a close up image showing XD2 access devices with multi-user sessions running video.

Appendix B – Benchmarking Comments

Benchmarking a multi-user system is a challenging task. Traditional PC benchmarks often focus on processor intensive applications and attempt to max-out the system's CPU utilization to deliver a "score" or "time" taken to perform tasks such as 3-D graphics rendering or audio/video compression. Such benchmarks may have relevance to high-end users (such as gamers or video editors) but are not representative of typical office or school environment work loads. Other "standard" benchmarks that try to simulate office workloads generate scores that represent maximum utilization of CPU performance and I/O performance for peripherals like disk drives, but again, a higher score on these types of benchmarks may not necessarily translate into a significantly different user experience with normal day to day computing tasks. The typical PC spends most of its time waiting for the user to type, read screen text with basic graphics material, as opposed to rushing through tasks as quickly as the "benchmark" programs simulate. (To understand this you only need to watch one of the "office mark" type benchmarks executing; the screens flash by so quickly you cannot actually "see" what is going on. Nobody types that fast or switches screens that quickly in real life).

Benchmarking a shared computing or desktop virtualization environment has never been easy. You cannot take a single-user CPU-intensive benchmark and run multiple simultaneous copies to get any meaningful multi-user results.

A better metric is to observe the end user experience when running a workload that is "typical" of what a user will be doing in normal day-to-day computing. The reason the CPU and PC vendors do not promote such benchmarks is that there would be little difference between today's PC and last year's model; because the system would be mostly waiting for the user to type the next keystroke or read a page just downloaded from the Internet.

One methodology of evaluating the performance of a multi-user environment is based on measuring system utilization during a simulated set of office tasks that includes realistic delays between tasks, and proves that even a basic PC of today can easily support 11 users running common applications. The focus here is user experience centric, not CPU cycle centric, and we believe this is much more relevant to most actual user environments.

Performance Metrics

There are a number of other metrics that most users find relevant in real-world office and school classroom environments.

i) System Boot time. How long does it take to get to a Windows logon prompt and access a usable desktop after powering up the system?

ii) Application and file opening time. How long does it take to open an office document?

iii) File save time. How long does it take to save your document?

iv) Internet page load time – measuring this can be difficult since it is generally more a function of the network performance, not the PC itself

v) Flash video playback performance. For example, does educational content play smoothly with synchronized sound?

vi) System power consumption. How much power is consumed by the system on average?

However, even in measuring these parameters, the goal is to deliver “responsive” performance, versus comparing absolute numbers. Will users really notice the difference between 31 second and 33 second boot times, or 1 second and 1.2 second file save times?

While the host system runs through its simulated work load, we can observe the system resource utilization through the performance monitor. Ideally, CPU performance should average below 90%, memory utilization should generally be less than the physical amount of memory installed (no system page thrashing), and the network should be sized and configured properly for the number of users. If these parameters are maintained, an NComputing environment will give each user performance that is very close to that of the native host system.

Thus, traditional PC benchmarks are generally not a good measure of real-world user experience and have been used by the PC industry to promote system capabilities not actually required for normal user computing. Furthermore, such benchmarks may not even work in a multi-user environment. However, if you run the simulated workload metrics outlined above you can demonstrate to yourself that NComputing vSpace virtual desktops deliver a user experience that is close to that of the host PC.