



| L-Series 30 User Environment

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Overview

NComputing's multi-user technology enables greatly expanded computing capabilities by allowing up to 30 users to simultaneously access a single PC. This multi-user desktop experience supports simultaneous users at lower costs in an easy to use, set-up and maintain environment that is eco friendly. The result is a significantly lower cost of computing, on-going management and power usage that is many times better than a traditional networked PC model.

Since most users only utilize a few percent of today's powerful PCs, NComputing leverages this power with small access terminals and proven software that enables a single PC or server to support up to 30 users at once. The goal in the multi-user environment is to maintain the performance of the host computer across many users; and as long as the host CPU, memory or LAN performance is not constrained, each access terminal should operate at a speed similar to the host.

NComputing and our reseller network have many customers that are utilizing up to 30 users per host. Most of these are used for office productivity with many applications, but some are used to run a single dedicated application (generally in a manufacturing or data entry environment).

In the following proof of concept we will demonstrate a 30-user environment that accesses a single (modest) host using our L-series products. Since most users today are running workloads such as email, office applications and internet browsing, these tasks represent a good measure for a proof of concept. A typical PC benchmark would not be appropriate or applicable to the multi-user environment since these benchmarks are made for stressing an individual PC in a comparison to another PC. For this demonstration, our goal is to show 30 active users all accessing a single host, while not creating constraints on the processing, memory or network capabilities of that host.

L-Series Environment

For the purpose of this exercise, we ran two scenarios:

- 1) 30 active users running 6 different applications
- 2) 30 active users, each running a PowerPoint slideshow

It is important to note that each of the L-Series products consumes only about 5 Watts of power each and that no special power considerations were needed for this environment. However, if 30 PC's were all deployed in a single room, power and heat would be big considerations.



The 30-User hardware configuration and setup details are described in Appendix A.

To evaluate typical office usage, during scenario 1 we ran sessions of Word, Excel, Outlook, Internet Explorer, Adobe Reader, and PowerPoint (slides included text, graphics and JPEG images). The details are listed below in Table 1:

Table 1: Summary of L-Series Benchmark Applications

Application/ Web Site	# of Instances Running	Details
YouTube.com	1	"Crazy Russian Tunnel Accidents" in normal mode
CNN.com	1	Live video feed, "UN Security Council"
Apple.com	1	"Ratatouille" Trailer in small mode
MS Excel	6	
MS Outlook	6	Checking POP3 email account every 5 minutes
MS Powerpoint	5	Slideshow with automatic 3 second slide transitions (with text, graphics and jpegs)
MS Word	5	
Adobe Reader	5	
Total	30	

The following are screen shots of the active applications taken during the test:

CNN.com



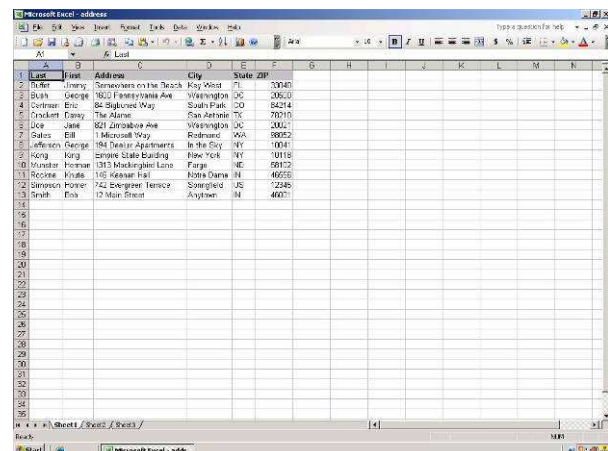
Apple.com



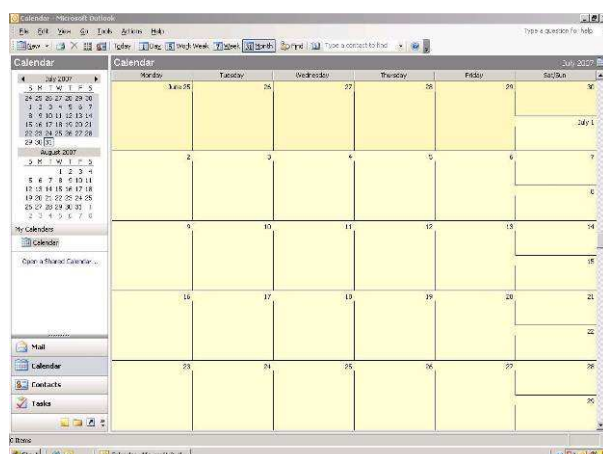
YouTube.com



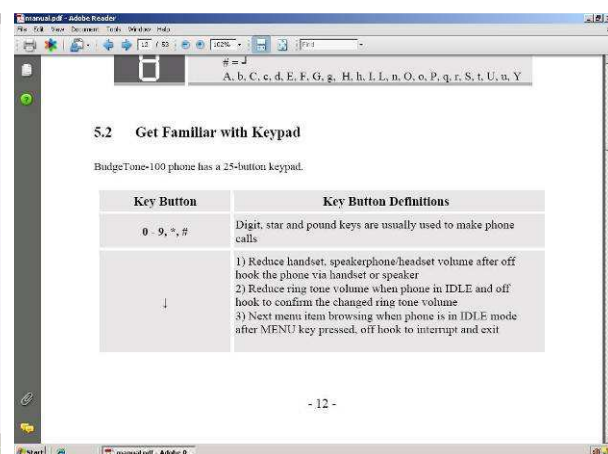
MS Excel



MS Outlook



Adobe Reader

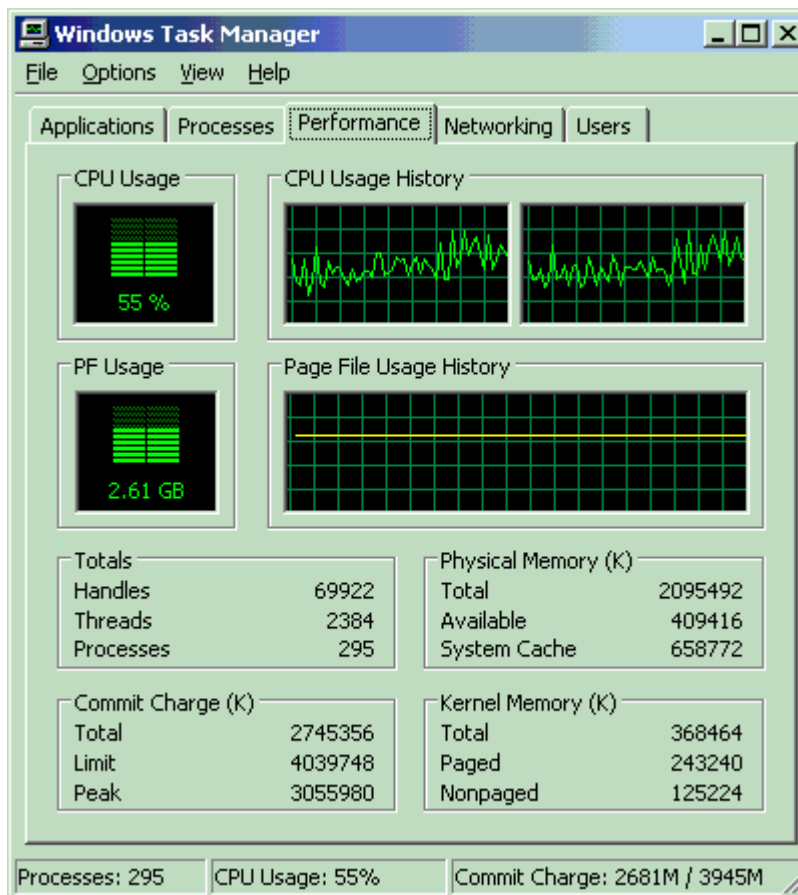
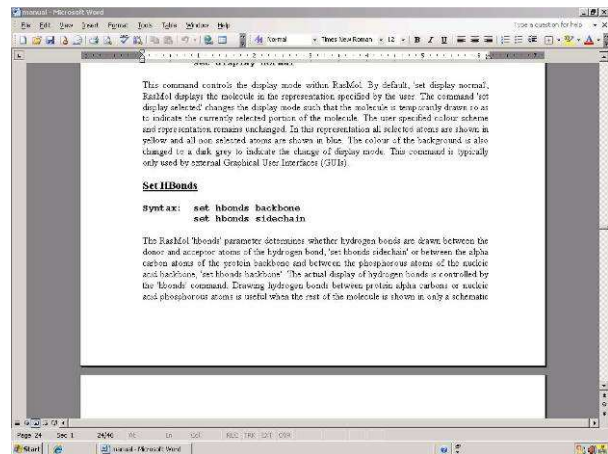


MS PowerPoint

MS Word

Suggested Agenda

- Company Vision & Background
- Solution Overview
- ➔ Enterprise Solutions
- NComputing in Action
- Demo/Q & A / Next Steps



Performance Results

The Windows System Monitor was used to gauge performance and provide some guidance as to the percent of CPU, memory and network resources used in each scenario. We recorded the statistics listed in Table 2 during the tests of 30 simultaneous users.

Table 2: Results from Windows Office Productivity + Internet Video Streaming

Average CPU Utilization	55%
Maximum CPU Utilization	75%
Maximum Network Utilization	5%
RAM Utilization (MB)	1,440
System Cache (MB)	524

NComputing Multi-User technology allows 30 Users to run six different applications, including 3 web video feeds, on a ~\$600 PC while using only half the average CPU resources with less than 2Gigabytes of memory!

Table 3: Results from 30 PowerPoint Slideshows

Average CPU Utilization	36%
Maximum CPU Utilization	52%
Maximum Network Utilization	3%
RAM Utilization (MB)	1,917
System Cache (MB)	516

Note: performance results will vary and are dependent upon the OS, applications used, total system memory, including virtual memory and other factors.

Determining Your Environment

The performance of each access terminal in the multi-user environment depends upon the host configuration & application needs of the customer. Specifically, performance is dependent upon the individual host hardware, memory, video card, applications being used, OS software and network conditions within any LAN/WAN. As long as the processor/memory/network utilization stays below 100%, the performance for each user should be comparable to that of the host PC. Power hungry applications can tax the processor to its limit and slow the performance of the multi-user environment; but even if these applications demand more processing power, these peak requests are generally very brief and performance should return to normal very quickly.

Although this environment does not examine performance with 30 “active” users that are typing, saving, switching between applications, sending email and more; the CPU utilization from those actions is generally 0-3% per user, and these tasks will be covered by the excess performance capacity of the host.

When setting up your multi-user environment, testing of your applications and usage model should be conducted to determine that host resources (CPU, memory, and networking) are sufficient to meet the performance expectations. Should the environment not meet those requirements, the options are to improve the resources in the host PC or lower the number of users.

Summary

The results from these 30-user scenarios clearly confirm what our users have been utilizing every day, and that most users only utilize a small fraction of the processing and memory performance provided in today's PCs. And that these PC's and access terminals can power up to THIRTY USERS simultaneously to perform productivity, office and multimedia applications on a single host with CPU resources to spare.

This environment demonstrates that NComputing utilizes this excess performance and distributes it to many users with our Multi-User technology; which results in a significantly lower cost of computing, on-going management and power usage that is many times better than a traditional networked PC model.

Appendix A – Setup Details



The hardware configuration consisted of:

- Host¹ PC
- 29 Terminals (8-L100s, 2-L120s, and 19-L200s)
- Two 16-port keyboard/video/mouse (KVM) switches
- 19" wide-panel monitor at 1024x768 resolution and 16-bit color
- Keyboard and mouse
- Gigabit Ethernet Switch (Gigabit backbone with 100mb to each terminal)

Setting up this demonstration is very easy. You simply connect each Terminal to a keyboard, monitor, mouse and LAN; then install NComputing Terminal Server on the host PC.

Please note that the KVM switches were used for convenience. This included the space constraints of setting up 30 workstations with monitors, keyboards and mice and the ability to display and control the sessions from one workstation.

See Appendix B for more detailed setup instructions.

¹ Host System Configuration: AMD Athlon 64X2 Dual Core 5200+ 2.61 GHz CPU, ECS HT2000 motherboard, 3Dfuzion PCI Express Graphics (nVidia 7300LE), 2GB DDR 800 Memory, Western Digital SATA 250GB Hard Drive; Microsoft Windows Server 2003 SP2 and Office 2003 (cost is roughly \$600, excluding software and taxes).

Appendix B – Detailed Setup Instructions

- 1) Get a PC that is comparable to the following:
 - a. AMD Athlon 64X2 Dual Core 5200+ 2.61 GHz CPU
 - b. ECS HT2000 motherboard
 - c. 3Dfuzion PCI Express Graphics (nVidia 7300LE)
 - d. 2GB DDR 800 Memory
 - e. Western Digital SATA 250GB Hard Drive
 - f. Microsoft Windows Server 2003 SP2
 - g. Microsoft Office 2003
- 2) Install the NComputing Terminal Server software
- 3) Create 30 users, with a unique Logon ID for each (password is optional)
- 4) Connect one keyboard, monitor and mouse to the “Console Port” of a Keyboard-Video-Mouse switch, such as the TRENDnet TK-1602R
- 5) Connect the L-Series Terminals to the KVM switch(es)
 - a. Connect one end of the KVM cable to the Terminal and the other end to the switch
 - b. Connect the daisy chain ports
 - c. Plug in the power cord for each Terminal
- 6) Connect the Ethernet cables
 - a. One Gigabit connection from the Host PC to the Gigabit Ethernet Switch, such as the TRENDnet TEG2248WS
 - b. Connect each Terminal to the Switch (100Mb)
 - c. Broadband connection to the LAN or Internet source to the Gigabit Switch
- 7) Power on the KVM, Ethernet Switch, and Terminals
- 8) Logon to each Terminal using the appropriate Logon ID and password
- 9) Run the applications!

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