Principled Technologies®

TEST REPORT
JUNE 2010

Dell ImageDirect vs. Symantec Norton Ghost 11.5 time savings evaluation

Executive summary

Dell Inc. (Dell) commissioned Principled Technologies (PT) to compare Dell's online ImageDirect image creation process with a typical corporate deployment solution such as the Symantec™ Norton™ Ghost™ 11.5 tool, a leading solution many organizations use. The test aimed to measure and compare the potential time an organization's IT staff might inve_st using the two imaging solutions and deployment processes across multiple locations.

We selected four commonly available systems that Dell ImageDirect supports with Microsoft® Windows® 7 Enterprise:

- Dell™ Latitude™ E5400 notebook
- Dell Latitude E6400 notebook
- Dell OptiPlex™ 780 desktop
- Dell Precision™ T1500 desktop

With the ability to order systems with a customized, preinstalled image or build customized images for download in a few clicks of the mouse button, we found that Dell ImageDirect could save significant amounts of IT staff members' time, time they would normally devote to imaging using a tool such as Norton Ghost.

KEY FINDINGS

- Deploying systems with Dell ImageDirect saved as much as 76 percent of IT staff time over using an imaging tool such as Norton Ghost 11.5.
- Deploying systems for users in remote facilities with Dell ImageDirect saved as much as 80 percent of IT staff time over using an imaging tool such as Norton Ghost 11.5.
- Creating images using Dell ImageDirect saved on average 97 percent of IT staff time over creating the images with an imaging tool such as Norton Ghost 11.5.
- Dell ImageDirect required no additional time to deploy an image on a different Dell model as our tests on the Dell OptiPlex 780 and Precision T1500 show.

We first created a standard company system image using both Dell ImageDirect and Norton Ghost 11.5 on a Dell Latitude E5400 notebook. We used Ghost as many small, medium-sized, and large organizations would. The difference between those usage models is that smaller organizations with fewer systems are more likely to install applications by hand. Larger organizations would develop silent installation scripts to speed up repeated application installations. We then ordered a Dell OptiPlex 780 desktop system using the image created and tested through Dell's ImageDirect service. We tested the other systems using the images created from Dell ImageDirect and compared setup times with the systems we used Norton Ghost 11.5 to set up. We repeated this process on the Dell Latitude E6400, changing the systems to mimic what would happen over time as an organization buys new and different systems and updates images, possibly distributing them across multiple sites.

Time savings of Dell ImageDirect over Norton Ghost 11.5					
Area of time savings	**Dell Latitude E5400**	**Dell Latitude E6400**	**Dell OptiPlex 780**	**Dell Precision T1500**	**Average across all four systems we tested**
One-time setup (percentage)	0:00:00 (N/A)	0:56:15 (94%)	0:31:39 (100%)	0:35:00 (100%)	0:30:43 (97%)
Deployment (percentage)	0:32:11 (73%)	0:37:34 (76%)	0:13:42 (53%)	0:16:03 (66%)	0:24:52 (66%)
Remote site deployment (percentage)	0:41:57 (78%)	0:47:16 (80%)	0:23:28 (66%)	0:25:22 (76%)	0:34:31 (78%)

Figure 1. The time savings of Dell ImageDirect over Norton Ghost 11.5 for setting up images and deploying images on systems (both at the central site and at remote sites). The time differences are in hours:minutes:seconds, with percentage differences in parentheses.

Figure 1 shows both the time savings and percentage time savings of Dell ImageDirect over Norton Ghost 11.5 in our image creation testing. These savings are what a small organization that does not use silent installations during their imaging process might expect. We base the times in Figure 1 not on elapsed times, but rather on the time an IT staff member would actually have to devote to a task. For example, if the task of copying an image to a system took a total of 40 minutes, but the actual time to start up the image copy and monitor its progress only took 8 minutes, we used the 8-minute figure. The 100% savings indicates that there was no time required for Dell ImageDirect imaging when switching to a different model of computer.

The one-time setup time is the time necessary to create an image for a system, either with Dell ImageDirect or Norton Ghost 11.5. This time would be necessary for each image within a customer's environment. IT staff members could then deploy that image on multiple similar systems. With Dell ImageDirect, IT staff members could also deploy the Dell ImageDirect image on different types of Dell systems with no additional setup time. Because we assume the initial image is already created for the Dell Latitude E5400, no time is necessary with either method and no time savings result. The deployment time is what is necessary to get the boxed up system unboxed, imaged, and personalized for the user. The remote site deployment time is the deployment time plus the necessary time to box the system back up, prepare it for shipping to the remote location, and unbox it there upon arrival.

We calculated our times on the Dell ImageDirect builds from the point after SYSPREP to creating the user and getting to the Windows desktop. We captured the ghost imaging comparison times from the point of powering on the system to the point that we created the user and the Windows desktop appears. We found these times to be much faster than with the Norton Ghost 11.5 setup, especially when it came to ordering a pre-configured system.

Test methodology

We first tested a Dell Latitude E5400 notebook system with an existing image. We then tested a Dell Precision T1500 desktop system with as similar an image as possible. This is the situation the IT staff faces when adding a new model of computer to the set of computers they already support. We chose a desktop to emphasize the differences when compared with a notebook. We also tested a Dell Latitude E6400 notebook with an updated image. This situation is a common one, where the IT staff needs to add updates, new applications, and make other changes over time. We completed the test by ordering a Dell OptiPlex 780 from the factory with the customized image already installed.

The initial image contained the following applications as part of our hypothetical company's corporate build:

- Adobe® Acrobat® Reader 8.1.2
- Adobe Photoshop® CS5
- Adobe Dreamweaver® CS5
- Microsoft Access® 2007
- Microsoft Excel® 2007
- Microsoft Outlook® 2007
- Microsoft PowerPoint® 2007
- Microsoft Project 2007
- Microsoft Word 2007
- Microsoft Visio® 2007
- Microsoft Groove® 2007
- Microsoft OneNote® 2007
- Microsoft Publisher 2007
- Microsoft InfoPath® 2007
- SPEC®jbb®2005 v1.07
- Symantec EndPoint Protection 11.0.4
- WinZip® 14.5

We also set the following in the image:

- Microsoft Internet Explorer® (IE) home page to www.principledtechnologies.com
- Corporate desktop wallpaper

- Corporate-mandated policy settings:
  - Under Security Settings→Account Policies→Password Policy→Change Maximum Password age to 20 days
  - Under Security Settings→Local Policies→User Rights Assignment→Add Administrator to Lock pages in memory (recommended for running SPECjbb2005)
  - Under Security Settings→Local Policies→Security Options→Rename guest account to `PTGuest`

For the Dell Precision T1500 system, we recorded the amount of time that it took to deploy the corporate image using the two imaging tools.

On the Dell Latitude E6400, we updated the corporate image to simulate quarterly changes. We made the following changes to the image:

- Replaced Symantec EndPoint Protection 11.0.4 with McAfee® VirusScan Enterprise 8.5i
- Replaced Adobe Reader 8.1.2 with Adobe Reader 9.3
- Changed IE home page from www.principledtechnologies.com to www.dell.com
- Added one system policy: Under Security Settings→Local Policies→Security Options→Rename Administrator account to `PTAdmin`

For the Dell OptiPlex 780 order from the factory, we recorded the time from powering on the system to the Windows desktop as well as how long it would take to use Norton Ghost 11.5 to build and image the system.

Dell Latitude E5400 notebook

We measured the amount of time we used with each of the two imaging solutions—Dell ImageDirect and Norton Ghost 11.5—to go from unboxing the notebook to having a functioning system with the following applications and settings:

- Adobe Acrobat Reader 8.1.2
- Adobe Photoshop CS5
- Adobe Dreamweaver CS5
- Microsoft Access 2007
- Microsoft Excel 2007
- Microsoft Outlook 2007
- Microsoft PowerPoint 2007
- Microsoft Project 2007
- Microsoft Word 2007
- Microsoft Visio 2007
- Microsoft Groove 2007
- Microsoft OneNote 2007
- Microsoft Publisher 2007
- Microsoft InfoPath 2007
- SPECjbb2005 v1.07
- Symantec EndPoint Protection 11.0.4
- WinZip 14.5

We also set the following in the image:

- IE home page to www.principledtechnolgies.com
- Corporate desktop wallpaper
- Corporate-mandated Policy settings
  - Under Security Settings→Account Policies→Password Policy→Change Maximum Password age to 20 days
  - Under Security Settings→Local Policies→User Rights Assignment→Add Administrator to Lock pages in memory (recommended for running SPECjbb2005)
  - Under Security Settings→Local Policies→Security Options→Rename guest account to `PT Guest`

Dell Precision T1500 desktop

We measured the amount of time we used with each of the two imaging solutions—Dell ImageDirect and Norton Ghost 11.5—to go from unboxing the desktop to having a functioning system with the following applications and settings:

- Adobe Acrobat Reader 8.1.2
- Adobe Photoshop CS5
- Adobe Dreamweaver CS5
- Microsoft Access 2007
- Microsoft Excel 2007
- Microsoft Outlook 2007
- Microsoft PowerPoint 2007
- Microsoft Project 2007
- Microsoft Word 2007
- Microsoft Visio 2007
- Microsoft Groove 2007
- Microsoft OneNote 2007
- Microsoft Publisher 2007
- Microsoft InfoPath 2007
- SPECjbb2005 v1.07
- Symantec EndPoint Protection 11.0.4
- WinZip 14.5

We also set the following in the image:

- IE home page to www.principledtechnolgies.com
- Corporate desktop wallpaper
- Corporate-mandated Policy settings
    - Under Security Settings→Account Policies→Password Policy→Change Maximum Password age to 20 days
    - Under Security Settings→Local Policies→User Rights Assignment→Add Administrator to Lock pages in memory (recommended for running SPECjbb2005)
    - Under Security Settings→Local Policies→Security Options→Rename guest account to PT Guest

Dell Latitude E6400 notebook

We measured amount of time we used with each of the two imaging solutions—Dell ImageDirect and Norton Ghost 11.5—to go from unboxing the notebook to having a functioning system with the following applications and settings:

- Adobe Acrobat Reader 8.1.2
- Adobe Photoshop CS5
- Adobe Dreamweaver CS5
- Microsoft Access 2007
- Microsoft Excel 2007
- Microsoft Outlook 2007
- Microsoft PowerPoint 2007
- Microsoft Project 2007
- Microsoft Word 2007
- Microsoft Visio 2007
- Microsoft Groove 2007
- Microsoft OneNote 2007
- Microsoft Publisher 2007
- Microsoft InfoPath 2007
- SPECjbb2005 v1.07
- Symantec EndPoint Protection 11.0.4

- WinZip 14.5

We also set the following in the image:

- IE home page to www.dell.com
- Corporate desktop wallpaper
- Corporate-mandated Policy settings
    - Under Security Settings→Account Policies→Password Policy→Change Maximum Password age to 20 days
    - Under Security Settings→Local Policies→User Rights Assignment→Add Administrator to Lock pages in memory (recommended for running SPECjbb2005)
    - Under Security Settings→Local Policies→Security Options→Rename guest account to PT Guest
    - Under Security Settings→Local Policies→Security Options→Rename Administrator account to PTAdmin.

Dell OptiPlex 780 desktop

We measured amount of time we used with each of the two imaging solutions—Dell ImageDirect and Norton Ghost 11.5—to go from unboxing the desktop to having a functioning system with the following applications and settings:

- Adobe Acrobat Reader 8.1.2
- Adobe Photoshop CS5
- Adobe Dreamweaver CS5
- Microsoft Access 2007
- Microsoft Excel 2007
- Microsoft Outlook 2007
- Microsoft PowerPoint 2007
- Microsoft Project 2007
- Microsoft Word 2007
- Microsoft Visio 2007
- Microsoft Groove 2007
- Microsoft OneNote 2007
- Microsoft Publisher 2007
- Microsoft InfoPath 2007
- SPECjbb2005 v1.07
- Symantec EndPoint Protection 11.0.4
- WinZip 14.5

We also set the following in the image:

- IE home page to www.principledtechnolgies.com
- Corporate desktop wallpaper
- Corporate-mandated Policy settings
    - Under Security Settings→Account Policies→Password Policy→Change Maximum Password age to 20 days
    - Under Security Settings→Local Policies→User Rights Assignment→Add Administrator to Lock pages in memory (recommended for running SPECjbb2005)
    - Under Security Settings→Local Policies→Security Options→Rename guest account to `PT Guest`

Appendix A – System configuration information

Figure 2 provides detailed configuration information about two notebook systems and Figure 3 provides detailed configuration information about the two desktop systems.

System	Dell Latitude E5400	Dell Latitude E6400
		
General		
Number of processor packages	1	1
Number of cores per processor	2	2
Number of hardware threads per core	2	2
System power management policy	Balanced	Balanced
Processor power-saving option	Enhanced Intel® SpeedStep® Technology	Enhanced Intel SpeedStep Technology
System dimensions (length x width x height)	13-1/4" x 9-1/2" x 1-1/4"	13-1/4" x 9-1/2" x 1-1/4"
System weight	5 lbs. 10 oz.	5 lbs. 2 oz.
CPU		
Vendor	Intel	Intel
Name	Core™ 2 Duo	Core 2 Duo
Model number	T7250	T8700
Stepping	M0	R0
Socket type and number of pins	Socket P (478)	Socket P (478)
Core frequency (GHz)	2.00	2.53
Bus frequency (MHz)	667	1,066
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	2,048 KB	3 MB
Platform		
Vendor	Dell	Dell
Motherboard model number	OD695C	0W620R
Motherboard chipset	Intel GM45	Intel GM45
BIOS name and version	Phoenix ROM BIOS PlUS Version 1.10 A15	Dell A17 (09/17/2009)
BIOS settings	Default	Default
Memory module(s)		
Vendor and model number	2,048 MB Qimonda 64T256020EDL2.5C2	2,048 MB Samsung M4 70T5663CZ3-CE6
Type	PC2-6400	PC2-5300
Speed (MHz)	800	667
Speed running in the system (MHz)	800	667
Timing/Latency (tCL-tRCD-tRP-tRASmin)	6-6-6-18	5-5-5-15
Size (MB)	2,048	4,096

System	Dell Latitude E5400	Dell Latitude E6400
Number of memory module(s)	2 x 2,048 MB	2 x 2,048 MB
Chip organization (single-sided/double-sided)	Double-sided	Double-sided
Channel (single/dual)	Dual	Dual
Hard disk		
Vendor and model number	Seagate ST9120312AS	Seagate ST980313AS
Number of disks in system	1	1
Size (GB)	120	80
Buffer size (MB)	8	8
RPM	5,400	5,400
Type	SATA 3.0 Gb/s	SATA 3.0 Gb/s
Controller	Intel 82801IM (ICH9-M)	Intel 82801IM (ICH9-M)
Driver	Intel 6.9.1001 (02/20/2008)	Intel 9.6.0.1014 (03/03/2010)
Operating system		
Name	Microsoft Windows 7 Enterprise	Microsoft Windows 7 Enterprise
Build number	7600	7600
Service Pack	N/A	N/A
File system	NTFS	NTFS
Kernel	ACPI x86-based PC	ACPI x86-based PC
Language	English	English
Microsoft DirectX version	DirectX 11	DirectX 11
Graphics		
Vendor and model number	Mobile Intel GMA X4500HD	Mobile Intel GMA 4500MHD
Type	Discrete	Discrete
Chipset	Mobile Intel 4 Series Express Chipset Family	Mobile Intel 4 Series Express Chipset
BIOS version	1659.0	1659.0
Total available graphics memory (MB)	1,545	1,543
Dedicated video memory (MB)	32	32
System video memory (MB)	32	32
Shared system memory (MB)	1,481	1,479
Resolution	1,280 x 800 x 32 bit	1,280 x 800 x 32 bit
Driver	Intel 8.15.10.1749 (05/06/2009)	Intel 8.15.10.1855 (07/28/2009)
Sound card/subsystem		
Vendor and model number	High Definition Audio	IDT High Definition Audio CODEC, Intel High Definition Audio HDMI
Driver	Microsoft 6.1.7600.16385 (07/13/2009)	IDT 6.10.0.6227 (07/31/2009), Intel 6.10.1.2073 (05/26/2009)
Ethernet		
Vendor and model number	Broadcom NetXtreme 57xx Gigabit	Intel 82567LM Gigabit
Driver	Microsoft 10.100.4.0 (04/26/2009)	Intel 10.0.6.0 (06/12/2009)
Wireless		
Vendor and model number	Dell Wireless 1397 WLAN Mini-Card	Intel 5100 AGN
Driver	Microsoft 4.176.75.21 (10/01/2008)	Intel 1.1.1.1 (01/13/2010)
Optical drive(s)		
Vendor and model number	HL-DT-ST DVD+-RW GT10N ATA	Matshita UJ862A
Type	DVD+-RW	DVD+-RW

System	Dell Latitude E5400	Dell Latitude E6400
USB ports		
Number	4	4
Type	2.0	2.0
IEEE 1394 ports		
Number	1 (4-pin)	1 (4-pin)
Monitor		
LCD type	WXGA	WXGA
Screen size (inches)	14.1	14.1
Refresh rate (Hz)	60	60
Battery		
Type	Dell KM742 lithium-ion	Dell PT434 lithium-ion
Size (length x width x height)	8-1/8" x 2" x 3/4"	8-1/4" x 2" x 3/5"
Rated capacity	5,050 mAh / 11.1V (56Wh)	5,050 mAh / 11.1V (56Wh)
Weight	11 oz.	11 oz.

Figure 2. Detailed system configuration information for the two notebook systems.

System	Dell OptiPlex 780	Dell Precision T1500
		
General		
Number of processor packages	1	1
Number of cores per processor	2	4
Number of hardware threads per core	2	4
System power management policy	Balanced	Balanced
Processor power-saving option	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology
CPU		
Vendor	Intel	Intel
Name	Pentium® Processor E5400	Core i5
Model number	E5400	750
Stepping	R0	B1
Socket type and number of pins	Socket 775 LGA	LGA1156
Core frequency (GHz)	2.70	2.67
Bus frequency	800 MHz	2,400 QPI Link
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	2 MB	1 MB (256 KB per core)
L3 cache	N/A	8 MB
Platform		
Vendor	Dell	Dell
Motherboard model number	0200DY	OP67HD
Motherboard chipset	Intel Q45	Intel P55
BIOS name and version	Dell A04 (04/30/2010)	Dell 2.0.2 (12/25/2009)
BIOS settings	Default	Default
Memory module(s)		
Vendor and model number	Kingston KP223C-ELD	Elpida EBJ21UE8BBF0-DJ-F
Type	PC3-10700	PC3-10700
Speed (MHz)	1,333	1,333
Speed running in the system (MHz)	800	1,333
Timing/Latency (tCL-tRCD-tRP-tRASmin)	6-6-6-15	9-9-9-24
Size (MB)	2,048	4,096
Number of memory module(s)	1 x 2,048 MB	2 x 2,048 MB
Chip organization (single-sided/double-sided)	Double-sided	Double-sided
Channel (single/dual)	Single	Dual
Hard disk		
Vendor and model number	Western Digital WD1600AAJS-75M0A0	Western Digital WD1600AAJS-75M0A0
Number of disks in system	1	1

System	Dell OptiPlex 780	Dell Precision T1500
Size (GB)	160	160
Buffer size (MB)	8	8
RPM	7,200	7,200
Type	SATA 3.0 Gb/s	SATA 3.0 Gb/s
Controller	Intel 82801JB (ICH10)	Intel 82801IR (ICH9R)
Driver	Intel 8.9.0.1023 (06/04/2009)	Microsoft 6.1.7600.16385 (06/21/2006)
Operating system		
Name	Microsoft Windows 7 Enterprise	Microsoft Windows 7 Enterprise
Build number	7600	7600
Service Pack	N/A	N/A
File system	NTFS	NTFS
Kernel	ACPI x86-based PC	ACPI x86-based PC
Language	English	English
Microsoft DirectX version	DirectX 11	DirectX 11
Graphics		
Vendor and model number	Intel 4 Series Internal Chipset	NVIDIA® Quadro® NVS 295
Type	Discrete	Discrete
Chipset	Intel 4 Series Internal Chipset Family	Quadro NVS 295
BIOS version	1785.0	62.98.56.0.11
Total available graphics memory (MB)	781	1,531
Dedicated video memory (MB)	32	256
System video memory (MB)	32	0
Shared system memory (MB)	717	1,275
Resolution	1,280 x 1,024 x 32 bit	1,280 x 1,024 x 32 bit
Driver	Intel 8.15.10.1872 (08/13/2009)	NVIDIA 8.15.11.9038 (07/14/2009)
Sound card/subsystem		
Vendor and model number	SoundMAX Integrated Digital High Definition Audio	High Definition Audio
Driver	Analog Devices 6.10.1.7260 (02/22/2009)	Microsoft 6.1.7600.16385 (07/13/2009)
Ethernet		
Vendor and model number	Intel 82567LM-3 Gigabit	Broadcom NetLink Gigabit
Driver	Intel 11.5.10.0 (12/10/2009)	Broadcom 12.2.2.2 (08/06/2009)
Optical drive(s)		
Vendor and model number	N/A	LG GH50N
Type	N/A	DVD-RW
USB ports		
Number	8	10
Type	2.0	2.0
IEEE 1394 ports		
Number	0	2
Monitor		
LCD type	Samsung SyncMaster 997DF	Samsung SyncMaster 997DF
Screen size (inches)	19	19
Refresh rate (Hz)	85	85

Figure 3. Detailed system configuration information for the two desktop systems.

Appendix B – Detailed results

Figure 4 provides more details on the test times of the individual tasks and activities for each of the systems with Dell ImageDirect and with Norton Ghost 11.5.

	Dell Latitude E5400		Dell Latitude E6400		Dell OptiPlex 780		Dell Precision T1500	
Timed activities	**Image-Direct**	**Ghost**	**Image-Direct**	**Ghost**	**Image-Direct**	**Ghost**	**Image-Direct**	**Ghost**
Total one-time setup	0:00:00	0:00:00	0:04:07	1:00:32	0:00:00	0:50:27	0:02:46	0:59:41
Install Windows 7	N/A	N/A	N/A	0:13:17	N/A	0:20:14	N/A	0:17:56
Upload new applications/edit image/audit image	N/A	N/A	N/A	0:17:17	0:00:00	0:07:21	N/A	0:10:53
Download and install drivers	N/A	N/A	N/A	N/A	N/A	0:02:58	N/A	N/A
Install applications	N/A	N/A	N/A	0:26:49	N/A	0:17:38	N/A	0:26:12
Customize image	N/A	N/A	N/A	0:03:09	N/A	0:02:16	N/A	0:04:40
Total deployment	0:12:07	0:48:13	0:12:03	0:49:37	0:08:10	0:28:18	0:05:13	0:45:35
Unbox system	0:02:26	0:02:26	0:02:22	0:02:22	0:01:59	0:01:59	0:02:27	0:02:27
Power on/deploy Ghost image	0:09:41	0:14:55	0:09:41	0:20:26	0:06:11	0:08:40	0:02:46	0:16:56
Install additional applications	N/A	0:30:52	N/A	0:26:49	N/A	0:17:38	N/A	0:26:12
Total remote site additional deployment	0:00:00	0:09:46	0:00:00	0:09:42	0:00:00	0:10:47	0:00:00	0:11:47
Repack system (average for all systems)	N/A	0:07:20	N/A	0:07:20	N/A	0:07:20	N/A	0:07:20
Unpack and set up	N/A	0:02:26	N/A	0:02:22	N/A	0:03:27	N/A	0:04:27

Figure 4. The organization's tested times for setting up images and deploying systems using them both to a single site and to a remote site. The times are in hours:minutes:seconds.

About Principled Technologies

We provide industry-technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help you assess how it will fare against its competition, its performance, whether it's ready to go to market, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.

Principled Technologies, Inc.
1007 Slater Rd., Suite 300
Durham, NC 27703
www.principledtechnologies.com
info@principledtechnologies.com