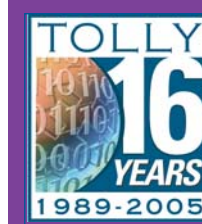


# Citrix Systems, Inc.

## Citrix Presentation Server 4.0

### Performance Study of Citrix Presentation Server and Windows Terminal Services



## Test Summary

*Premise: Windows Terminal Services, an element of Microsoft Windows Server, provides basic remote desktop functions and is the platform for Citrix Presentation Server. Customers looking at Terminal Services or Citrix Presentation Server-based solutions aren't choosing "either/or" but rather whether to augment Terminal Services with Citrix Presentation Server. Customers need to understand the performance and network capacity ramifications of these solutions as they assess the value-add that Citrix Presentation Server provides for Windows Terminal Services. .*

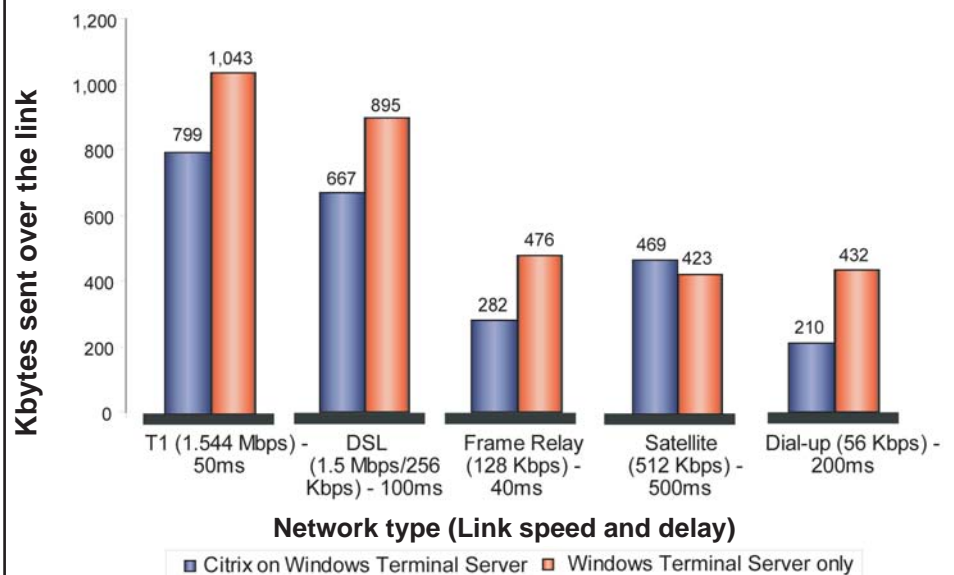
Citrix Systems, Inc. commissioned The Tolly Group to evaluate its Presentation Server 4.0 and its value-add to Windows Server 2003 Terminal Services. The test focused: performance, user experience, and network impact. Tolly Group engineers measured the number of bytes transmitted and the elapsed time necessary to view a sample PowerPoint presentation over multiple simulated networks varying link speed and latency types with clients implementing either Citrix Presentation Server (on top of Windows Terminal Services) or Microsoft Windows Terminal Services (standalone). Using the same environment, engineers also examined the average network throughput achieved when copying a file between a server and a remote Windows XP client. Finally, The Tolly Group measured the throughput achieved when performing a remote printing operation over the same network environment.

All tests were conducted at The Tolly

### Test Highlights

- Use of Citrix Presentation Server on top of Windows Terminal Services enabled a PowerPoint application to execute up to 43% faster over a remote connection than with Windows Terminal Services alone
- For typical remote and WAN connections, augmenting Windows Terminal Services with Citrix Presentation Server provided 2X to 3X faster printing and file transfer performance than Windows Terminal Services alone
- A PowerPoint application test showed that Citrix Presentation Server sent 25% to 50% fewer bytes over typical WAN links than Windows Terminal Services alone
- Citrix Presentation Server includes features to synchronize the audio and video for multimedia playback

### Bytes Transferred to View a PowerPoint Presentation (375KB Eight-Slides) File over Multiple Simulated Network Types

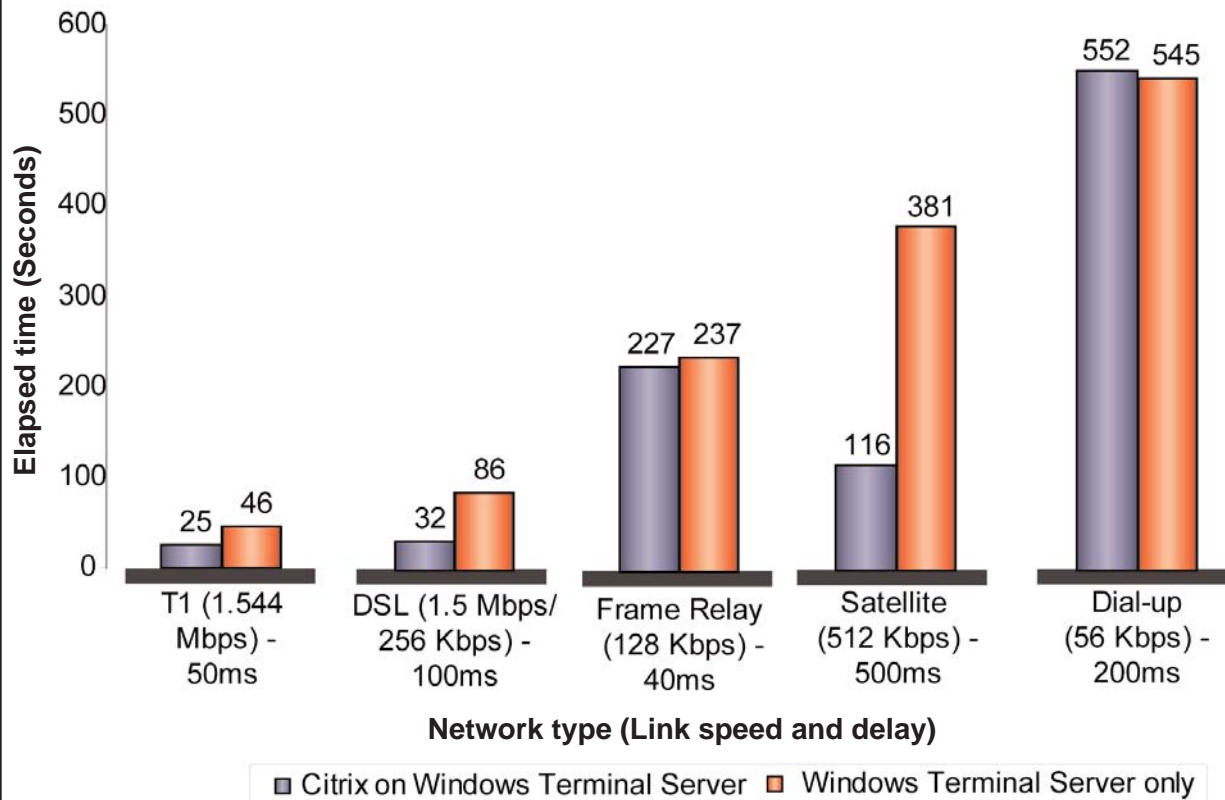


Note: Lower bars are better

Source: The Tolly Group, October 2005

Figure 1

### Elapsed Time (Seconds) While Copying a 4MB PDF Document over Various Simulated Network Types Supporting a Citrix Presentation Services or Windows Terminal Services Session



Source: The Tolly Group, October 2005

Figure 2

Group's Boca Raton, FL, facilities in September/October 2005.

Tests show that the Citrix Presentation Server can more effectively utilize available bandwidth during "batch" operations like file transfer and remote printing resulting in faster task completion. Similarly, in the test of viewing a screen-based presentation, the Citrix solution optimized the delivery of the server-based presentation and was consistently able to complete that task more rapidly than Windows Terminal Services by itself.

*Note: In the "Results and Analysis" section below, where reference is made to the "Citrix" solution, this refers to the Citrix Presentation Server product running on top of Windows Terminal Services. Where reference is made to the "Windows"*

*solution, this refers to a standalone Windows Terminal Services implementation.*

## RESULTS & ANALYSIS

### POWERPOINT PRESENTATION

Tolly Group engineers measured the number of bytes transmitted across the link and the amount of time (in seconds) required to run a PowerPoint presentation (sample) eight-slide PowerPoint file between a backend server and a remote client PC over various network types supporting a Citrix Presentation Server session or a Microsoft's Windows Terminal Services session.

Results show that Citrix Presentation Server transmitted up to 12% fewer

bytes across the network link than just using Microsoft's Windows Terminal Services alone. (See Figure 1 and Figure 4.) Results show that Citrix Presentation Server is particularly beneficial when transferring the PowerPoint over low-speed dial-up and frame relay connections, sending between 11% and 12% less data over the network. That frees up low-bandwidth connections for other data.

Moreover, Citrix Presentation Server also significantly improved the elapsed time to run the PowerPoint file across each network link tested. In fact, depending upon the network scenario, Citrix Presentation Server can run the PowerPoint in 11% to 43% less time than Windows Terminal Services. (See Figure 4.)

Over a dial-up 56-Kbps link, for instance, Windows Terminal

Services ran the PowerPoint in 76 seconds, while Citrix Presentation Server handled the task in just 43 seconds, or about 43% less time. Likewise, with a 128-Kbps frame relay link, Windows Terminal Services ran the PowerPoint in 43 seconds, versus just 26 seconds for Citrix Presentation Server — a 40% run-time improvement. Even over the 512-Kbps satellite connection, with 500 ms. of latency, Citrix Presentation Server delivered a 36% time savings over Windows Terminal Services.

#### FILE TRANSFER

Tolly Group engineers measured the level of throughput achieved to drive a file transfer (4MB PDF document) between a back-end server and a remote client PC over various network types supporting a Citrix Presentation Server session or a Microsoft's Windows Terminal Services session.

Results show that at higher link speeds (512 Kbps to T1/DSL), the Citrix Presentation Services session achieves consistently greater throughput — in some cases almost 3X more throughput. For instance, over a T1 connection, the Citrix Presentation Services session achieved throughput of 1.2 Mbps versus 653 Kbps for Windows Terminal Services. Yet, from an elapsed time perspective, the Citrix solution used the link for just 25 seconds versus 46 seconds for the Windows solution. (See Figures 2 and Figure 4.) Similarly, over a DSL connection the Citrix solution was almost 3X faster, completing the transfer in 32 seconds vs. 86 seconds for the Windows solution. Thus, the time to task completion was much shorter for Citrix thereby resulting in a more positive user experience.

Likewise, over the 512-Kbps satellite link, Citrix Presentation Services session achieved throughput of 236 Kbps versus just 80 Kbps for the Windows alternative — almost 3X

more throughput. From an elapsed time perspective, the Citrix Presentation Services session used the link for 116 seconds, far less than the 381 seconds required by Windows Terminal Services.

Over lower-speed dial-up and frame-relay connections, both products displayed similar performance, although during the dial-up and frame relay tests the Windows solution saturated the links.

#### REMOTE PRINTING

Tolly Group engineers measured the amount of throughput required to operate a remote print operation (using a sample eight-slide PowerPoint file) between a backend server and a remote client PC over various network types supporting a Citrix Presentation Server session or a Microsoft's Windows Terminal Services session.

Results show that in every network scenario Citrix Presentation Server delivered greater throughput and completed the operation in less time than Windows Terminal Services. In the T1 scenario, Citrix Presentation Server achieved 642 Kbps of throughput, versus 340 Kbps for Windows Terminal Services. However, the Citrix solution needed just 16 seconds to handle the task, while Windows Terminal Services needed double the time - 32 seconds. (See Figures 3 and Figure 4.) In the DSL scenario, Citrix Presentation Server required 68% less time to handle the print operation and delivered nearly 3X more throughput.

The greatest remote printing disparity occurred over the satellite connection. Citrix Presentation Server achieved throughput of 353 Kbps in 29 seconds, versus 57 Kbps in 199 seconds for the Windows Terminal Services solution. The dial-up and frame relay scenarios demonstrated that both solutions work equally well, with Citrix solution having only a slight advantage

**Citrix Systems  
Inc.**

**Citrix  
Presentation  
Server 4.0**



#### Throughput Evaluation

#### Citrix Systems, Inc. Citrix Presentation Server 4.0 Product Specifications\*

##### Feature (Partial list)

- SpeedScreen multimedia acceleration
- Client drive mapping
- Client printer mapping using Citrix Universal Print Driver 3
- Persistent bitmap caching and 2D graphics enhancements
- Session reliability
- Application isolation environment
- Virtual IP support
- Support for ActiveSync for synchronization of client connected PDA devices
- Workspace control

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*\*Vendor-supplied information not verified  
by The Tolly Group*



(about 5% faster) in time to complete the print job.

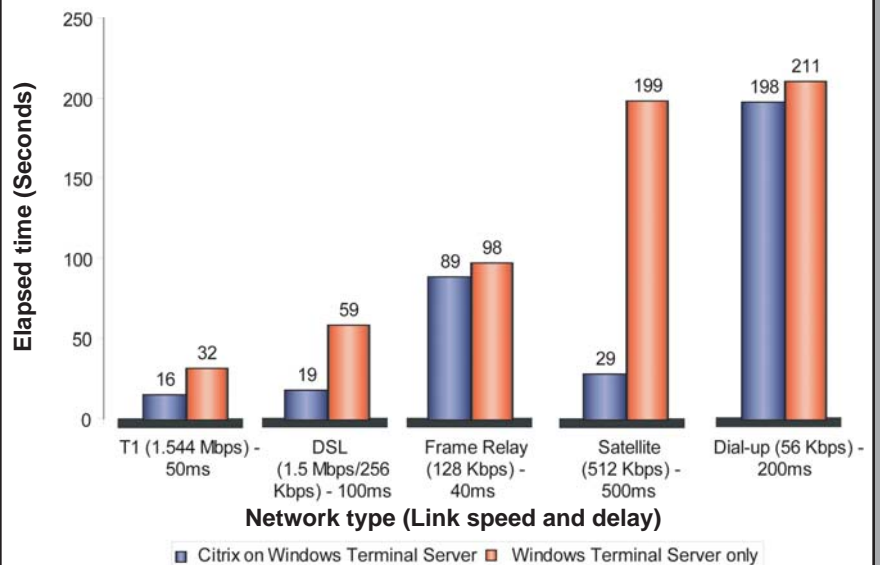
**MULTIMEDIA SUPPORT**

While not a formal part of the test, Tolly Group engineers ran several demonstrations where an MPEG video clip was streamed from server to client. Engineers observed that the Citrix solution provided for synchronization between audio and video where these elements were disjointed when streaming using the Windows solution.

**POLICY CONTROL**

While not a formal part of the test, Tolly Group engineers ran several demonstrations that utilized the bandwidth control features offered by Citrix (Microsoft does not offer a similar capability). In these demonstrations, engineers observed that the Citrix solution could "tune" the amount of bandwidth utilized by a particular function like file transfer or remote printing to provide for better performance for interactive applications.

**Elapsed Time (Seconds) to Print a 375KB Eight-Slide PowerPoint File over Multiple Simulated Network Types Supporting a Citrix Presentation Services or Windows Terminal Services Session**



Source: The Tolly Group, October 2005

Figure 3

**TEST CONFIGURATION AND METHODOLOGY**

For performance tests, The Tolly Group tested Citrix Presentation

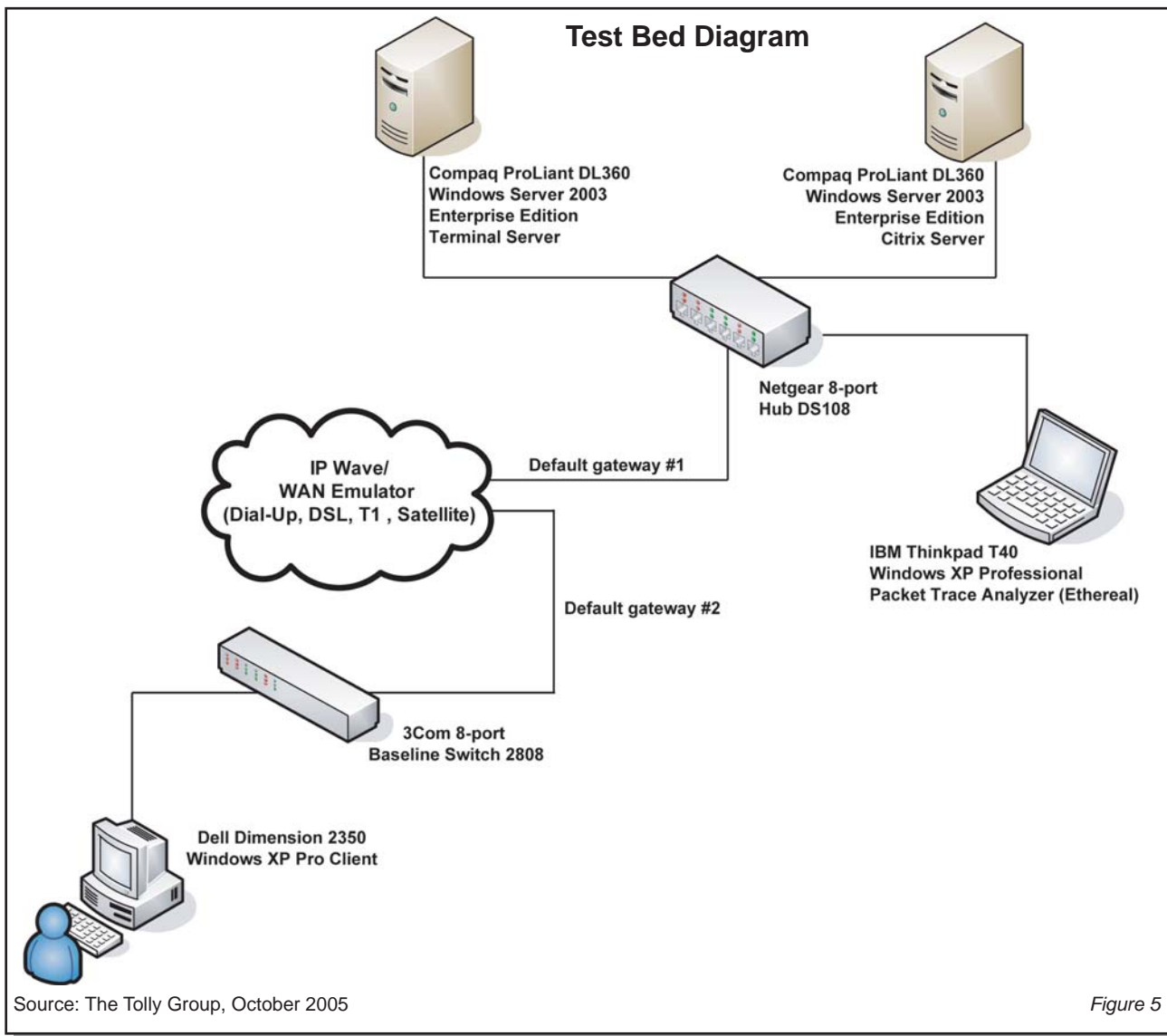
Server 4.0 running on a Compaq ProLiant DL360. The ProLiant DL 360 was equipped with an Intel Pentium III running at 1.4 GHz, 1.25 MB RAM, Microsoft Windows Server 2003 Enterprise Edition and

Test Results Summary							
Network Type	Metric	File Transfer (4MB PDF file)		Remote Printing (Eight-slide PowerPoint)		PowerPoint (See note)	
		Citrix	Microsoft	Citrix	Microsoft	Citrix	Microsoft
Dial-up (56 Kbps) - 200ms	Throughput (Avg. Mbps)	0.05	0.057	0.053	0.052	0.039	0.045
	Time elapsed (seconds)	552	545	198	211	43	76
	Bytes sent over the link	3,424,519	3,855,921	1,305,121	1,381,922	210,080	432,098
DSL (1.5 Mbps/256 Kbps) - 100ms	Throughput (Avg. Mbps)	0.882	0.347	0.538	0.185	0.282	0.311
	Time elapsed (seconds)	32	86	19	59	19	23
	Bytes sent over the link	3,528,128	3,757,073	1,280,052	1,365,039	667,455	895,474
T1 (1.544 Mbps) - 50ms	Throughput (Avg. Mbps)	1.156	0.653	0.642	0.34	0.394	0.451
	Time elapsed (seconds)	25	46	16	32	16	18
	Bytes sent over the link	3,606,348	3,756,629	1,282,352	1,362,097	799,075	1,042,928
Satellite (512 Kbps) - 500ms	Throughput (Avg. Mbps)	0.236	0.08	0.353	0.057	0.163	0.094
	Time elapsed (seconds)	116	381	29	199	23	36
	Bytes sent over the link	3,429,424	3,798,501	1,304,781	1,412,678	469,136	422,835
Frame Relay (128 Kbps) - 40ms	Throughput (Avg. Mbps)	0.118	0.128	0.117	0.114	0.087	0.089
	Time elapsed (seconds)	227	237	89	98	26	43
	Bytes sent over the link	3,342,412	3,807,131	1,299,128	1,396,531	282,331	475,631

Note: The simulated satellite scenario had a higher "Bytes sent over the link" count than other simulated speeds. Citrix best practices for the satellite network scenario recommends altering the default TCP packet size (used in these tests) from 1,460 to 512 bytes in order to achieve better "Bytes sent over the link."

Source: The Tolly Group, October 2005

Figure 4



Microsoft Office Professional 2003.

Engineers also tested a second ProLiant DL 360, this one running Windows Terminal Server. It also was configured with an Intel Pentium III running at 1.4 GHz, 1.25 GB RAM, Microsoft Windows Server 2003 Enterprise Edition and Microsoft Office Professional 2003.

Both servers were connected to a Netgear DS108 eight-port hub, which was connected to Dell PowerEdge 1400SC equipped with a 1.13-GHz Intel Pentium III CPU, 512MB RAM, Microsoft Windows 2000 Advanced Server (Service Pack 3) and Spirent Communications IP Wave — Network Impairment

Emulator (ver. 3.0.0.0). The WAN emulator varied the network types and speeds, offering dial-up, wireless/satellite, ADSL and T1 connection scenarios.

An IBM ThinkPad T40 laptop PC running Windows XP Profession supported the Ethereal (ver. 0.10.12) packet capture trace tool. It also was connected to the Netgear hub. On the client side, a 3Com 2808 eight-port switch connected to a client PC — a Dell Dimension 2350 running Windows XP PRO.

#### PowerPoint Test

Engineers set the client mapping for both Citrix Presentation Server and

Windows Terminal Services as follows:

- a- Drive Mapping: Disabled
- b- Audio Mapping: Disabled
- c- Printer Mapping: Disabled
- d- LPT Port Mapping: Disabled
- e- COM Port Mapping: Disabled
- f- Clipboard Mapping: Disabled

Engineers ran a 375-KB PowerPoint presentation of eight slides with graphics, text and animation included. Engineers captured the data while the PowerPoint presentation was running and gathered the information provided by Ethereal.

#### File transfer test

The PDF document used for the file transfer was the "MetaFrame

Presentation Server Administrator's Guide," an Adobe Acrobat Ver. 5.0 file of 4.2MB in size.

Engineers set the client mapping for both Citrix Presentation Server and Windows Terminal Services as follows:

- a- Drive Mapping: Enabled
- b- Audio Mapping: Disabled
- c- Printer Mapping: Disabled
- d- LPT Port Mapping: Disabled
- e- COM Port Mapping: Disabled
- f- Clipboard Mapping: Enabled

Engineers then used a 4.2-MB PDF document to transfer it from the server to the client machine. For this operation, the C: drive on the client PC was mapped to the server once the remote session was established.

The transfer file operation was done by dragging the file from the server and dropping it inside a folder in the client side. Engineers then captured the data while the file was being transferred and gathered the information provided by Ethereal, which was connected to a network hub port in the test bed. All Ethereal data captures include Ethernet header info and payload info.

#### Remote printing test

Engineers used the same file from the File Transfer test. (See above.)

Engineers set the client mapping for both Citrix Presentation Server and Windows Terminal Services as follows

- a- Drive Mapping: Disabled
- b- Audio Mapping: Disabled
- c- Printer Mapping: Enabled
- d- LPT Port Mapping: Enabled
- e- COM Port Mapping: Disabled
- f- Clipboard Mapping: Disabled

Engineers set up and configured an HP LaserJet 6L printer into the client PC (Dell Dimension 2350) in order to print documents once the Citrix or Windows remote session has been established. On Citrix Presentation Server, engineers changed the printer driver configuration to use only the Citrix Universal Printer Driver (UPD). Engineers chose a 375-KB file to print out. Engineers captured the data while the file was being printed and then, they gathered the information provided by Ethereal.

### The Tolly Group gratefully acknowledges the providers of test equipment used in this project.

Vendor	Product	Web address
Spirent Communications	IP Wave Network Impairment Emulator Version 3.0.0.0	<a href="http://www.spirentcom.com">http://www.spirentcom.com</a>



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## PROJECT PROFILE

**Sponsor:** Citrix Systems, Inc.

**Document number:** 205141

**Product Class:** Application virtualization software

**Products under test:**

- Citrix Presentation Server 4.0
- Windows Server 2003 Terminal Services, RDP ver. 5.2

**Testing window:** September through October 2005

**Software status:**

- Generally available

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