Ascend Communications
Ascend MAX 4048
Remote Access Concentrator Performance

Test Summary

Ascend Communications commissioned The Tolly Group to evaluate the Ascend MAX™ 4048 and the Total Control Hub from U.S. Robotics. The Tolly Group conducted performance benchmarks on the products in a variety of configurations utilizing actual FTP (File Transfer Protocol) session traffic. The performance testing was conducted across both 56 Kbit/s and 33.6 Kbit/s asynchronous modems. The products being tested were configured with the most current software and hardware available at the time of the test. Testing was performed in June of 1997.
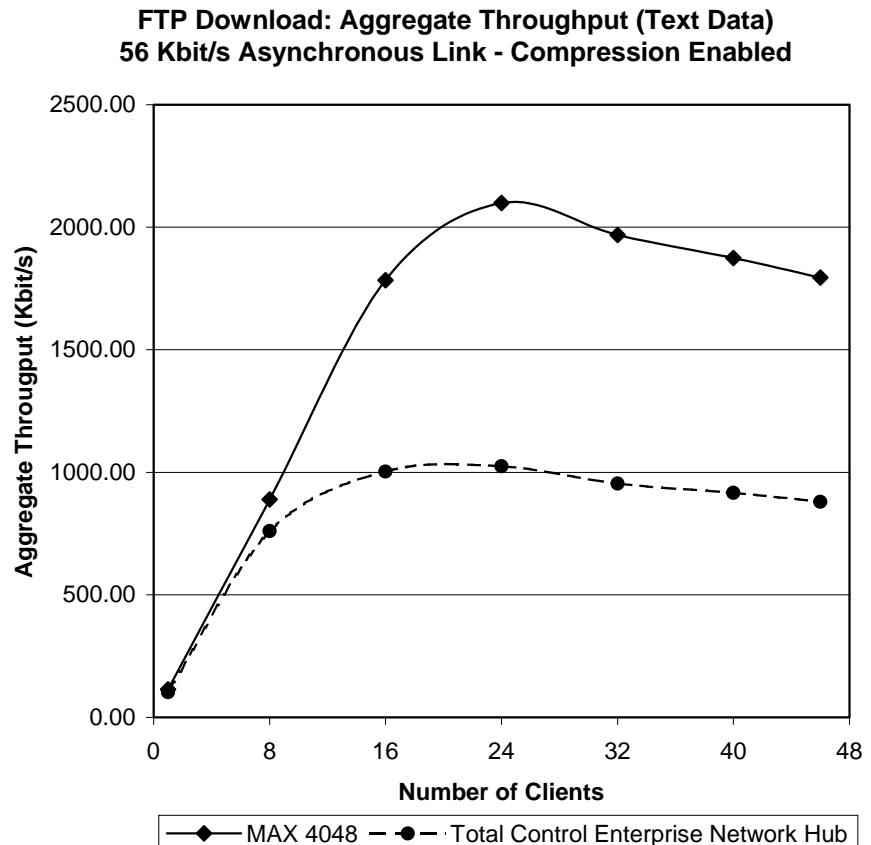
Test Results

The tests delivered data to the clients from one to 46 simultaneous client connections, via FTP. The testing showed that the Ascend MAX 4048 exhibited better effective throughput at every data point measured for 56 Kbit/s modems than the U.S. Robotics Total Control Enterprise Network Hub. With the 33.6 Kbit/s modems, at every point other than the single user connection (with a compressed file) the MAX 4048 exhibited higher throughput than the Total Control Hub.

Text File Transfer at 56.6 Kbit/s

Figure 1 represents the aggregate throughput for the transfer of an ASCII text file from a server to clients via FTP over 56 Kbit/s modem connections. The Ascend MAX 4048 delivers the highest aggregate throughput, nearly 2,100 Kbit/s at 24 client connections. The performance of the Total Control Hub levels off after 16 connections at roughly 1,004 Kbit/s and improves only to 1,024 Kbit/s at 24 connections.

Test Highlights

❍ The Ascend MAX 4048 maintains higher client throughput for file transfers than the U.S. Robotics Total Control Enterprise Network Hub at every data point tested for 56 Kbit/s modem connections.

❍ The Aggregate throughput attained by the Ascend MAX 4048 exceeds that of the USR Total Control Hub for 56 Kbit/s connections for every data point tested.

❍ The throughput measured for the MAX 4048 exceeded that of the Total Control Hub at every data point. The only exception was for a single client session performance run at 33.6 Kbit/s.

FTP Download: Aggregate Throughput (Text Data)
56 Kbit/s Asynchronous Link - Compression Enabled

Legend: ◆ MAX 4048 ● Total Control Enterprise Network Hub

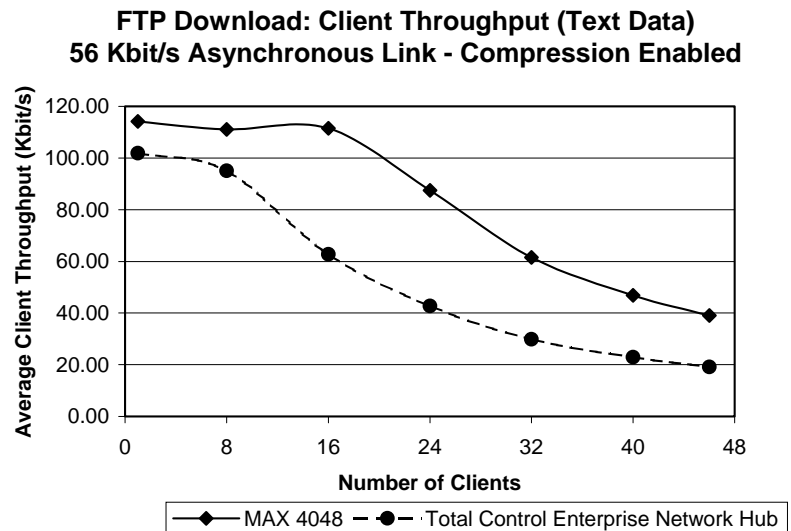Source: The Tolly Group, July 1997   *Figure 1*

Figure 2 shows the results for transferring an ASCII text file from a server to clients via FTP over 56 Kbit/s modem connections. The chart shows the average client throughput for an FTP 'GET' of the text file as additional client transfers are added. The text file is highly compressible and the devices under test are able to achieve more than 56 Kbit/s effective throughput. The Ascend MAX 4048 starts out with one client with a throughput of 114.14 Kbit/s at 56 Kbit/s (due to compression), compared to the 101.88 Kbit/s throughput exhibited by the Total Control Hub. The throughput per client for the MAX 4048 scales much better than that for the Total Control Enterprise Network Hub.

Compressed File Transfer at 56.6 Kbit/s

Figure 3 shows the aggregate throughput for the compressed file transfer over the 56 Kbit/s modems. The MAX 4048 shows the highest aggregate throughput at 1,677 Kbit/s for 40 active connections. The Total Control Hub's highest throughput for this test is 654 Kbit/s (at 16 active connections). The throughput for the MAX 4048 climbs steadily through most of the tests, whereas the Total Control Hub levels off and begins to degrade after 16 simultaneous connections.
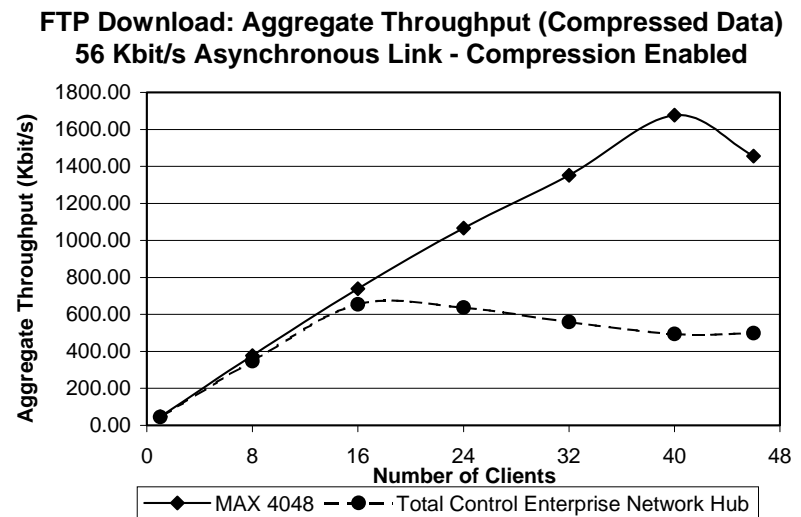
Figure 4 shows the results for transferring a pre-compressed (PKZIPPED) file via FTP over 56 Kbit/s modem connections. Again, the chart shows the FTP 'GET' throughput (averaged across the clients) as additional client transfers are made. While the two products start at nearly the same point on the graph, the U.S. Robotics Total Control Hub degrades very rapidly after 16 client connections, the initial throughput declines until the average client throughput is less than 11 Kbit/s.

Figure 5 shows the numeric results for all the 56 Kbit/s performance testing for both products. The results
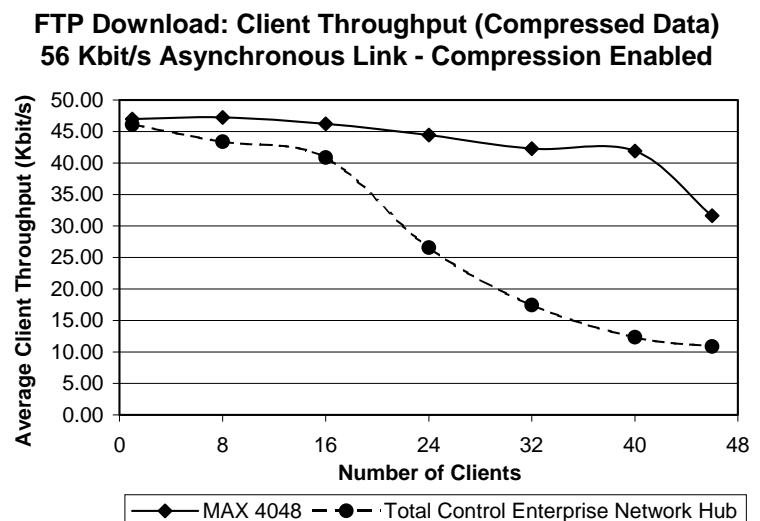
FTP Download: Client Throughput (Text Data)
56 Kbit/s Asynchronous Link - Compression Enabled

Source: The Tolly Group, July 1997

Figure 2

FTP Download: Aggregate Throughput (Compressed Data)
56 Kbit/s Asynchronous Link - Compression Enabled

Source: The Tolly Group, July 1997

Figure 3

FTP Download: Client Throughput (Compressed Data)
56 Kbit/s Asynchronous Link - Compression Enabled

Source: The Tolly Group, July 1997

Figure 4

are measured in Kbit/s and the average values reported were obtained by running three test iterations and calculating the average.

33.6 Kbit/s Performance

Figure 6 shows the complete set of test results for the 33.6 Kbit/s modem testing. The per client throughput and aggregate throughput for both text data and compressed data for both products is shown at all client connection levels. The Ascend MAX 4048 outperforms the U.S. Robotics Total Control Hub at all of the data points except for the single client connection using compressed data. The numbers in bold indicate the highest throughput for each data point.

Text File Transfer at 33.6 Kbit/s

Figure 7 shows the aggregate throughput for the MAX 4048 and the Total Control Enterprise Network Hub when transferring a text file over 33.6 Kbit/s analog connections. The curve of the data for the MAX 4048 shows that the aggregate performance continues to scale well and increase until 32 active connections. The data also shows that aggregate throughput of the Total Control Hub decreases after 16 active connections.

Figure 8 shows the per client throughput for transferring a text file across 33.6 Kbit/s modem connections. The MAX 4048 shows a much more even scaling of performance per client connection than the Total Control Hub does.

Compressed File Transfer at 33.6 Kbit/s

Figure 9 shows the aggregate throughput results for a compressed file transfer over 33.6 Kbit/s connections. The MAX 4048 consistently outperforms the Total Control Hub.

Figure 10 shows the per client throughput measured when transferring a compressed file over 33.6 Kbit/s connections. As shown on the graph, the Total Control Hub starts

off with a slightly higher throughput with one client connection but the MAX 4048's throughput is higher at every other point on the graph.

Test Methodology

The testing measured the client/server throughput of remote node PC clients performing FTP 'Gets' from a central FTP server through multiple concurrent connections. The tests showed the aggregate throughput of PCs communicating through a remote access concentration device to a central server over 33.6 Kbit/s and 56 Kbit/s analog phone connections using FTP. Results are presented in Kbit/s per client as well as aggregate Kbit/s.

For each data point, (tests were run using 1, 8, 16, 24, 32, 40, & 46 PCs) the client(s) logged into the central server via dial-up networking and a file was retrieved from the server using an FTP 'GET'. A Network General Expert Sniffer was used to capture the traffic flow from the server to the clients on the central Ethernet.

Once the client logged into the FTP server the client started to download a file from the server. When all the clients were engaged in FTPing the file from the server, a steady-state measurement was made using the Sniffer to determine effective throughput. (Frame retransmissions were discarded since the retransmissions were only replacing data that was lost in the transfer to the client and didn't reflect the effective throughput of the device under test.) The trace from the Sniffer provided the cumulative bytes captured, relative time, average frames per second, total retransmission bytes and the total time of the network trace. The analyzer was also used to verify the number of active connections during the test. If one or more connections were lost during testing, the results were discarded and the test was re-run. Each test iteration was run for

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Ascend Communications, Inc.

MAX 4048

Performance

Ascend Communications, Inc.
MAX 4048
Product Specifications*

The MAX 4048 WAN access switch is designed for remote networking applications. Supports ISDN PRI (up to two), T1 (up to two) and one Ethernet on the base unit. Allows 48 simultaneous sessions from ISDN BRI, Frame Relay and/or analog modem users over ISDN PRI, channelized T1.

LAN protocol support:
TCP/IP, IPX, AppleTalk

Routing protocol support:
BCP bridging, RIP, RIP2, OSPF (IP only), IGMP multicast forwarding

Bandwidth management support:
Multilink PPP, Multilink Protocol Plus™, TCP header compression, Data compression, AppleTalk Remote Access

Network management:
SMNP-based, multivendor management using NetClarity

Security support:
Secure Access™ Firewall (dynamic, fully-integrated), Ascend Access Control™ (extended RADIUS), TACACS+, PAP, CHAP, CLID, Packet filtering, SNMP, User authentication

Additional information/features:
The MAX 4048 also supports a wide range of modem and WAN protocols as well as multimedia support.

For more information contact:
Ascend Communications, Inc.
1701 Harbor Bay Parkway
Alameda, CA 94502
Tel: 800-272-3634
Fax server: 415-688-4343
E-mail: info@ascend.com

Vendor-supplied information not verified by The Tolly Group

56 Kbit/s Modem Performance

# of Clients	Per Client Throughput				Aggregate Throughput			
	Text Data		Compressed Data		Text Data		Compressed Data	
	MAX 4048	Total Control Enterprise Network Hub	MAX 4048	Total Control Enterprise Network Hub	MAX 4048	Total Control Enterprise Network Hub	MAX 4048	Total Control Enterprise Network Hub
1	**114.14**	101.88	**46.98**	46.10	**114.14**	101.88	**46.98**	46.10
8	**111.13**	94.99	**47.24**	43.37	**889.04**	759.88	**377.89**	346.93
16	**111.52**	62.72	**46.22**	40.87	**1784.36**	1003.46	**739.50**	653.95
24	**87.48**	42.67	**44.43**	26.53	**2099.46**	1024.19	**1066.32**	636.65
32	**61.50**	29.81	**42.26**	17.46	**1968.15**	953.97	**1352.25**	558.64
40	**46.85**	22.91	**41.93**	12.33	**1874.06**	916.49	**1677.04**	493.35
46	**39.00**	19.11	**31.63**	10.84	**1793.90**	879.28	**1455.15**	498.68

Source: The Tolly Group, July 1997   *Figure 5*

33.6 Kbit/s Modem Performance

# of Clients	Per Client Throughput				Aggregate Throughput			
	Text Data		Compressed Data		Text Data		Compressed Data	
	MAX 4048	Total Control Enterprise Network Hub	MAX 4048	Total Control Enterprise Network Hub	MAX 4048	Total Control Enterprise Network Hub	MAX 4048	Total Control Enterprise Network Hub
1	**70.73**	63.45	13.95	**16.29**	**70.73**	63.45	13.95	**16.29**
8	**70.73**	63.55	**15.14**	13.27	**565.84**	508.43	**121.13**	106.16
16	**70.94**	63.18	**15.05**	13.59	**1134.97**	1010.93	**240.82**	217.37
24	**70.59**	35.75	**14.85**	12.48	**1694.14**	858.05	**356.44**	299.62
32	**59.76**	25.83	**14.55**	8.73	**1912.34**	826.45	**465.68**	279.26
40	**43.90**	18.94	**14.23**	6.72	**1756.09**	757.43	**569.18**	268.89
46	**32.04**	15.60	**14.01**	6.49	**1473.67**	717.43	**644.44**	298.51

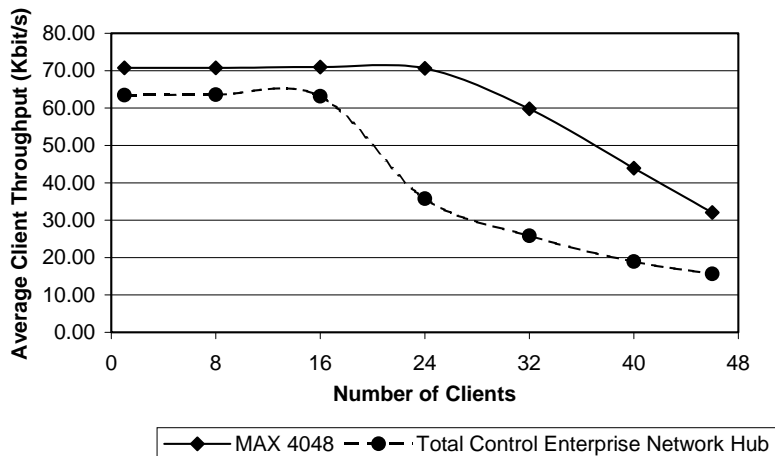Source: The Tolly Group, July 1997   *Figure 6*

FTP Download: Aggregate Throughput (Text Data)
33.6 Kbit/s Asynchronous Link - Compression Enabled
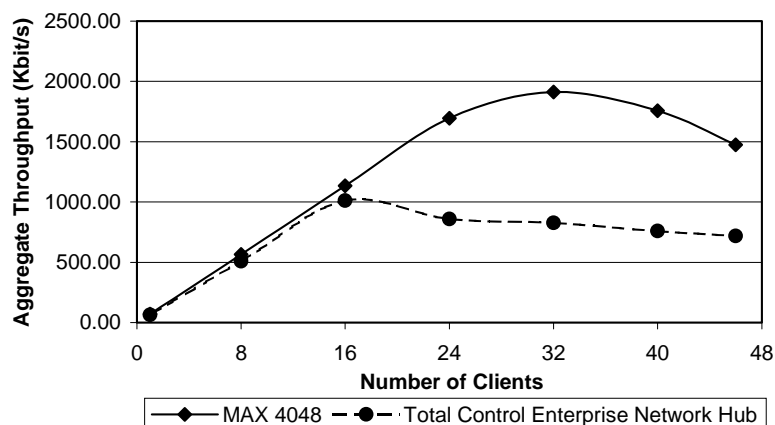
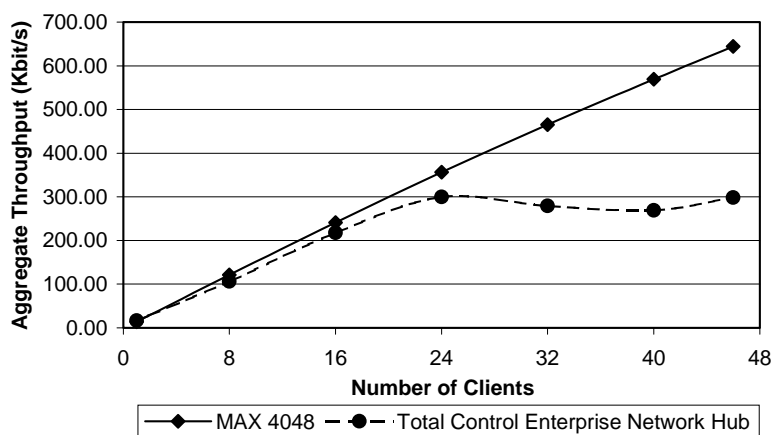Source: The Tolly Group, July 1997   *Figure 7*

**FTP Download: Client Throughput (Text Data)
33.6 Kbit/s Asynchronous Link - Compression Enabled**

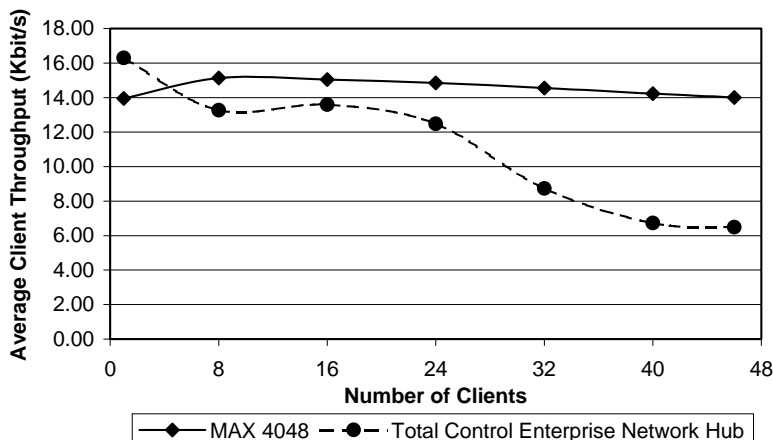Source: The Tolly Group, July 1997   *Figure 8*

**FTP Download: Aggregate Throughput (Compressed Data)
33.66 Kbit/s Asynchronous Link - Compression Enabled**

Source: The Tolly Group, July 1997   *Figure 9*

**FTP Download: Client Throughput (Compressed Data)
33.6 Kbit/s Asynchronous Link - Compression Enabled**

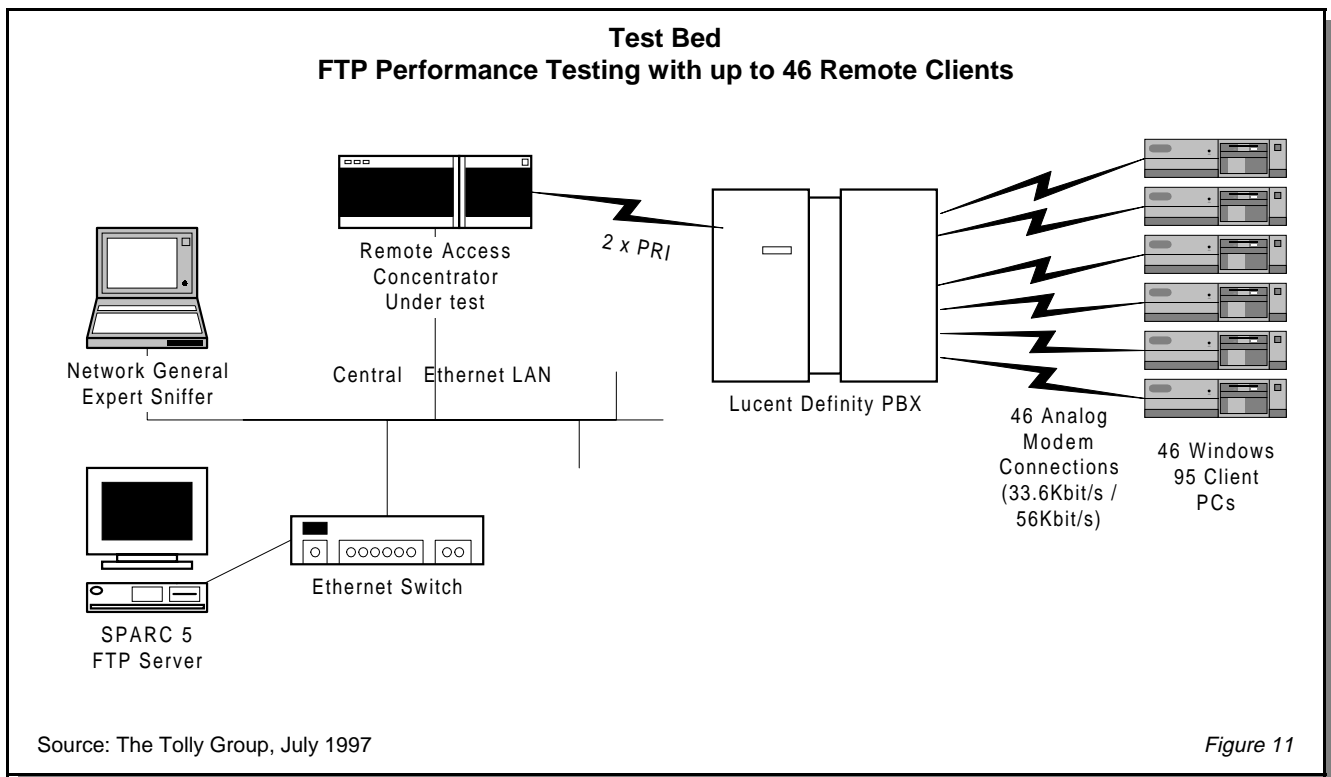Source: The Tolly Group, July 1997   *Figure 10*

approximately 30 seconds. Three test iterations were run and the results were averaged.

Throughput was measured as the total bytes transferred between the clients and the frame capture (in seconds), multiplying the server over the sample time. The Kbit/s throughput rate was calculated by dividing the cumulative bytes recorded (minus retransmissions) by the length of the frame capture (in seconds), multiplying by 8 bits/byte and dividing by 1,024.

The test was repeated using the next greater number of clients, until the maximum number of clients to be tested were used or until any dial-up connections were lost.

Test Bed

Figure 11 shows the test bed used for the performance testing. The test bed consisted of a central FTP server (SPARC 5) connected to a switched Ethernet backbone. 46 Windows 95 client PCs were connected to either a 56 Kbit/s or 33.6 Kbit/s modem (one at a time) and simulated remote clients dialing into the central LAN. For the V.34 (33.6 Kbit/s) testing, U.S. Robotics V.Everything modems were used. For the 56 Kbit/s testing, Diamond Multimedia Supra Express 56E modems were used when testing the MAX 4048 and U.S. Robotics X2 V.Everything modems were used to test the Total Control Hub. The client PCs, dialed the system under test through a Lucent Definity PBX. The remote access concentrator device under test was connected to the FTP server on the central LAN via an Ethernet switch. A Network General Ethernet Sniffer was connected to the Ethernet LAN between the system under test and the SPARC 5 FTP server, using an Ethernet concentrator. The clients were set up for IP networking and all clients were configured identically.

Test Bed
FTP Performance Testing with up to 46 Remote Clients

Remote Access
Concentrator
Under test

2 x PRI

Network General
Expert Sniffer

Central Ethernet LAN

Lucent Definity PBX

46 Analog
Modem
Connections
(33.6Kbit/s /
56Kbit/s)

46 Windows
95 Client
PCs

Ethernet Switch

SPARC 5
FTP Server

Source: The Tolly Group, July 1997

Figure 11

About The Tolly Group

The Tolly Group provides strategic consulting, independent testing, and industry analysis. It offers a full range of services designed to furnish both vendor and end-user communities with authoritative, unbiased information. *Fortune* 1,000 companies look to The Tolly Group for vendor-independent assessments of critical corporate technologies. Leading manufacturers of computer and communications products engage The Tolly Group to test both pre-production and production equipment.

The Tolly Group is recognized worldwide for its expertise in assessing leading-edge technologies. By combining engineering-caliber test methodologies with informed interpretation, The Tolly Group consistently delivers meaningful analyses of technology solutions. The Tolly Group has published more than 100 product evaluations, network design features and columns in the industry's most prestigious publications.

Kevin Tolly is President and CEO of The Tolly Group. He is a leading industry analyst and is responsible for guiding the technology decisions of major vendor and end-user organizations. In his consulting work, Tolly has designed enterprise-wide networks for government agencies, banks, retailers, and manufacturers.

For more information on The Tolly Group's services, visit our World Wide Web site at *http://www.tolly.com,* email to info@tolly.com, call 800-933-1699 or 732-528-3300, or fax 732-528-1888.

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