Ascend Communications, Inc.
Ascend MAX TNT
Remote Access Concentrator Performance and Scalability

**Test Summary**

A scend commissioned The Tolly Group to evaluate two remote access concentrators: the Ascend MAX TNT™ (version 1.3) and the Bay Networks MSX 5000 with the Remote Annex 5399 (version R14). The Tolly Group conducted performance benchmarks of the products using actual FTP (File Transfer Protocol) session traffic. Both products were tested using up to 288 sessions across 33.6 Kbit/s modems. Additionally, the Ascend MAX TNT was benchmarked using 56 Kbit/s modems. A previous test of the same products (see The Tolly Group document 7288), benchmarked up to 46 clients and used a previous version of Ascend software (ver 1.2A). Bay results remained consistent in both tests. Testing was performed in October of 1997.

In tests of clients connected via 33.6 modem links, the Ascend MAX TNT delivered higher throughput than the Bay Networks remote access concentrator at every data point from 32 up to 288 simultaneous clients. The tests consisted of FTP downloads of text files and compressed files. With 288 clients, the Ascend system delivered 14,890 Kbit/s of data compared to 8,243 Kbit/s for the Bay Networks System. The Ascend MAX TNT was also tested using 56 Kbit/s modem connections. (Note: 56 Kbit/s modem support was not available for the Bay Networks 5399 in time for testing.)

Test Highlights

❍ In tests of up to 288 simultaneous sessions, the MAX TNT consistently delivers higher per client throughput than the Bay Networks remote access concentrator for the two files types tested.

❍ The aggregate throughput of the MAX TNT is nearly twice as high as that of the Bay Networks MSX 5000 outfitted with the Remote Annex 5399.

FTP Download: Client Throughput (Text Data)
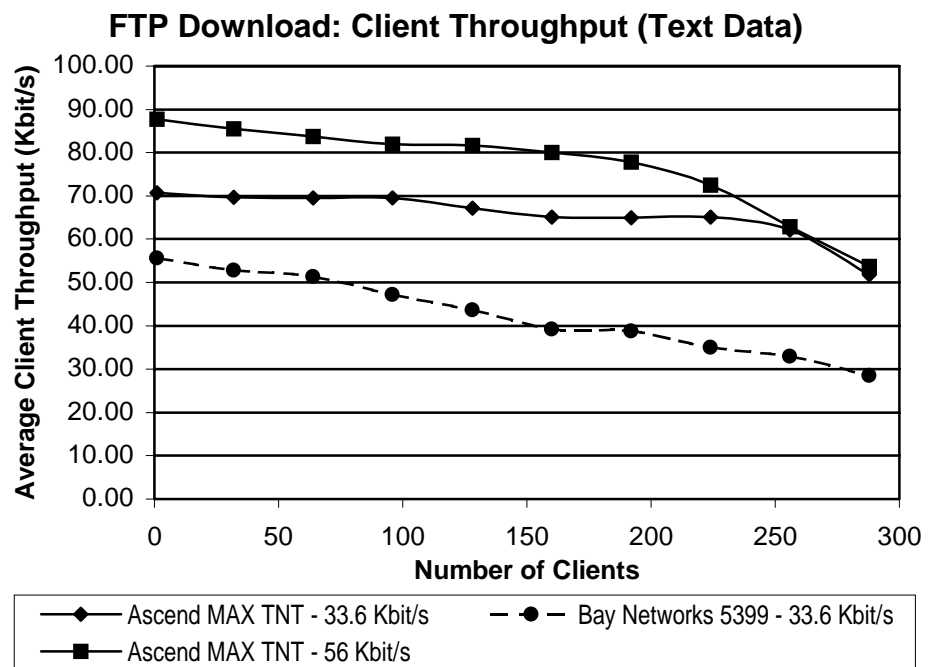
Source: The Tolly Group, November 1997   *Figure 1*

Test Results

Figures 1 and 2 show the composite results of the FTP text download test. Tests were run at 33.6 Kbit/s and, for Ascend only, at 56 Kbit/s modem connection speeds. Figure 1 presents the test results as average throughput per client, where figure 2 shows the same tests in terms of aggregate system throughput.

Text File Download at 33.6 Kbit/s

Both systems were tested using 33.6 Kbit/s modem links. The Ascend MAX TNT deliv-

ered the highest "per client" and aggregate system throughput at every data point. (Data points were taken in increments of 32 client connections.) For a single client, the MAX TNT's throughput was 70.72 Kbit/s compared with 55.57 Kbit/s for the Bay Networks' 5399. See figure 5 for tabular data.

At 32 clients, the per client throughput for the MAX TNT was 69.65 Kbit/s, the 5399 delivered 52.82 Kbit/s. The aggregate system throughput was 2,228 Kbit/s for the MAX TNT and 1,690 Kbit/s for the Bay Networks 5399 for 32 client connections.

With 288 simultaneous clients, the Ascend MAX TNT delivered 51.7 Kbit/s per client compared to the Bay Networks 5399 delivering 28.62 Kbit/s per client. The aggregate system throughput at 288 connections for the MAX TNT was 14,890 Kbit/s and for the 5399 was 8,243 Kbit/s.

TEXT FILE DOWNLOAD AT 56 KBIT/S

The same test was run at 56 Kbit/s for the Ascend MAX TNT. At 32 clients, the per client throughput for the MAX TNT showed 85.5 Kbit/s per client and the aggregate system throughput for the MAX TNT was 2,735 Kbit/s. At 288 clients, the average client throughput was 53.77 Kbit/s and the aggregate system throughput was 15,486 Kbit/s.

COMPRESSED FILE TESTING

The Tolly Group executed the same series of tests again, this time using previously compressed data files as the source files for the download. This effectively removes any throughput benefits achieved through use of the compression built into the system under test since the file is already compressed. Without compression, the maximum theoretical throughput for each connection is the rated link speed. Figures 3 and 4 show the composite results of the FTP compressed file download. Tests were run at both 33.6 Kbit/s and at 56

FTP Download: Aggregate System Throughput (Text Data)

Ascend MAX TNT - 33.6 Kbit/s   Bay Networks 5399 - 33.6 Kbit/s
Ascend MAX TNT - 56 Kbit/s
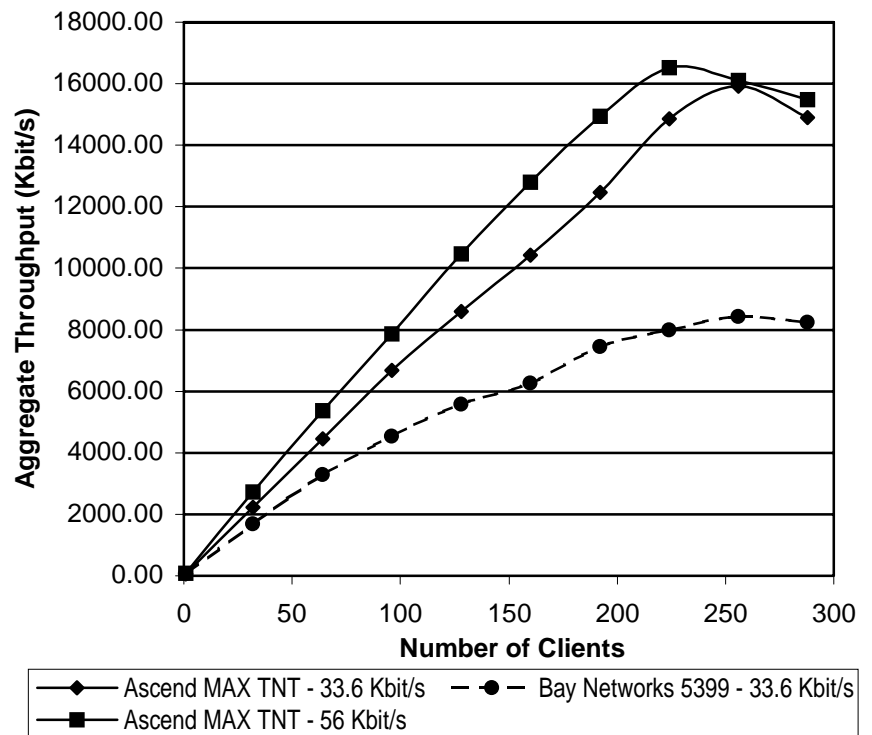
Source: The Tolly Group, November 1997   *Figure 2*

Kbit/s modem connection speeds. Figure 3 represents the test results as average throughput per client, where figure 4 shows the same tests in terms of aggregate system throughput.

COMPRESSED FILE DOWNLOAD AT 33.6 KBIT/S

Both devices were included in the tests at 33.6 Kbit/s link speed. The Ascend MAX TNT delivered the highest "per client" an aggregate system throughput at every data point. (Data points were taken in increments of 32 client connections for both products.) For a single client, the MAX TNT's throughput was 30.32 Kbit/s compared with 32.75 Kbit/s for the Bay Networks' 5399. See figure 6 for tabular data.

At 32 clients, the per client throughput for the MAX TNT was 29.96 Kbit/s and the 5399 delivered 29.5

Kbit/s. The aggregate system throughput was 958 Kbit/s for the MAX TNT and 943 Kbit/s for the Bay Networks 5399 for 32 clients.

With 288 simultaneous clients, the Ascend MAX TNT delivered 29.63 Kbit/s per client compared to the Bay Networks 5399 delivering 18.36 Kbit/s per client. The aggregate system throughput at 288 connections for the MAX TNT was 8,532 Kbit/s and for the 5399 was 5,365 Kbit/s.

COMPRESSED FILE DOWNLOAD AT 56 KBIT/S

The test was run at 56 Kbit/s for the Ascend MAX TNT. With 32 clients active, the per client throughput for the MAX TNT was 42.88 Kbit/s per client. At 32 connections, the aggregate system throughput for the MAX TNT was 1,372 Kbit/s. The MAX TNT was tested up to 288 active client connections at 56 Kbit/s. Per-

formance for the MAX TNT was very consistent for all data points. At 288 clients, the per client throughput was 44.29 Kbit/s and the aggregate system throughput was 12,756 Kbit/s.

Test Configuration and Methodology

Systems Under Test

Two remote access concentrator systems were tested. The Ascend MAX TNT was outfitted with 288 modems (dual speed 33.6 Kbit/s and 56 Kbit/s), 13 ISDN PRIs and a Fast Ethernet connection. The Bay Networks 5399 was outfitted with 288 modems (33.6 Kbit/s only), 13 PRIs and a Fast Ethernet connection.

The versions of the devices under test were as follows: the Ascend MAX TNT was running version 1.3Ap6 and the Bay Networks Remote Annex 5399 was using version R14 with H/W MLB Rev 132.0, the 5110 (Supervisory Module) was H/W ver J and S/W version 1.1.1.

Test Bed Description

Figure 7 shows the test bed used for the performance testing. The test bed consisted of nine Windows NT (version 4, SP3 - Pentium 166's with 64 MB of RAM) servers acting as FTP Servers each connected to a dedicated Fast Ethernet segment. 288 Windows 95 client PCs (Pentium 133's with 32 MB of RAM) 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 (version 1.000-003) were used.

The client PCs dialed the system under test via a Lucent Definity PBX. The PBX was attached to the device under test by 13 PRI WAN connections. The system device under test was connected to the FTP servers on the central LAN via a dedicated Fast Ethernet / Ethernet Router.

A Network General Ethernet Sniffer (version 5.02) and a Shomiti Century LAN analyzer (version 2.1) were connected to the Ethernet LAN between the system under test and the router, using a Fast Ethernet concentrator. The clients were set up for IP networking and all clients were configured identically.

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. Two files were transferred during the testing. The first file was an ASCII text file that was highly compressible (the file was a version of the Windows 95 Help File concatenated to itself to create a larger file). The second file was a compressed file (a PKZIP file) that was non-compressible. Both average throughput per client and aggregate system throughput were recorded.

For each data point, (tests were run using steps of 1, 32, 64, 96, 128, 160, 192, 224, 256, and 288 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 to check for data retransmissions. A Shomiti Century LAN analyzer was used to determine the aggregate throughput.

Procedure

Once the client(s) logged into the FTP server, the client began a download of the file being tested from the server. (When all the clients were engaged in FTP download from the server, a steady-state measurement was established using

both the Sniffer and the Shomiti to determine effective throughput.) Frame retransmissions were not included in the aggregate throughput 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 traces from the Sniffer and from the Century LAN analyzer provided the cumulative bytes captured, relative time, average frames per second, total retransmission bytes, the total time of the network trace, and showed any errors that occurred during testing.

The analyzers were 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 20 seconds or longer. Three iterations were run for each test point and the results were averaged.

The test was repeated using the next greater number of clients, until the maximum number of clients to be tested was used. During the course of a test if any of the dial-up client connections were lost, the results were discarded and the test was re-run.

Calculations

Throughput was measured as the total bytes transferred between the clients and 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 the result by 8 bits/byte and dividing by 1,000.

Equipment Acquisition and Support

The product from Bay Networks was acquired from an authorized reseller. The competitive product was set up and configured for optimum performance by on-site technicians of the authorized reseller. TheTolly Group engineers monitored and validated this process.
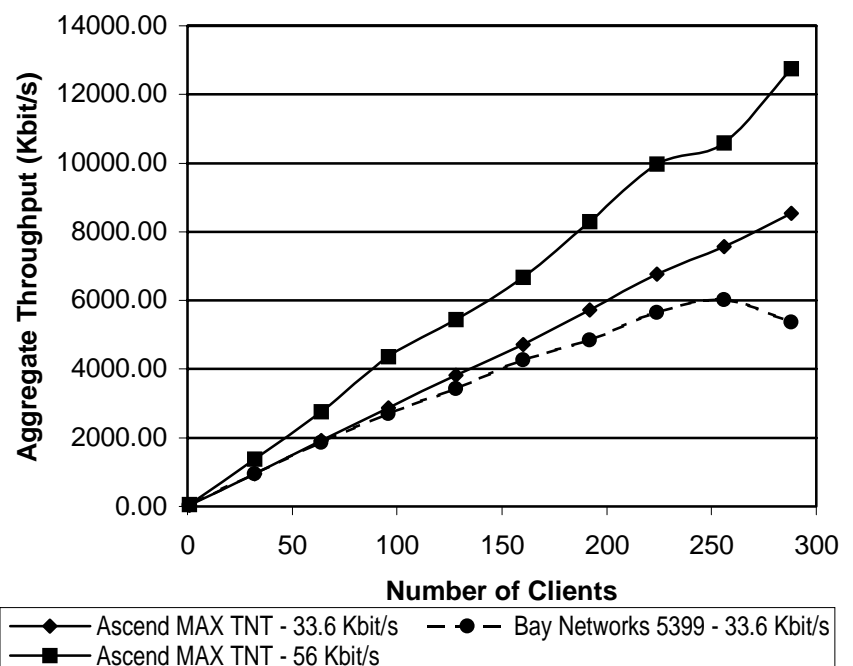

FTP Download: Client Throughput (Compressed Data)

Legend:
- Ascend MAX TNT - 33.6 Kbit/s
- Ascend MAX TNT - 56 Kbit/s
- Bay Networks 5399 - 33.6 Kbit/s
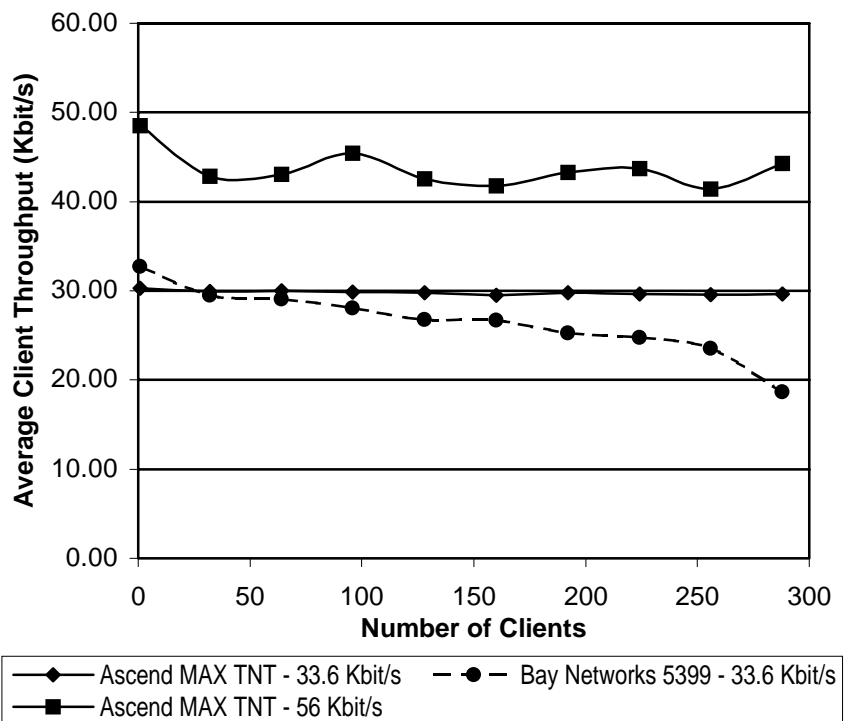
Source: The Tolly Group, November 1997   *Figure 3*

FTP Download: Aggregate System Throughput (Compressed Data)

Legend:
- Ascend MAX TNT - 33.6 Kbit/s
- Ascend MAX TNT - 56 Kbit/s
- Bay Networks 5399 - 33.6 Kbit/s

Source: The Tolly Group, November 1997   *Figure 4*

All Text File Transfer Results

Number of Clients	Average Client Throughput Text Data			Aggregate System Throughput Text Data		
	Ascend MAX TNT - 33.6 Kbit/s	Bay Networks 5399 - 33.6 Kbit/s	Ascend MAX TNT - 56 Kbit/s	Ascend MAX TNT - 33.6 Kbit/s	Bay Networks 5399 - 33.6 Kbit/s	Ascend MAX TNT - 56 Kbit/s
1	70.72	55.57	87.65	70.72	55.57	87.65
32	69.65	52.82	85.50	2228.73	1690.26	2735.84
64	69.58	51.38	83.78	4453.03	3288.36	5361.96
96	69.54	47.21	81.97	6675.41	4531.83	7869.03
128	67.15	43.60	81.72	8595.15	5580.69	10460.45
160	65.13	39.21	80.04	10421.03	6273.54	12805.83
192	64.90	38.81	77.86	12461.21	7451.78	14949.23
224	65.13	35.04	72.49	14848.78	7988.91	16526.99
256	62.15	32.95	62.90	15909.77	8436.07	16102.90
288	51.70	28.62	53.77	14890.94	8243.40	15486.23

Source: The Tolly Group, November 1997

Figure 5

All Compressed File Transfer Results

Number of Clients	Average Client Throughput Compressed Data			Aggregate System Throughput Compressed Data		
	Ascend MAX TNT - 33.6 Kbit/s	Bay Networks 5399 - 33.6 Kbit/s	Ascend MAX TNT - 56 Kbit/s	Ascend MAX TNT - 33.6 Kbit/s	Bay Networks 5399 - 33.6 Kbit/s	Ascend MAX TNT - 56 Kbit/s
1	30.32	32.75	48.53	30.32	32.75	48.53
32	29.96	29.50	42.88	958.59	943.95	1372.16
64	30.02	29.03	43.08	1921.17	1858.19	2757.30
96	29.83	28.06	45.41	2864.00	2694.09	4359.45
128	29.80	26.76	42.56	3814.09	3424.86	5447.82
160	29.49	26.70	41.74	4717.88	4271.31	6678.81
192	29.81	25.27	43.24	5723.16	4851.18	8302.54
224	29.66	24.78	43.73	6762.84	5649.89	9970.67
256	29.54	23.51	41.39	7561.86	6017.56	10596.39
288	29.63	18.63	44.29	8532.00	5365.90	12756.65

Source: The Tolly Group, November 1997

Figure 6

Test Bed
FTP Performance Testing with up to 288 Remote Clients

Source: The Tolly Group, November 1997　　　　　　　　　　　　*Figure 7*
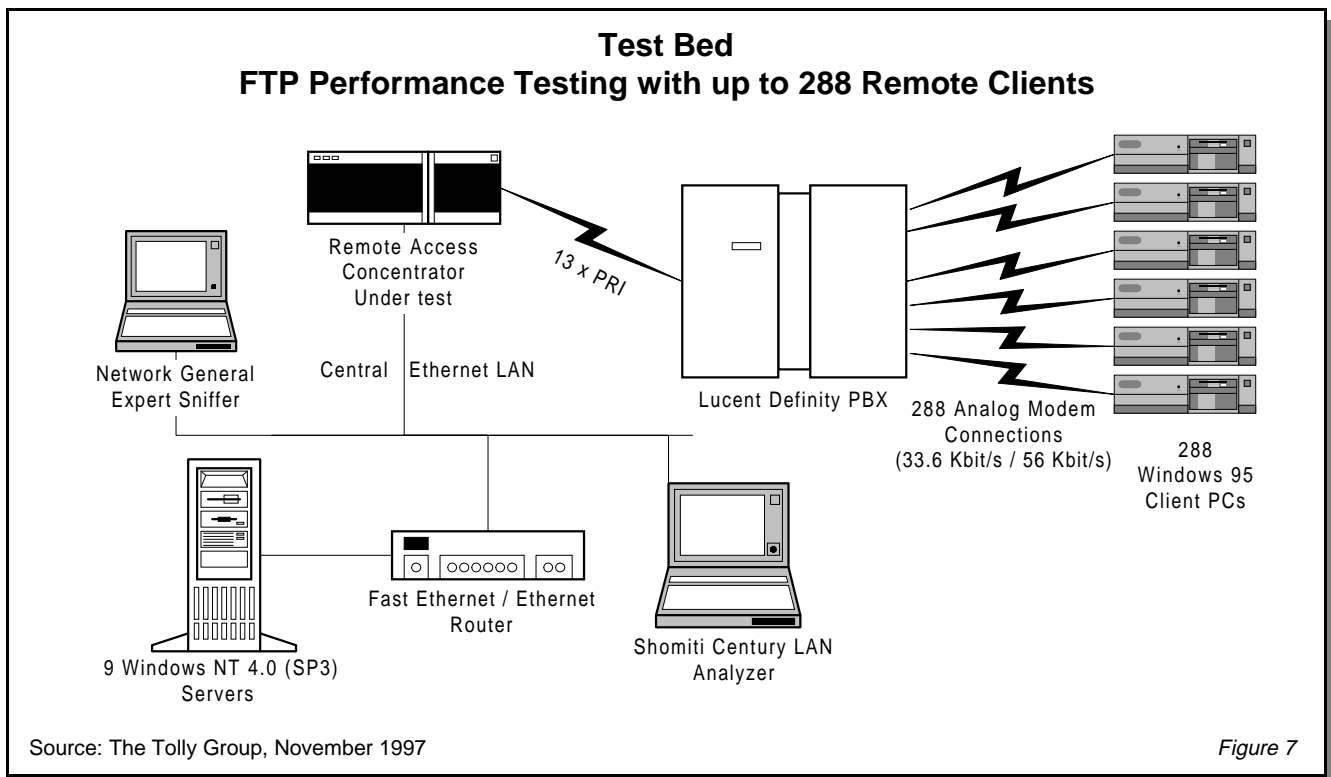
The Tolly Group gratefully acknowledges the provider of test equipment used in this project.		
Vendor	**Product**	**Web address**
Network General	Ethernet Sniffer 5.02	http://www.networkgeneral.com
Shomiti Systems	Century LAN Analyzer 2.1	http://www.shomiti.com

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 400 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.