THE TOLLY GROUP

No. 7297 August 1997

BreezeCOM Wireless Communications

BreezeNET PRO Series Access Point and Station Adapters

Wireless Network Performance Test

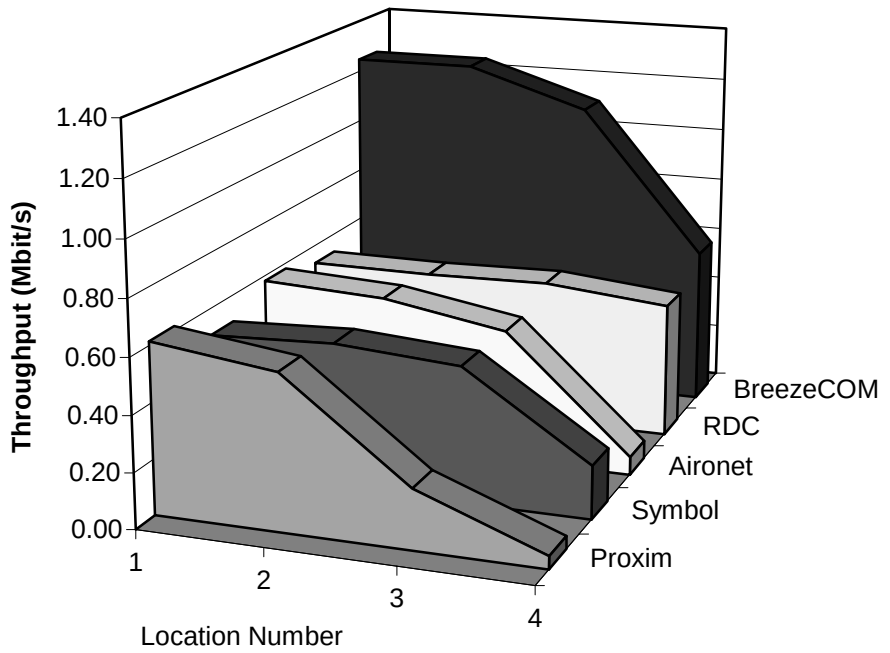
Test Summary

BreezeCOM Wireless Communications, Inc. commissioned The Tolly Group to benchmark the throughput of wireless LAN systems from BreezeCOM Wireless Communications, Inc., Aironet Wireless Communications Inc., Proxim, Inc., RDC Networks Inc., and Symbol Technologies Inc. as listed in figure 6. The Tolly Group quantified the effective system performance of both notebook (PCMCIA) and desktop wireless LAN adapters each in conjunction with their appropriate access points in a typical office environment. The tests were conducted in August 1997.

Test Highlights

- Results show the BreezeNET PRO Series Wireless systems demonstrated the highest effective throughput of all desktop and laptop wireless adapters tested.
- BreezeCOM notebook adapter achieved up to 417% better performance than the competitive notebook adapters tested.
- The OMNI-6, BreezeCOM's 6dBi Access Point Antenna, improved throughput by up to 130% over its standard 2dBi antenna.

Effective System Throughput vs. Location
NetWare File Transfers
Notebook (PCMCIA) Wireless LAN Adapters



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

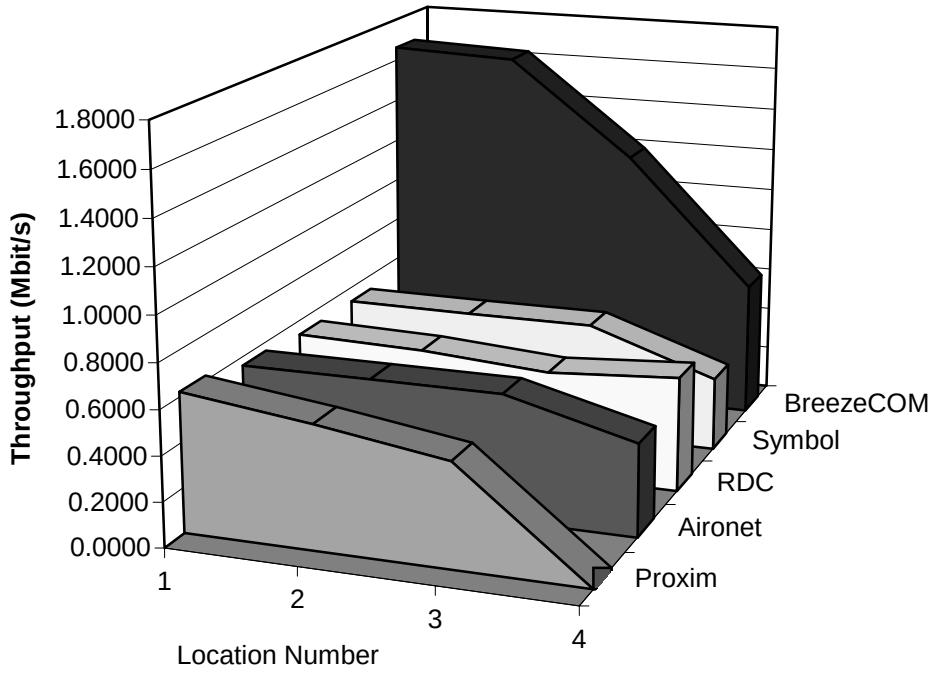
Test Results

Notebook Performance

Testing was conducted by transferring a file from a wired Novell NetWare server to a wireless Windows 95 client at four locations. Testing was conducted in a typical office environment consisting of plaster walls and wooden doors. A higher location number indicates a test point farther from the fixed position access point. Test locations 1 through 4 were 5, 90, 127, and 183 feet (1.5, 27.4, 38.7, and 55.8 meters) from the access point respectively. Refer to figure 5 for a diagram of the test locations.

Because they are based on different implementations of spread spectrum frequency-hopping technology, the various systems under test offer different maximum data rates. Since they are

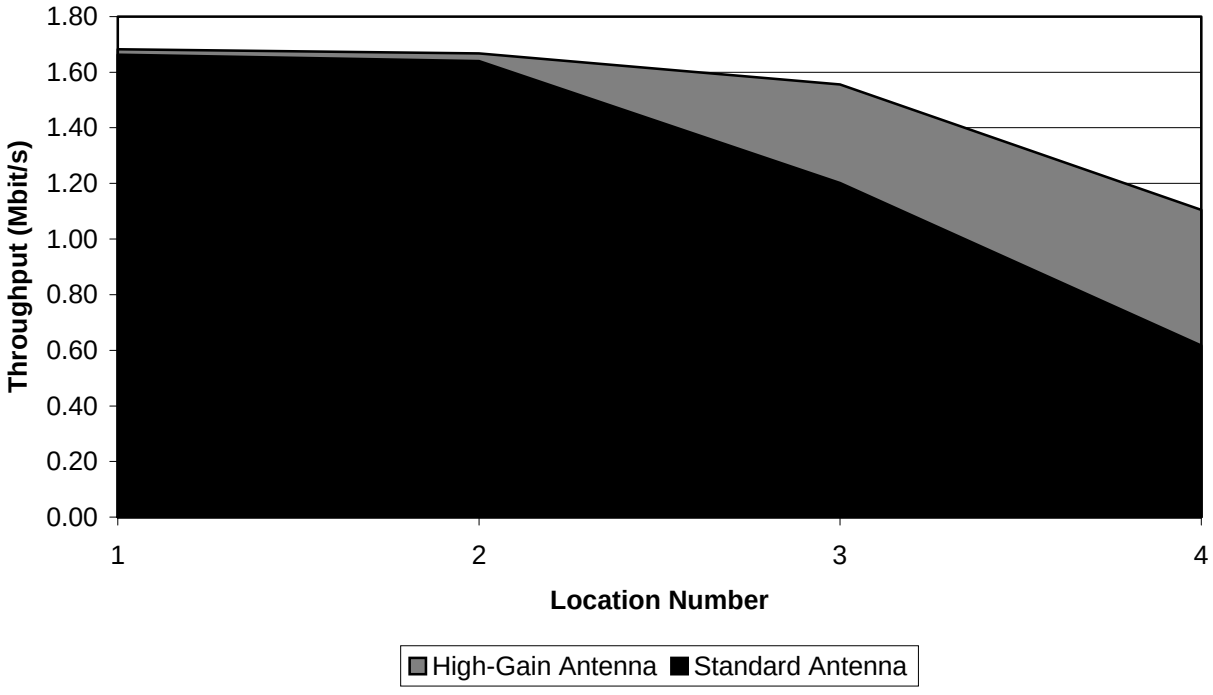
Effective System Throughput vs. Location
NetWare File Transfers
Desktop Wireless LAN Adapters



Source: The Tolly Group, August 1997

Figure 2

Effective System Throughput Degradation Vs. Location
BreezeCOM High Gain (OMNI-6) and Standard Access Point Antennas
NetWare File Transfer



Source: The Tolly Group, August 1997

Figure 3

all offered as solutions to the same business problem, comparing the products is appropriate. The BreezeCOM products have a data rate of 2 Mbit/s (for notebook adapter) and 3 Mbit/s (for desktop adapter and access point), Proxim has a rate of 1.6 Mbit/s, and Aironet, Symbol and RDC have a rate of 1Mbit/s.

Test results show that the BreezeNET PRO Series systems delivered the highest NetWare file transfer throughput of the systems tested. Figure 1 illustrates the system throughput when copying files from a wired Ethernet server via wireless network access point to a notebook computer outfitted with PCMCIA wireless LAN adapters. (Note: tabular results are shown in figure 4.)

Not only did the BreezeCOM system outperform the competitive products at all locations, the BreezeCOM notebook adapter outperformed the competitive notebook adapters with up to 417% higher effective system throughput. Additionally, the BreezeCOM notebook adapter was able to maintain the same performance level at both location 1 and 2 which were 5 and 90 feet (1.5 and 27.4 meters) away from the access point, respectively.

Desktop Performance

The Tolly Group ran the same set of tests using the various vendors' desktop solutions. With BreezeCOM and Aironet, the desktop solution required a wireless adapter connected to the 10BaseT adapter of the desktop system. Proxim, Symbol and RDC required an internal wireless adapter which plugs into the ISA bus. Figure 2 shows the effective system throughput of NetWare file transfers using desktop systems.

BreezeCOM Wireless Communications, Inc.

BreezeNET PRO Series Access Point and Station Adapters

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Once again, the BreezeCOM system provided the most robust performance, demonstrating up to 215% better effective system throughput than the competitive desktop products. The performance level of the BreezeCOM desktop system decreased by only 1.3% between locations 1 and 2. Proxim did not connect at location 4. The slope between points does not indicate a drop-off in performance.

BreezeCOM Wireless Communications, Inc.
BreezeNET PRO Series Access Point and Station Adapters
Product Specifications*

Universal Compatibility

AP-10 and SA-10/40

- Transparent to operating system and network protocol
- No hardware or drivers installation required.
- Supports ANY device with Ethernet port

SA-PC

- Supports Window 95, Windows NT, Novell NetWare (ODI)

Performance

- Data rate - up to 3Mbps (2Mbps for SA-PC)
- Net throughput – up to 1.7Mbps (1.3 for SA-PC).
- Range – up to 600 ft. (200m) indoors, up to 8 miles outdoors (with external high gain antennas).

Standards compliance

- Designed to meet the IEEE 802.11 drafts
- Software upgradable to the final IEEE 802.11 spec
- Ethernet port IEEE 802.3 standard compliant

Technology

- DSP based Modem with adaptive equalization
- High performance 3Mbps radio
- Antenna diversity for enhanced reliability

Additional features

- High speed roaming for fastest roaming
- Load balancing for dense user environments
- Multi-rate support maximizes efficiency
- Remote management with SNMP (MIB II, Bridge MIB, Wireless and proprietary MIB)

Form Factor

- Smallest AP: 5.1"x3.4"x1.2"
- One piece PC card with integral folding antenna

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

Numerical Results of System Performance vs. Location
NetWare File Transfer (Mbit/s)

Adapter Type	Location	Aironet	BreezeCOM	Proxim	RDC	Symbol
Notebook	1	0.5797	1.2470	0.6156	0.5297	0.5034
	2	0.5583	1.2477	0.5595	0.5280	0.5221
	3	0.4823	1.1080	0.2145	0.5372	0.4904
	4	0.0653	0.5764	0.0452	0.4947	0.1921
Desktop	1	0.5603	1.6624	0.6218	0.5342	0.5328
	2	0.5620	1.6401	0.5499	0.5201	0.5301
	3	0.5622	1.2009	0.4631	0.4806	0.5322
	4	0.4142	0.6171	0.0000	0.5193	0.3363

Source: The Tolly Group, August 1997

Figure 4

BreezeCom High-Gain Antenna test

In addition to the standard 2dBi access point antenna, BreezeCOM offers the OMNI-6, a high-gain antenna suitable for greater indoor or outdoor distances. The Tolly Group reran the effective system throughput test with the OMNI-6 antennas. The Tolly Group tests illustrate that the high-gain antenna allows users to avoid system degradation as distance increases, as shown in figure 3. Effective system throughput with the high-gain antenna at location 4 was 1.1 Mbit/s.

Test Methodology

The Tolly Group conducted testing at a vacant office building in Carlsbad, California, as noted earlier. Refer to figure 5 for a diagram of the test facility and locations.

The tests were conducted by transferring a 1.7 Mbyte file of compressed data (output from the PKZIP compression utility) from a Novell NetWare 3.12 server via an access point under test to a Windows 95 client outfitted with the wireless client hardware under test.

The desktop client was an AcerPower 200 MHz Pentium with 32 MB of RAM running Windows 95 Version 4.00.950B and Windows 95 NWLink IPX/SPX Compatible Transport loaded. The laptop client was a Texas Instruments Extensa 610DT 150 MHz Pentiums with 16 MB of RAM and two PCMCIA slots, running Windows 95 Version 4.00.950B and Windows 95 NWLink IPX/SPX Compatible Transport loaded.

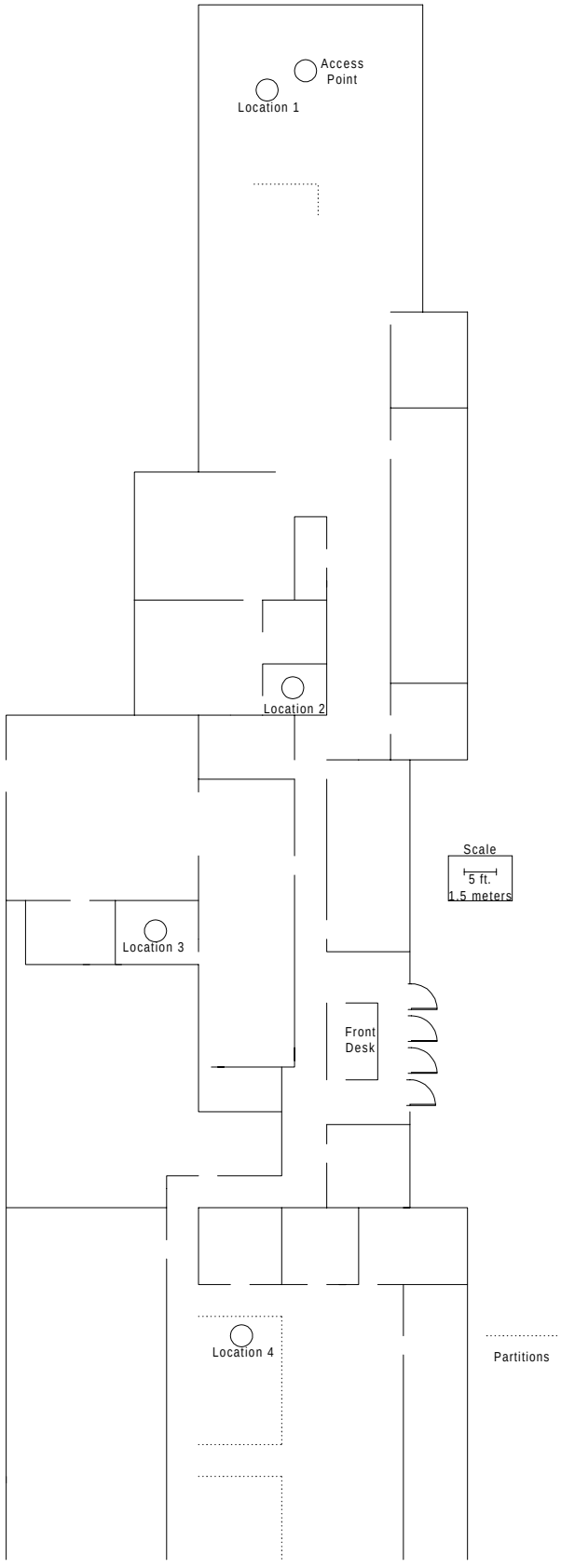
The NetWare server PC was a Basic Systems Services 100 MHz Pentium with 12 MB of RAM. The Ethernet adapter was a 3Com Etherlink II (3C5X9). Each vendor's access point under test was connected via a 10BaseT hub connection to the same wired segment as the Novell server. Only one access point, the one under test, was powered on at any one time.

A NetWare file transfer operation, from server to client, was used to generate all data traffic for this round of testing. Stations were configured to use NetWare's native IPX protocol. At each location, the client attempted to establish a connection with the server. In some cases, that connection could not be established. If a connection could be made, the client initiated a COPY command.

A Network General Ethernet Sniffer, version 5.02, was connected to the wired segment and recorded all communication between the server and client. No other devices were connected to the wired LAN. The beginning and the ending time of the file transfers were marked and the effective system throughput was calculated based on the transfer time and the file size. Each test was performed three times at each location and the results averaged. At location 4, laptop clients were tested from a location on top of a fixed sheet rock half-wall partition. Desktop clients were tested from behind the partition.

The performance of the BreezeCOM OMNI-6 antenna was tested by replacing the standard access point antenna with the OMNI-6 and performing the NetWare file transfers as described above with desktop clients only.

Diagram of Test Facility



Source: The Tolly Group, August 1997

Figure 5

Systems Tested

Vendor	Access Point (AP) Product Name and Power	AP Version	Maximum System Data Rate (Mbit/s)	Notebook (PCMCIA) Adapter Product Name and Power	Notebook Adapter Driver Version	Desktop Adapter Product Name and Power	Desktop Adapter Type	Desktop Adapter Driver/ Microcode Version
Aironet	ARLAN AP3000E Wireless Ethernet Access Point (250 mW)	4.1J	1	ARLAN LM3000 Wireless LAN Adapter (250 mW)	2.04	ARLAN UC3000-E Ethernet Universal Client (100 mW)	External	4.1S
BreezeCOM	PRO Series AP-10D Pro (100 mW)	3.42	3 (desktop adapter and access point) and 2 (notebook adapter)	PRO Series SA-PC Wireless LAN Adapter (100 mW)	1.0B	PRO Series SA-10 PRO Station Adapter (100 mW)	External	3.42
Proxim	RangeLAN2 7520 AP-II (100 mW)	1.2	1.6	RangeLAN2 7400 PC Card (100 mW)	1.2-B5/B6	RangeLAN2 7100 ISA (100 mW)	Internal	1.2
RDC Networks	PortLAN Wireless Access Point (100 mW)	5.0	1	PortLAN*SLIM PCMCIA Wireless LAN Adapter (100 mW)	5	PortLAN Wireless LAN ISA Adapter Rev. F (100 mW)	Internal	5
Symbol	Spectrum24 AP 2410 Ethernet Access Point (500 mW)	3.01	1	Spectrum24 LA 2400 Wireless LAN Adapter (500 mW)	3.01	Spectrum24 LA 2470 ISA Wireless LAN Adapter (500 mW)	Internal	3.01

Source: The Tolly Group, August 1997

Figure 6

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.

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