THE TOLLY GROUP

TEST REPORT

No. 5281 September 1995

# RDC Communications Ltd.

## PortLAN*PCMCIA Wireless LAN Adapter

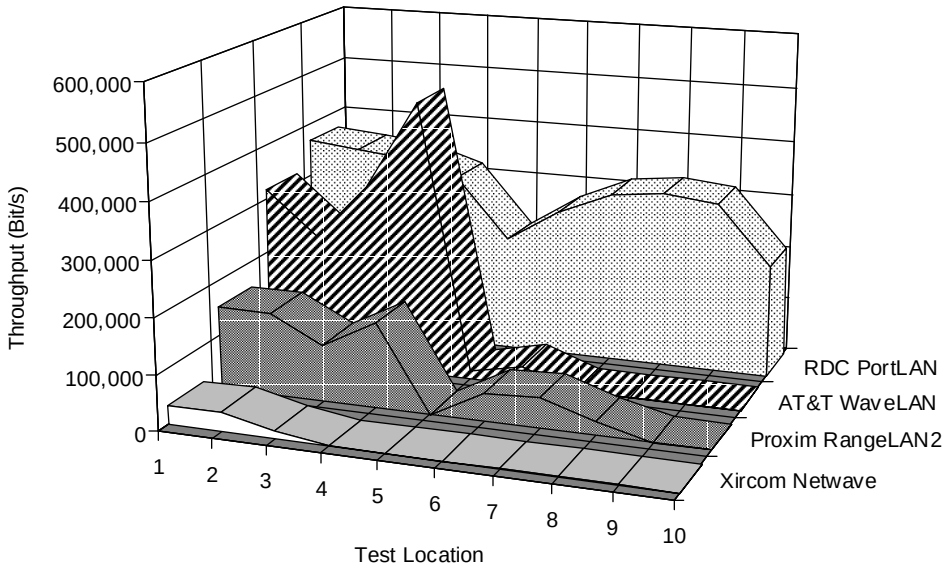
## Wireless Network Adapter Performance and Robustness

In the world of wireless communications, the integrity of a network link cannot be taken for granted. Unlike the "wired" world, radio links are sensitive to interference of all kinds, and radio waves are subject to fading due to signal reflections. Today's typical office environment presents many impediments to wireless communication: microwave ovens, office construction (walls, doors, etc.), and even the movement of employees throughout the office serve to weaken or even obliterate radio signals. Therefore, one of the most critical components of a wireless system is radio-link robustness.

RDC Communications Ltd. commissioned The Tolly Group to evaluate their PortLAN PCMCIA Wireless LAN Adapter and compare it to three competitive 2.4 GHz band wireless products: the AT&T WaveLAN, the Proxim RangeLAN2, and the Xircom Netwave. The Tolly Group evaluated the products for performance in a typical office environment. Key aspects of the radio link, such as reliability and availability, were exercised and quantified.

Results show that the RDC PortLAN provides, by far, the most robust and reliable network connectivity along with consistent and competitive performance. In intra-office tests, the PortLAN maintained client/server connections even when construction elements (doors, plaster walls, concrete walls, etc.) came between the user and the base station (access point). Other products failed to establish a connection to the test server in many of these same environments.

**System Performance vs. Location**
**PERFORM3 Test Suites**




Note: Each test conducted in a fixed location. Refer to figure 2 for diagram of test locations.

Source: The Tolly Group, September 1995

*Figure 1*

In interference tests, “jamming” signals (similar to interference created by microwave ovens, cellular phones, office machines, or wireless devices), were transmitted in the test environment. The PortLAN maintained stable connections and consistentperformance under interference levels that crippled other products.

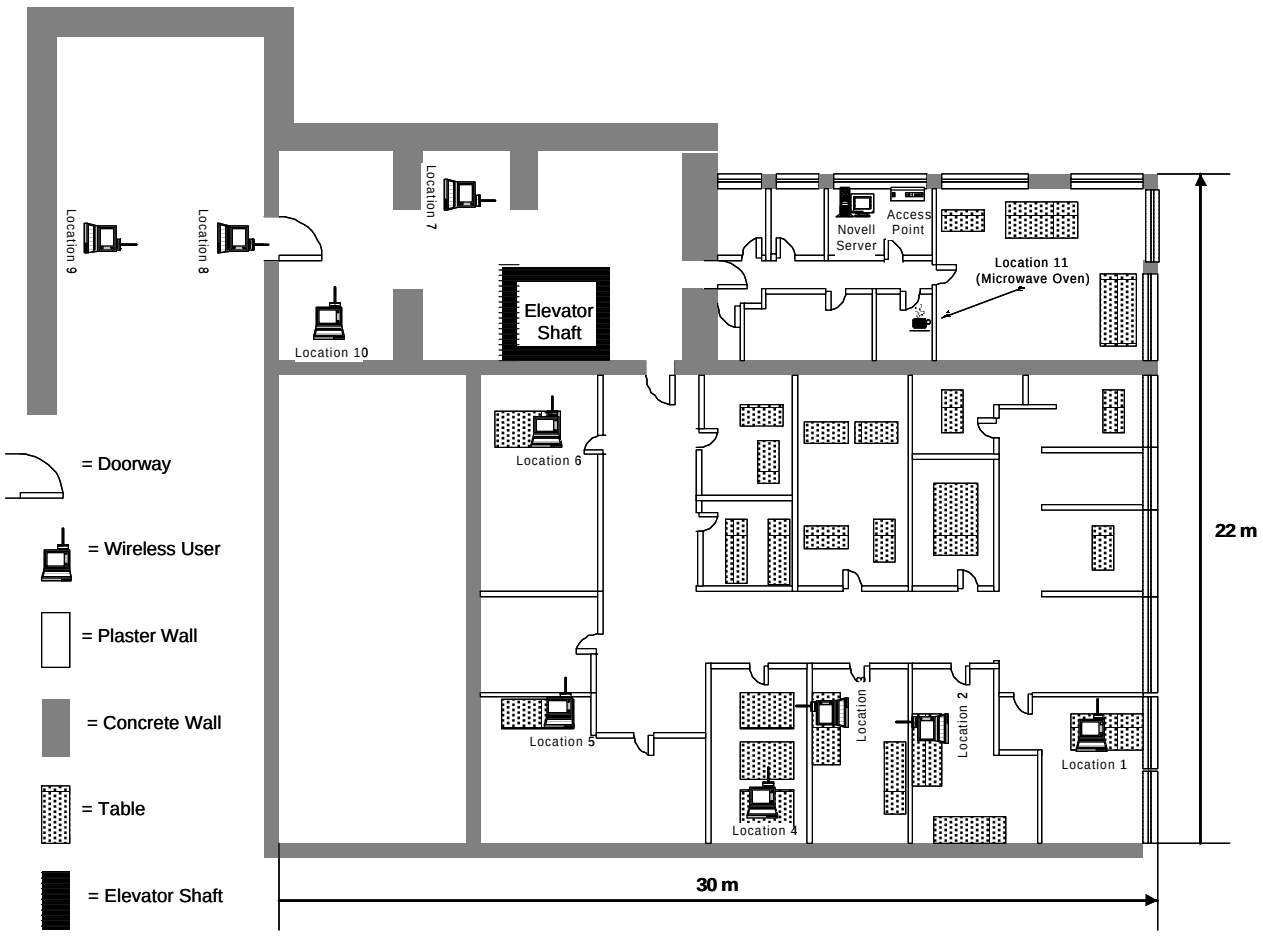
## Test Results

Figure 1 shows performance results for intra-office tests. The vertical axis shows the adapter performance, in bit/s, as reported by the PERFORM3 test utility, while the horizontal axis indicates the location of the test. Refer to figure 2 for a diagram of test locations.

As seen in figure 1, the PortLAN exhibited robust performance in all test locations. Other products tested demonstrated not only inconsistent performance but also communication failure of client/server sessions (depicted by 0 bit/s performance on thediagram). Only the PortLAN completed all tests without failure. For a listing of numerical test results, see figure 5.

Figure 3 shows graphical results of performance tests run with interference introduced into the test environment. These tests were conducted at location 3, shown in figure 2. The Tolly Group used a signal generator to transmit a “jamming” signal, atseveral signal levels, in proximity to the user station, and observed the effect on product performance. These tests show the robustness of the wireless products in extreme conditions. They do not necessarily represent a typical office environment, rather they are used to demonstrate the stability of a wireless system. For a listing of numerical results, see figure 6.
As seen in figure 3, interference had little effect on the RDC PortLAN. The AT&T WaveLAN failed to function when signallev-

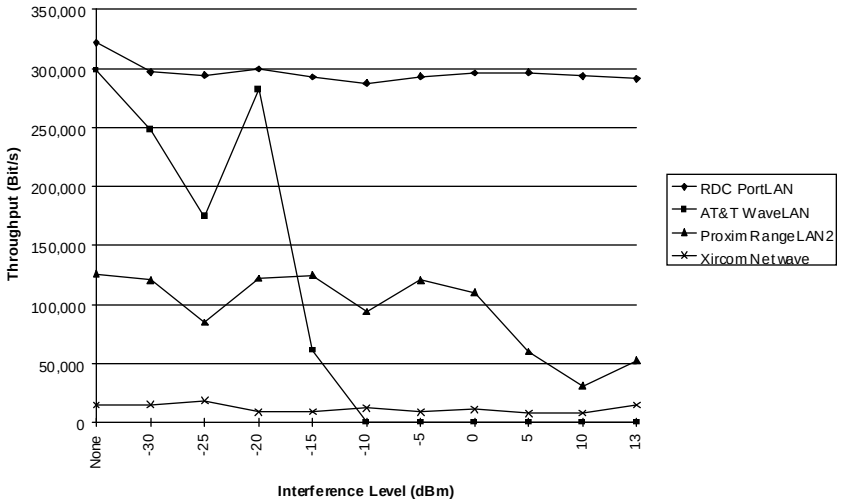
**Diagram of Test Facility**




Source: RDC Communications, September 1995

*Figure 2*

els exceeded -10 dBm, while the Proxim RangeLAN2 dropped to a third of its non-interference performance at 10 dBm. The Xircom Netwave was also affected by interference. However, because it does not have the range of other products, the Netwave had difficulty simply maintaining a connection to its access point even without interference.




Note (for reference only): -12 dBm is the signal level generated by a typical, 900 MHz, 1 Watt cellular handset at a distance of 3 meters.

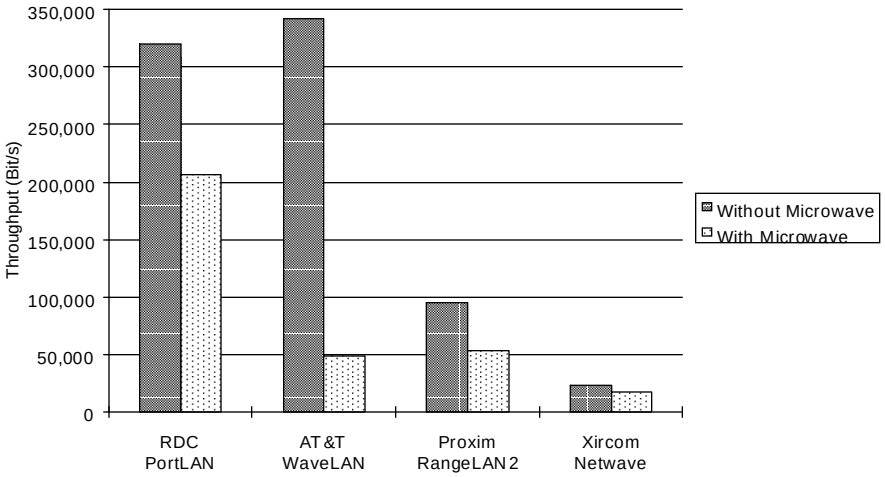
Source: The Tolly Group, September 1995 *Figure 3*

Interference tests were also conducted using a microwave oven as an interference source. Microwave ovens operate at approximately 2.45 GHz, within the same frequency band as the wireless LAN systems tested. Since all microwave ovens "leak" some radiation while running, they pose a real-world interference threat to wireless communication. Figure 4 shows the effect on performance of running a microwave oven at a distance of 6 meters from the access point of the wireless client adapters. Of the products tested, the RDC PortLAN had the highest throughput in the presence of interference. The results of both interference tests show that the RDC PortLAN provides end users with consistent and predictable network performance despite unpredictable noise in an office environment.

Results shown in figure 4 are an average of many test iterations. The numbers reflect that the AT&T WaveLAN at times exhibited 0 throughput, though its connection to the server remained intact, when the microwave was activated.

## Test Bed

The Tolly Group conducted this test at the RDC facility in Jerusalem, Israel. Performance tests were conducted using the PERFORM3 adapter test utility from Novell, Inc. PERFORM3 ran between the wireless client station and a NetWare 3.12 server. The client PC was an AST Power Exec 3/25 SL (80386 25 MHz) laptop PC with 8 Mbyte RAM and two PC card slots, running MS-DOS 6.2. The NetWare ran on an AcerMate (80486 66 MHz) ISA bus PC with 8 Mbyte RAM. The server was equipped with a 3Com Etherlink III ISA Ethernet adapter. Access points communicated with the server via 10 Mbit/s Ethernet BNC. It is important to note the test facility was a "live" environment; tests were subject to arbitrary movement of personnel throughout the office.




Source: The Tolly Group, September 1995 *Figure 4*

## Test Methodology

For intra-office tests, PERFORM3 was set to run at file sizes of 10,004, 10,003, 10,002, 10,001, and 10,000 bytes, in succession, at 12 second inter-

vals. Performance was reported, in Kbyte/s, at each interval by PERFORM3. The intra-office test suites, as well as interference test suites, described below, were each run two to three times, depending on the consistency of results. This same methodology was used for each adapter in all ten office locations shown in figure 2.

Interference tests involving the signal generator were run using PERFORM3 file sizes of 10,025 to 10,000 bytes, in successive, one-byte decrements, at 12 second intervals. In these tests, the client station was located at location 3, shown in figure 2, with the signal generator located 3 meters from the client PC. The first four 12-second intervals of the test were run without interference to establish a baseline. On the fifth interval, the interference signal was transmitted at -30 dBm. From this point, at every other interval, the signal strength was increased by 5 dBm, up to the point where the signal strength was 10 dBm. The final signal increase was by 3 dBm to 13 dBm, the highest signal strength possible from the signal generator, a Hewlett Packard model 8648C. Performance numbers were reported by PERFORM3 at each interval.

RDC, Proxim, and Xircom are all frequency hopping devices, which means they transmit

*(continued on page 6)*

**Numerical Results of System Performance vs. Location**

| | System Performance in Bit/s | | | |
|---|---|---|---|---|
| Test Location | RDC PortLAN | AT&T WaveLAN | Proxim RangeLAN2 | Xircom Netwave |
| 1 | 367,800 | 318,800 | 151,900 | 35,200 |
| 2 | 359,100 | 240,000 | 150,300 | 35,000 |
| 3 | 348,800 | 340,300 | 103,200 | 14,100 |
| 4 | 319,800 | 501,800 | 153,600 | 0 |
| 5 | 209,300 | 13,600 | 0 | 0 |
| 6 | 271,000 | 35,200 | 50,200 | 0 |
| 7 | 312,400 | 0 | 54,100 | 0 |
| 8 | 323,400 | 0 | 23,900 | 0 |
| 9 | 312,800 | 0 | 0 | 0 |
| 10 | 205,800 | 0 | 0 | 0 |

Source: The Tolly Group, September 1995 *Figure 5*

**Numerical Results of System Performance vs. Interference**

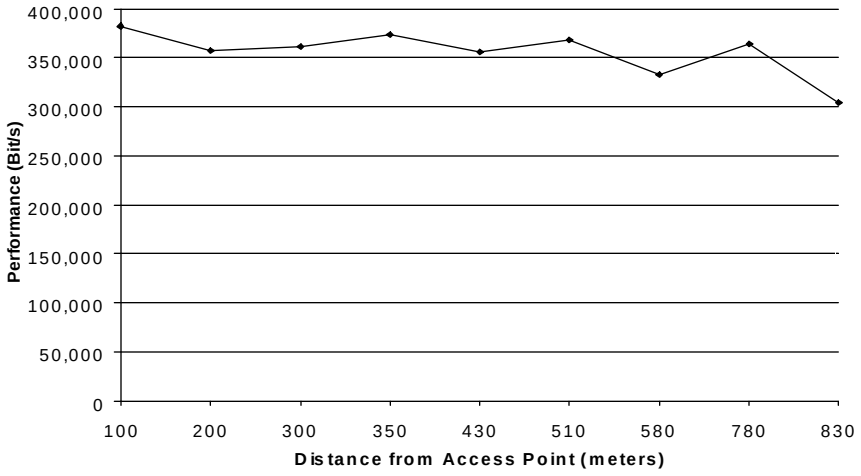
| | System Performance in Bit/s | | | |
|---|---|---|---|---|
| Interference Level (dBm) | RDC PortLAN | AT&T WaveLAN | Proxim RangeLAN2 | Xircom Netwave |
| None | 321,800 | 298,300 | 125,700 | 14,700 |
| -30 | 297,100 | 247,900 | 120,800 | 14,900 |
| -25 | 294,400 | 174,700 | 84,800 | 18,400 |
| -20 | 299,500 | 282,300 | 122,300 | 8,700 |
| -15 | 292,700 | 61,000 | 125,000 | 9,000 |
| -10 | 287,500 | 0 | 93,900 | 12,000 |
| -5 | 293,200 | 0 | 120,600 | 8,800 |
| 0 | 296,300 | 0 | 110,000 | 10,900 |
| 5 | 296,500 | 0 | 60,000 | 7,700 |
| 10 | 293,700 | 0 | 31,000 | 7,900 |
| 13 | 291,200 | 0 | 52,400 | 14,800 |

Source: The Tolly Group, September 1995 *Figure 6*

## Range

As an additional test, The Tolly Group verified the RDC claim that the PortLAN has line-of-sight range capability of over 800 meters. Figure 7 shows performance as a function of distance of the PortLAN. As seen, the PortLAN proved consistent performance over the full range of the test site (830 meters). Tests at greater distances were not conducted because of geographical constraints of the test area.

**RDC PortLAN*PCMCIA Performance as a Function of Distance**




Source: The Tolly Group, September 1995 *Figure 7*

**RDC Communications Ltd.**
**PortLAN*PCMCIA**

THE TOLLY GROUP CERTIFIED UP TO SPEC

**Wireless LAN Adapter**
**Performance and Robustness**

## Seamless Roaming

In large, office environments, multiple access points may be placed throughout a building. In such "multi-cell" environments it is imperative that clients be able to "roam" between access points. In other words, if the signal from an access point becomes weak or if the access point fails, a client connected to the cell must be able to seek a secondary connection to the network.

The Tolly Group verified that the RDC PortLAN*PCMCIA has seamless roaming in a multi-cell environment. To test roaming, The Tolly Group established a client connection to the NetWare server via one of two access points attached to the network. While the client was performing a directory command on the server, its access point was powered off, thus disabling the client's path to the server. The client automatically roamed; it reestablished to the server via the secondary access point and continued with the directory command. This test was repeated multiple times to verify consistency of the results.

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## RDC Communications PortLAN*PCMCIA Product Information[+]

Reliability:
- Antenna diversity for communication enhancement
- Medium Access Control (MAC) protocol optimized for heavy traffic and hostile RFI (Radio Frequency Interference) conditions
- Operates down to $10^{-3}$ BER (Bit Error Rate)

High Performance:
- 1 Mbit/s client data rate; up to 3 Mbit/s aggregate system data rate

Network Management
- SNMP agent built into access point
- Graphical management application available for use with HP OpenView for Windows

Security:
- Data scrambling
- User authentication at the access point
- Frequency hopping: Pseudo-random sequence

Distance Coverage (*verified by The Tolly Group*):
- Up to 1,660 meter (5,450 ft.) diameter of cell coverage. More coverage available with optional, high-gain antennas

[+] *Vendor supplied information (except for Distance Coverage) not verified by The Tolly*

## Systems Tested

| Vendor | Access Point | Client Adapter | ODI Driver Name | Date of ODI Driver |
|---|---|---|---|---|
| **RDC** | PortLAN*AP Wireless LAN Access Point/Bridge | PortLAN*PCMCIA Wireless LAN Adapter | *rdcwl06.com* | 5/15/95 |
| **AT&T** | WavePOINT | WaveLAN/PCMCIA 2.4 GHz Communications Adapter | *wvlan05.com* | 3/9/95 |
| **Proxim** | RangeLAN2/Access Point | RangeLAN2/PCMCIA | *rl2pcm.com* | 7/28/94 |
| **Xircom** | Netwave Access Point for Ethernet | Credit Card Netwave Adapter | *cnwodi.com* | 11/14/94 |

data on many frequency channels. For these products, interference was transmitted at 2.450 GHz to jam the center frequency of one of the channels. AT&T uses direct sequence technology, where a spreaded bandwidth of 2.447 to 2.473 GHz is used in transmission. A 2.460 GHz signal was used to interfere with the center frequency of this product.

Interference tests involving the microwave oven were very similar to those using the signal generator. They were run using PERFORM3 file sizes of 10,010 to 10,000 bytes, in successive, one-byte decrements, at 12 second intervals. The client was located in location 3, and the microwave oven was located in location 11, 6 meters from the access point. The first five intervals were run with the microwave off. On the sixth interval, the microwave was turned on (with a glass of water inside), and the next five intervals were run with the microwave operating.

## *About The Tolly Group*

*strategic consulting • independent testing • industry analysis*

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 preproduction and production equipment.

The Tolly Group is recognized worldwide for its expertise in assessing leading edge technologies including networking, multimedia, and messaging. By combining engineering-caliber test methodologies with informed interpretation, The Tolly Group consistently delivers meaningful analyses of technology solutions.

Kevin Tolly is President and Chief Executive Officer 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. Tolly writes regularly for*Data Communications* and *Imaging* magazines on architectural and technology issues for an international audience.

For more information on The Tolly Group's services, please call 800-933-1699 or 908-528-3300, fax 908-528-1888, send e-mail to ***info@tolly.com***, or visit our World Wide Web site at ***http://www.tolly.com.***

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