Testing Report

Modem Insight Report for:

3Com Megahertz 3CXM756 PC Card modem
Xircom RealPort REM56G-100 PC Card modem
IBM ThinkPad Mwave built-in modem

Henderson Communications Laboratories

Modem Insight Report

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Executive Summary

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V.90 Modems Covered in this Report:

3Com Megahertz	3CXM756 PC Card modem
Xirxom	RealPort REM56G-100 PC Card modem
IBM	ThinkPad Mwave built-in modem

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Executive Summary

This report describes testing that was performed to evaluate the throughput of three leading ITU-V.90 compatible modems, designed for use in notebook computers:

3Com Megahertz 3CXM756 PC Card modem

Xircom RealPort REM56G-100 PC Card modem

IBM ThinkPad Mwave built-in modem

Summary of Methodology

Testing was performed by HENDERSON COMMUNICATIONS LABORATORIES (HCL), using equipment designed to model the full range of line impairments typically encountered on the public switched telephone network (PSTN) in the continental United States. For each line impairment tested, a likelihood of occurrence (LOO) rating represented the chance of encountering that impairment on any given modem call. To represent the PSTN accurately, modem throughput was tested against each of 160 impairments, and the results were weighted and graphed by LOO, from the fastest connection to the slowest. Modems were tested against each of three leading remote access servers—the 3Com Total Control RAS, Ascend Max 2000 RAS, and Lucent PortMaster 3 RAS—giving an accurate representation of the real-world conditions in which these modems are intended to be used.

Summary of Results

Test results are illustrated in the Network Coverage Model and Weighted Average Throughput charts included in the "Results" section at the end of this report.

Informally known as a "waterfall" chart, the Network Coverage Model chart depicts the throughput achieved by each modem when connecting over lines that suffer from the various impairments typically encountered on the PSTN. For each modem, these line impairments are ranked from the highest throughput achieved (0% on the X axis) to the lowest throughput achieved (100% on the X axis). This ranking method gives the plotted line for each modem its distinctive "waterfall" shape, and a comparison of these shapes indicates the relative performance of each modem's signal converter or "data pump." Prospective buyers can use these charts to select a modem that performs best overall (the line representing the modem is higher than the others over most or all of the chart) and the modem that retains the best throughput over the largest percentage of impairments represented in the network model (the "waterfall" effect occurs farther to the right side of the chart compared to the others).

The Weighted Average Throughput charts give average modem throughput across all 160 lines tested, where each line is weighted by its LOO score. Prospective buyers can easily select the modem that performs best overall by looking for the highest ranking in the bar chart.

Summary of Conclusions

HCL's testing showed that the 3Com Megahertz PC Card modem, model 3CXM756, achieved consistently higher throughput than the others, across the network model, on each RAS tested. In some RAS configurations, the Xircom and IBM products failed to achieve true V.90 speeds over 50% or more of the network model. By contrast, the 3Com product achieved true V.90 speeds 70% to 80% of the time, making it the only viable choice for users who require maximum return on their V.90 modem investment.

Technical Report Summary

Test Goal

HENDERSON COMMUNICATIONS LABORATORIES tested the performance of three leading ITU-V.90 compatible modems designed for use in notebook PCs.

The purpose of this testing was to determine modem throughput over the full range of telephone network conditions that are likely to be encountered in actual, daily use. Modem buyers can use this information to decide which modem has the best price/performance ratio for their needs, or even to decide whether a V.90 modem provides enough of a performance advantage over a V.34 modem to warrant the additional investment.

Products Tested

This test evaluated the following V.90 modems for notebook computers:

3Com Megahertz 3CXM756 PC Card modem

Xircom RealPort REM56G-100 PC Card modem

IBM ThinkPad Mwave built-in modem

Because modem throughput depends partly on the remote access server (RAS) to which the modem is connected, each modem was tested against each of three leading servers:

- 3Com Total Control RAS
- Ascend Max 2000 RAS
- Lucent PortMaster 3 RAS

Combined with the test equipment and protocol described under "Test Methodology" (below), the nine possible combination of modem and RAS give a rich model of the products and conditions that are likely to be encountered in the real world. In particular, the test results should be helpful in deciding which V.90 notebook modem to purchase.

Conclusions

Charts of the test results are shown in the Results section at the end of this report. The "Test Methodology" section, below, explains how these results were achieved and how to read the charts.

The testing showed that the 3Com Megahertz 3CXM756 modem consistently outperformed the Xircom and IBM offerings in all test configurations:

- The 3Com Megahertz 3CXM756 modem was superior in Network Model Coverage (robust operation against line impairments).
- The 3Com Megahertz 3CXM756 modem was superior in Weighted Average Throughput (overall data transmission speeds).
- The 3Com Megahertz 3CXM756 modem was consistently superior, regardless of the Remote Access Server configuration used in the test.

Second-place results varied, depending on the configuration and percentage of the network model coverage. In certain configurations, the Xircom RealPort and IBM Mwave modems achieved true V.90 speeds only about 50% of the time or less, making the 3Com Megahertz 3CXM756 modem the only clear choice for users who require the best possible modem throughput over the widest range of conditions.

Test Methodology

Equipment and Configuration

The 3Com, Xircom, and IBM V.90 modems were tested on a system consisting of the TAS Series II Telephone Network Emulator, TAS 240A Loop Emulator, and other components that simulate the full range of telephone network conditions and impairments that exist in the continental United States. Modems were connected to this equipment over a standard analog voice line. The simulation equipment was, in turn, connected over a T1 line to a remote access server (RAS).

Each of the three modems was tested in combination with each of three remote access servers: the 3Com Total Control RAS, the Ascend Max 2000 RAS, and the Lucent PortMaster 3 RAS. The 3Com and Ascend servers were tested for two-way simultaneous communications, while the Lucent RAS was tested for one-way downstream communications.

Test Standards

The test standards employed were developed by the TR-30 technical committee of the Telecommunications Industry Association (TIA), an ANSI-accredited organization that develops voluntary industry standards for a wide range of telecommunications products. Comprising representatives from the modem industry, chipset vendors, telcos, the media, and other pertinent interests, the TR-30.3 subcommittee is proposing standards for testing modem throughput in the working document PN3857—Telephone Network Transmission Model for Evaluating PCM Modem Performance. These standards are designed to incorporate an accurate representation of the PSTN network model into modem testing equipment and procedures. It is expected that the PN3857 document will be ratified by the Electronic Industries Alliance (EIA), which includes TIA among its member groups. Draft 11 of the document was used in designing this V.90 modem throughput test.

Data Collected

For each of the nine possible setups (three modems in combination with three remote access servers), 160 calls were placed. On each call, the test equipment measured the connect speed negotiated by the modem and RAS, and the number of times a standard 32K text file could be transferred during a 150-second period. The transfer rate was recorded in characters per second (cps).

Because the purpose of the test was to determine the actual throughput for each modem, no data compression was used. This ensured that the efficiency of the modem's own signal converter was tested, rather than the efficiency of a compression scheme that could be used on any modem/RAS combination. Error correction was always turned on, simulating the way modems are typically configured in actual use.

Throughput versus Connect Speed

In evaluating modems, it's important to distinguish actual throughput from the "connect speed" that is reported by Microsoft's Dial-Up Networking and other similar programs. Users often believe, incorrectly, that the connect speed represents actual modem performance for the duration of a given connection. However, the connect speed only represents the speed negotiated between the modem and RAS when the connection is first established. Some modems connect aggressively in order to report a good connect speed, then slow down to compensate for poor line conditions. To use connect speed as a measure of "performance" is analogous to advertising a car's top speed without mentioning the slowdowns that may be caused by driving on a curvy or bumpy road.

"Throughput," on the other hand, takes the actual network conditions into account. To measure modem throughput, it is necessary to simulate all the line impairments—the curves and bumps—that are likely to be encountered when the modem is used to transmit actual data over actual phone lines. Just as some cars can go faster than others over a rough road, some modems can deal better than others with line noise, dropouts, and fluctuating signals. Ideally, a modem should achieve a good connect speed, followed by good throughput. The test described in this report was designed to determine true modem performance based on connect speed and throughput under conditions that simulate real-world use.

Visualizing the Results

The test was designed to measure the robustness of each modem's signal converter, or "data pump," by measuring actual modem throughput over a large number of different connections—each with a different type and level of impairment—that model the conditions typically encountered on the PSTN. The data can be represented visually on a Network Model Coverage chart or a Weighted Average Throughput chart.

Network Model Coverage. For each of the 160 calls placed for each modem/RAS combination, line conditions were weighted by likelihood of occurrence (LOO), and plotted by throughput along the X axis of a two-dimensional chart, representing a percentage of the total network model.

As you read from left to right on the Network Model Coverage chart, you are moving from the line impairment over which each modem achieved its highest throughput at 0% to its lowest throughput at 100%. The Y axis indicates actual throughput in characters per second (cps). The plotted lines, therefore, show the throughput of each modem over the entire network model—from the fastest throughput achieved to the slowest.

The characteristic "waterfall" shape of each line on the Network Model Coverage chart is produced when results are sorted by throughput for each modem. This sorting makes it easy to compare modem performance over the entire network model. The best performing modem has the highest line on the chart, with the "waterfall" effect occurring furthest to the right side of the chart.

Reading from left to right on the Network Model Coverage chart, you can see how throughput declines as each modem encounters the range of line impairments represented in the network model. For example, the top line on Figure 1 ("Results" section, below) shows that the 3Com modem connected to a Total Control RAS achieves:

A maximum throughput of 5866 cps

5614 cps or better over half the lines tested (50% of the network model)

2384 cps or better over all 160 lines tested (100% of the network model)

Weighted Average Throughput. Another way to visualize the results is to calculate the total two-dimensional area contained in the region bounded by the X axis, Y axis, and the "waterfall" line for a particular modem. The total area beneath the "waterfall" can be represented in a simple bar chart, showing the relative throughput for each modem averaged over the entire network model. When making the calculation, line impairments are weighted by LOO to represent real-world throughput as accurately as possible. This visualization is called the Weighted Average Throughput chart.

For example, Figure 2 ("Results" section, below) gives a Weighted Average Throughput chart for the Total Control RAS. The bars represent the total area beneath each of the "waterfall" lines in Figure 1, as adjusted to account for the LOO of each impairment. Looking at Figure 2, you can clearly see that the 3Com Megahertz 3CXM756 modem outperformed the IBM and Xircom modems by an average of approximately 800 cps and 1600 cps, respectively.

The Weighted Average Throughput chart gives a straightforward picture of the overall throughput for each modem, but does not provide the subtlety of the Network Model Coverage or "waterfall" chart. For example, what you can't see in Figure 2 (but can see in the Figure 1 "waterfalls") is that the IBM and 3Com modems significantly outperform the Xircom modem even on a minimally impaired line. Likewise, the Figure 2 bar chart doesn't show the dramatic falloff in throughput for the IBM modem as the test nears 100% coverage of the network model.

Careful buyers will be interested in overall results represented by the Weighted Average Throughput charts, but will also want to examine the shapes of the "waterfalls" shown in the Network Model Coverage charts, looking for lines that remain higher and straighter as they approach the 100% mark.

Interpreting Data Against a V.34 Baseline. Based on calculations found in EIA/TIA publication TSB-38, the highest throughput that a V.34 (33,600 bps) modem can normally achieve is approximately 3950 cps. Purchasers who are considering an investment in V.90 technology may want to evaluate how often, and by how much, each modem is capable of exceeding these speeds. A V.90 modem may not be worth the extra money if it achieves true V.90 speeds less than half the time.

This test was not specifically designed to compare V.90 modem performance against V.34 standards. However, you can make a rough comparison yourself by drawing an imaginary line at 3950 cps on either the Network Model Coverage chart or the Weighted Average Throughput chart. The area above this imaginary line represents the extra throughput you are paying for when you choose a V.90 modem over a V.34 modem.

For example, on the Weighted Average Throughput chart (the bar chart) for the Total Control RAS, the 3Com modem exceeds the imaginary 3950 cps line by 1375 cps, and the IBM modem exceeds it by 560 cps. The Xircom modem, on the other hand, falls 190 cps short of the line.

Drawing the same imaginary line on the Network Model Coverage chart for the same RAS (the "waterfall"), you can see that the 3Com modem exceeded V.34 speeds for approximately 94% of the connections made, while the IBM modem exceeded V.34 speeds 77% of the time. The Xircom modem exceeded 3950 cps for only 56% of the network model.

This method of comparison is not scientific, but it does provide the purchaser with a simple baseline for deciding whether a particular V.90 modem model is likely to provide a boost in throughput commensurate to its additional cost over a V.34 modem. This information must, of course, be weighed against the types of files to be transferred, and the transfer speeds desired.

Results

The charts on the following pages show the Network Model Coverage and Weighted Average Throughput results for each modem, tested against the 3Com Total Control, Ascend Max 2000, and Lucent PortMaster RAS, respectively.

V.90 Modem Throughput for 3Com Total Control

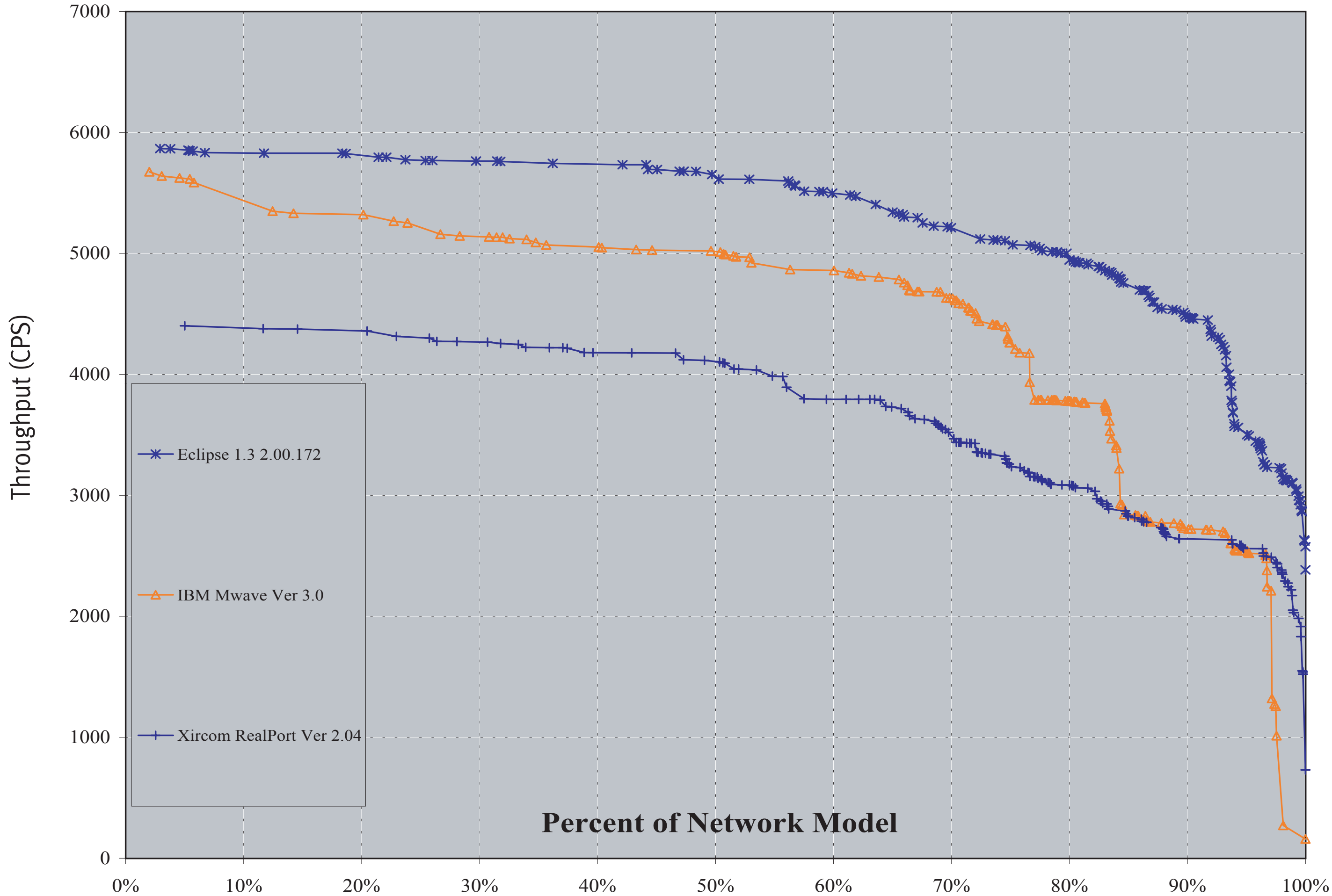

Figure 1. Network Model Coverage - 3Com Total Control

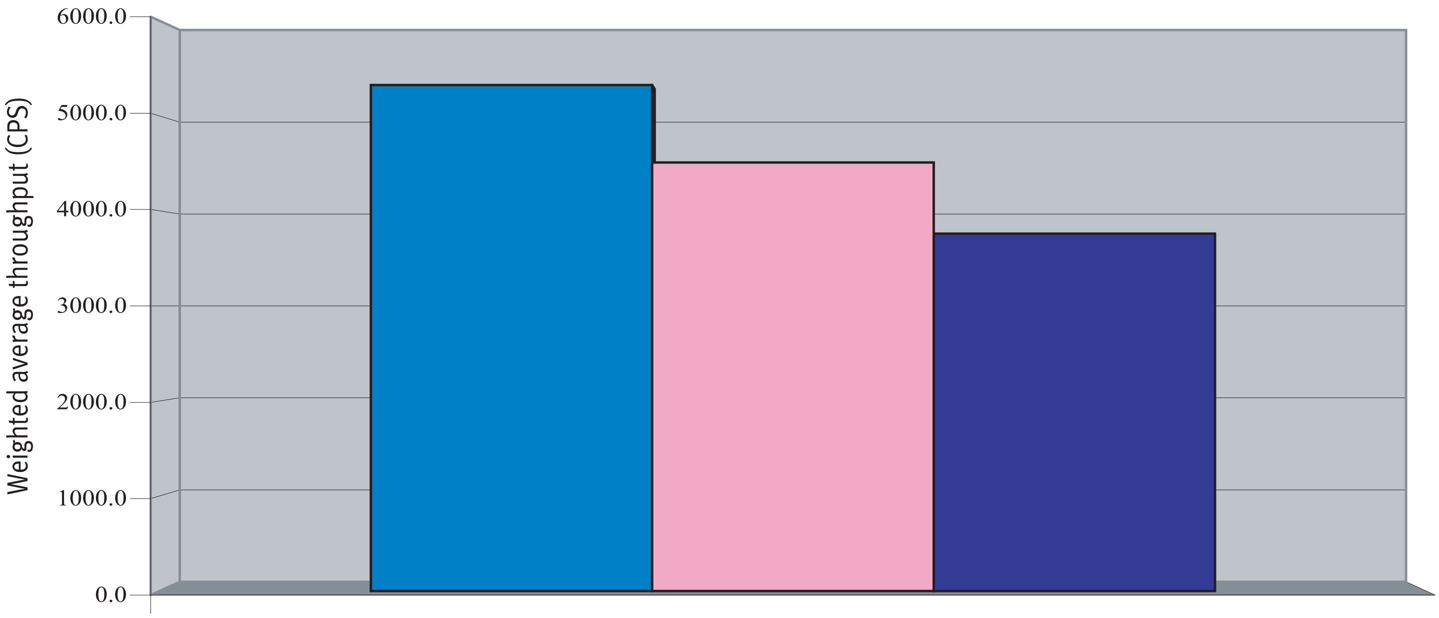

Figure 2. Weighted Average Throughput - 3Com Total Control

	1
Eclipse 1.3 2.00.172	5324.9
IBM Mwave Ver 3.0	4510.4
Xircom RealPort Ver 2.04	3759.8

V.90 Modem Throughput forAscend Max 2000

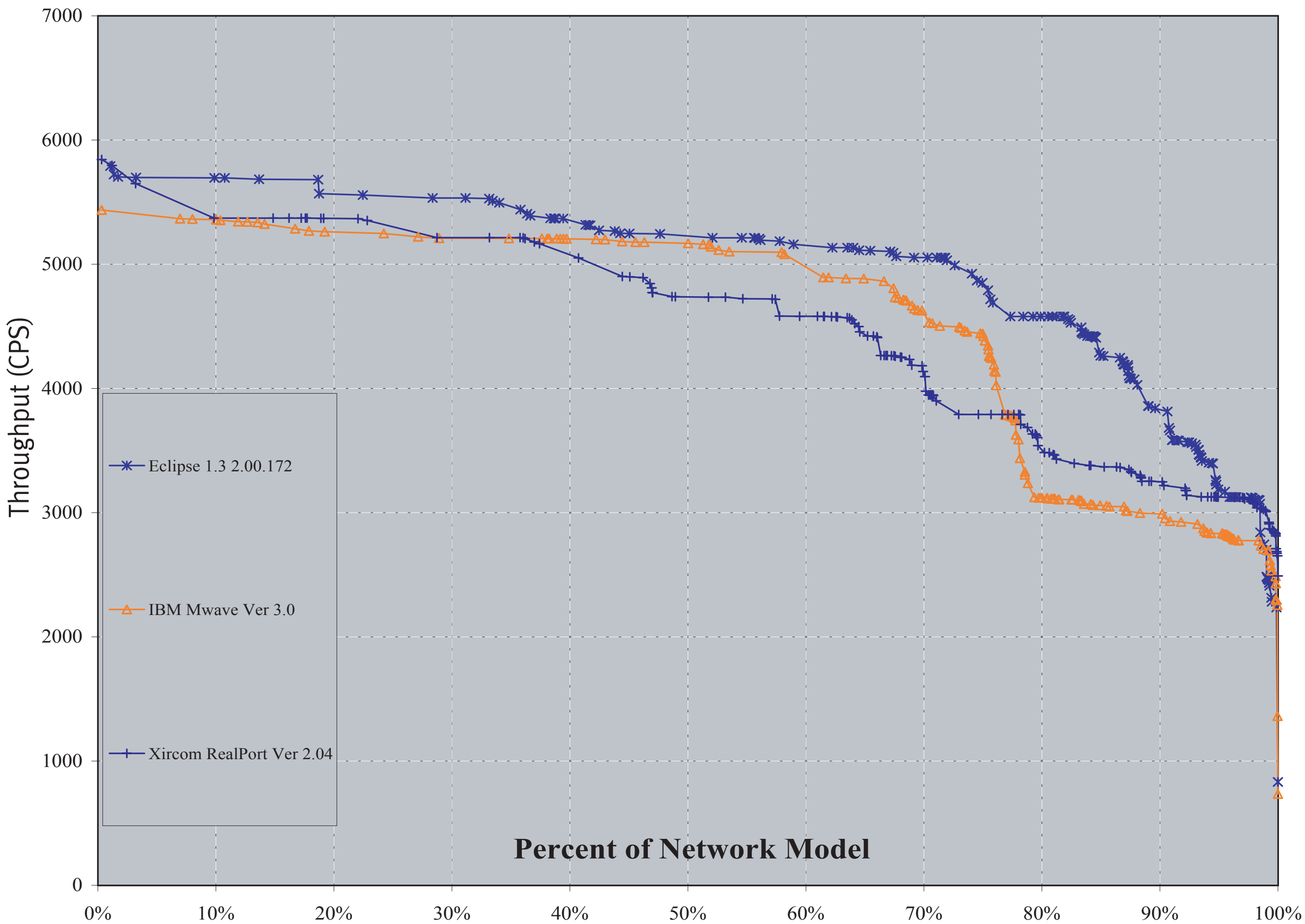

Figure 3. Network Model Coverage - Ascend Max 2000

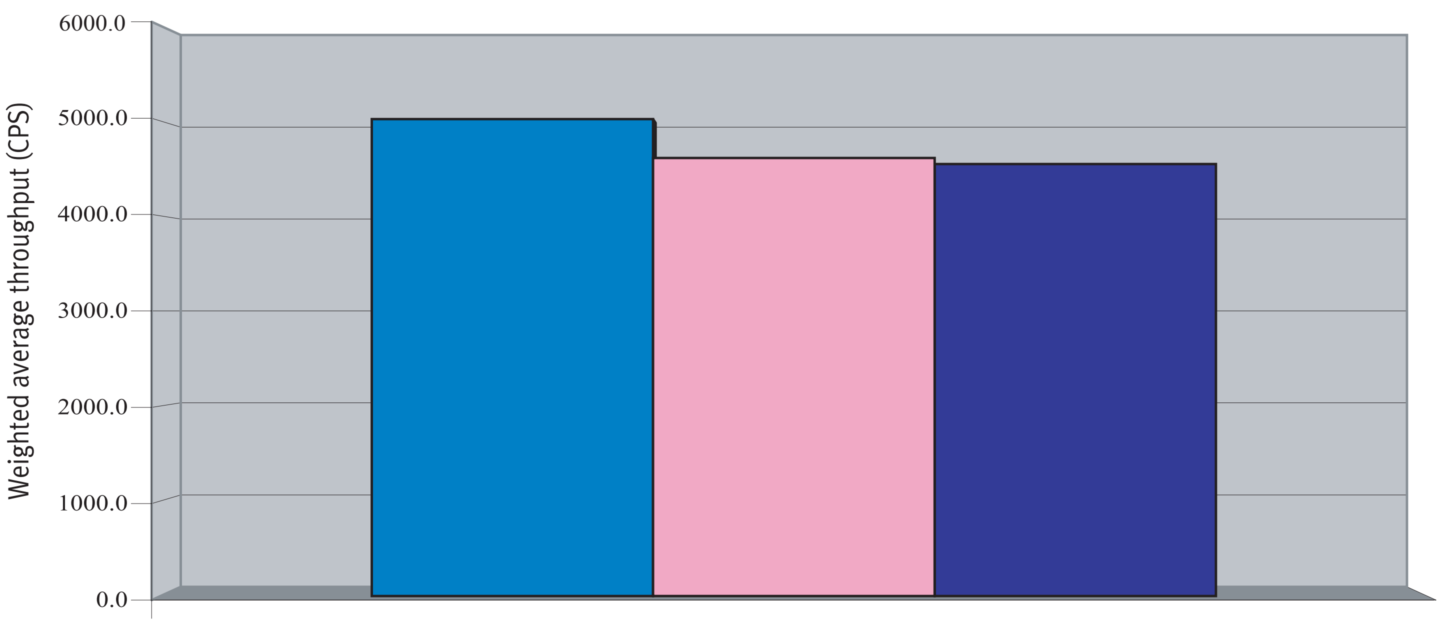

Figure 4. Weighted Average Throughput - Ascend Max 2000

	1
Eclipse 1.3 2.00.172	5018.3
IBM Mwave Ver 3.0	4610.2
Xircom RealPort Ver 2.04	4546.9

V.90 Modem Throughput for Lucent PortMaster 3

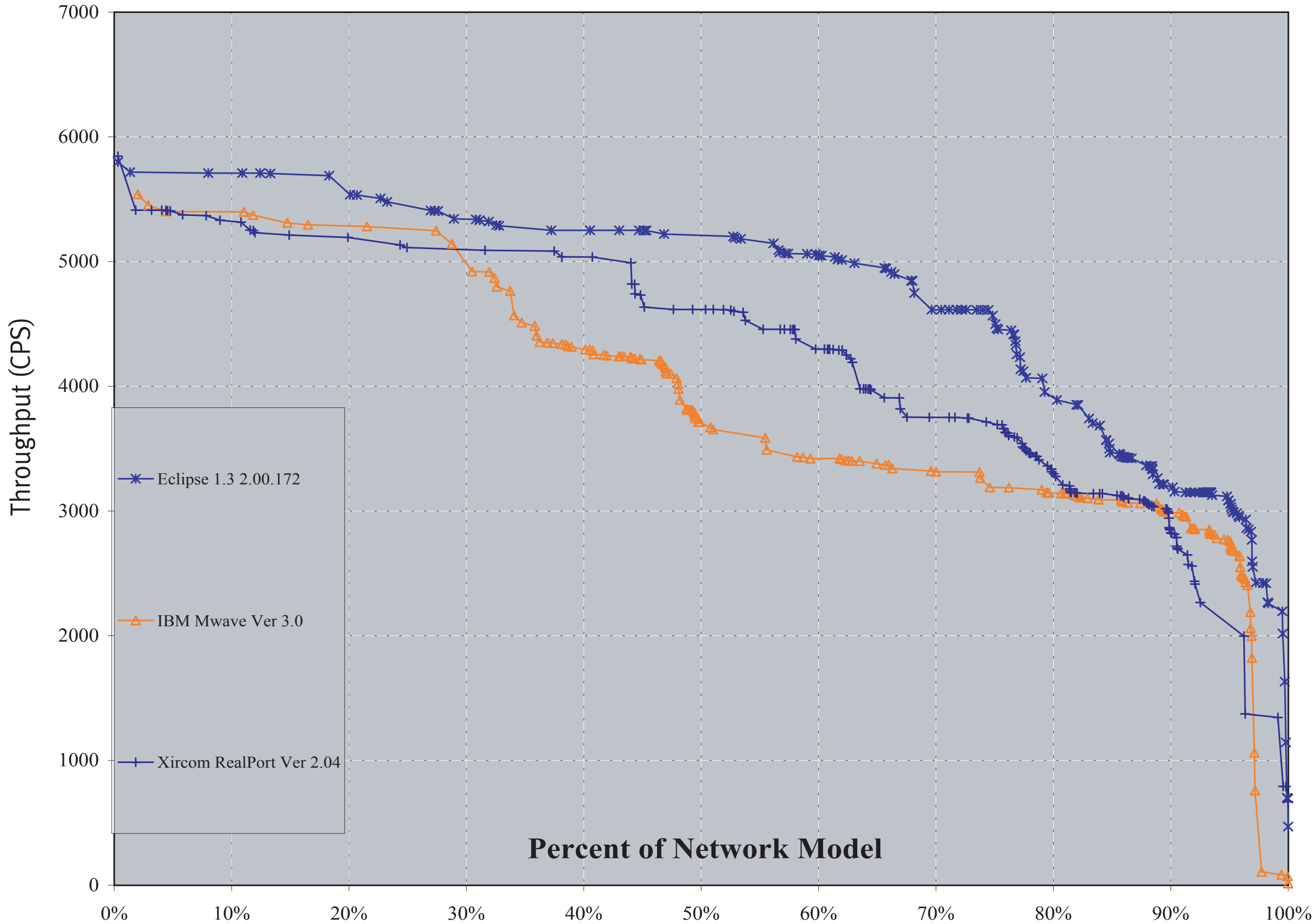

Figure 5. Network Model Coverage - Lucent PortMaster 3

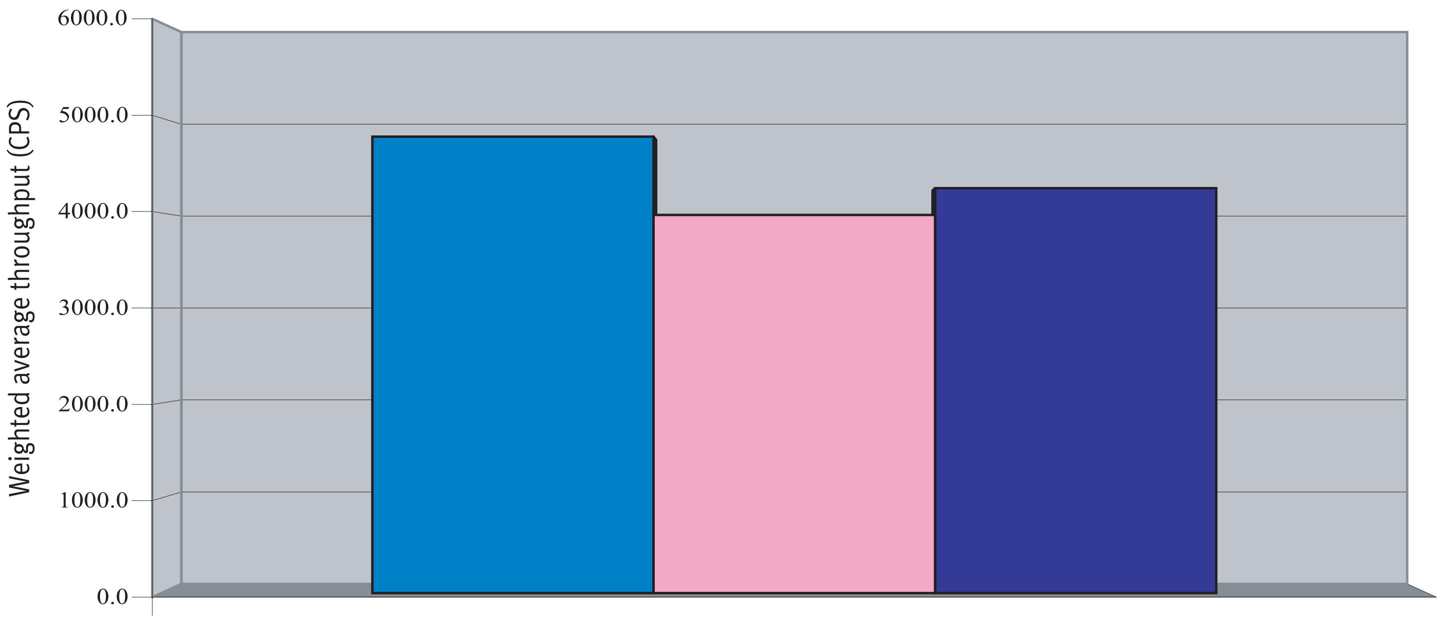

Figure 6. Weighted Average Throughput - Lucent PortMaster 3

	1
Eclipse 1.3 2.00.172	4805.1
IBM Mwave Ver 3.0	3978.7
Xircom RealPort Ver 2.04	4261.1

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