THE TOLLY GROUP

No. 200229 December 2000

Moby Dark Inc.
MDZR Wireless Router
Wireless 802.11b LAN/WAN Network Routing Evaluation

Test Summary

Premise: *Broadband wireless technologies are becoming more commonplace in both Local Area Networks (LANs) and Wide Area Networks (WANs) today because of benefits such as wire-free flexibility and increasingly higher data rates. Network managers implementing wireless devices need to know that such devices are interoperable with their wired networks and that the functionality of their devices can route around failures unique to wireless networks like interference from a broken antenna or line noise.*

Moby Dark, Inc. commissioned The Tolly Group to evaluate its MDZR Wireless Router. This device is a purpose-built chassis housing an Intel processor that runs a network-centric operating system kernel called MobyBSD. The chassis is outfitted with one 802.3 10/100 Ethernet card and up to two 802.11b Wireless Ethernet cards turning it into a standards-based wireless router capable of integrating wired and wireless nets into a unified IP network. The MDZR Wireless Router works with industry-standard wireless network interface cards available in the market today.

For these tests, The Tolly Group built a legacy "wired" IP network based around a Cisco Systems Inc. 2600 IP Router running IOS version 12.0 (3) T3. The MDZR wired-to-wireless IP router was integrated into this environment and tests were conducted to demonstrate that the MDZR Wireless Router could interoperate with the Cisco router running Routing Information Protocol (RIP) v. 2, Open Shortest Path First (OSPF) v. 2 and Border Gateway Protocol (BGP) v. 4 routing protocols. Each MDZR Wireless Router was equipped with two Lucent WaveLAN Wireless adapters. Tolly engineers also showed that in the event of a catastrophic antenna failure, or during extreme attenuation (any reduction in the strength of a signal whether digital or analog), the MDZR Wireless Router could dynamically choose the best route based on radio-channel or network properties. Testing was performed in September and October 2000.

Test Highlights

- Interoperates with a legacy Cisco IP router running RIP v. 2, OSPF v. 2 and BGP v. 4
- Demonstrates route recovery when a catastrophic antenna failure occurs
- Chooses the best route based on radio-channel or network characteristics

IP Routing Compatibility

Protocols Tested	Results
RIP v. 2	All Tests **PASS**
OSPF v. 2	All Tests **PASS**
BGP v. 4	All Tests **PASS**

* The Tolly Group tested interoperability with a Cisco Systems, Inc. Catalyst 2600 Router running the following three protocols: RIP v. 2 (Routing Information Protocol); OSPF v. 2 (Open Shortest Path First); and BGP v. 4 (Border Gateway Protocol).

Source: The Tolly Group, December 2000 *Figure 1*

Results

IP Routing Protocol Operational Compatibility

The Tolly Group verified that the Moby Dark MDZR Wireless Router was capable of inter-operating with a wired Cisco Catalyst 2600 IP Router running Routing Information Protocol (RIP) v. 2, Open Shortest Path First (OSPF) v. 2 and Border Gateway Protocol (BGP) v. 4, three main routing protocols. Specifically, engineers confirmed that the routing tables were updated dynamically via the specific protocol under test. See figure 1.

Route Path Selection

Tolly engineers also showed that when catastrophic antenna failure, or extreme attenuation (any reduction in the strength of a signal whether digital or analog) conditions were introduced, the MDZR Wireless Router could dynamically migrate traffic to an alternate wireless IP routing path based on radio-channel or network characteristics. See figure 2.

Analysis

Network managers implementing wireless LANs or WANs to supplement their existing

networks without the labor costs and copious amounts of time required in wiring to new buildings on their campus networks, need to know that their existing networks can interoperate with new wireless equipment.

Generally, wireless nodes are connected via wireless interface cards that connect to an access point, which in turn connects to existing wired network switches and routers. It is these existing (or added) wired network routers that perform all the routing functions.

Moby Dark's MDZR Wireless Router is a purpose-built device with its own proprietary operating system called MobyBSD. The device is a chassis with software and hardware that allows for the insertion of up to four wireless Ethernet cards. It is capable of handling typical routing functions without having to connect to an access point. These MDZR Wireless Routers serve as "digital extension cords" between networks and can provide a high-performance, cost-effective alternative to T1 connectivity to nearby company locations.

What is important to remember is that a wireless network must interoperate with the IP routing protocols of the wired network to which it is interconnected and must be capable of understanding and applying route updates with different routing protocols.

The Tolly Group interoperability tests of the MDZR Wireless Router demonstrated that it could interoperate with an existing network router running RIP v. 2, OSPF v. 2, and BGP v. 4, three commonly used routing protocols.

Other concerns that network managers face when implementing an additional wireless system is the potential for failures as a result of external antenna damage and attenuation (reduction in the strength of a signal whether digital or analog) causing network interference.

The MDZR Wireless Router proved in these tests its capability to recover after catastrophic antenna failure such as destruction due to a lightning storm. The device also demonstrated that it could alter its route during severe attenuation.

Route Path Selection

Test	Results
Catastrophic Antenna Failure	All Tests **PASS**
Route Path Selection Due to Excessive Attenuation	All Tests **PASS**

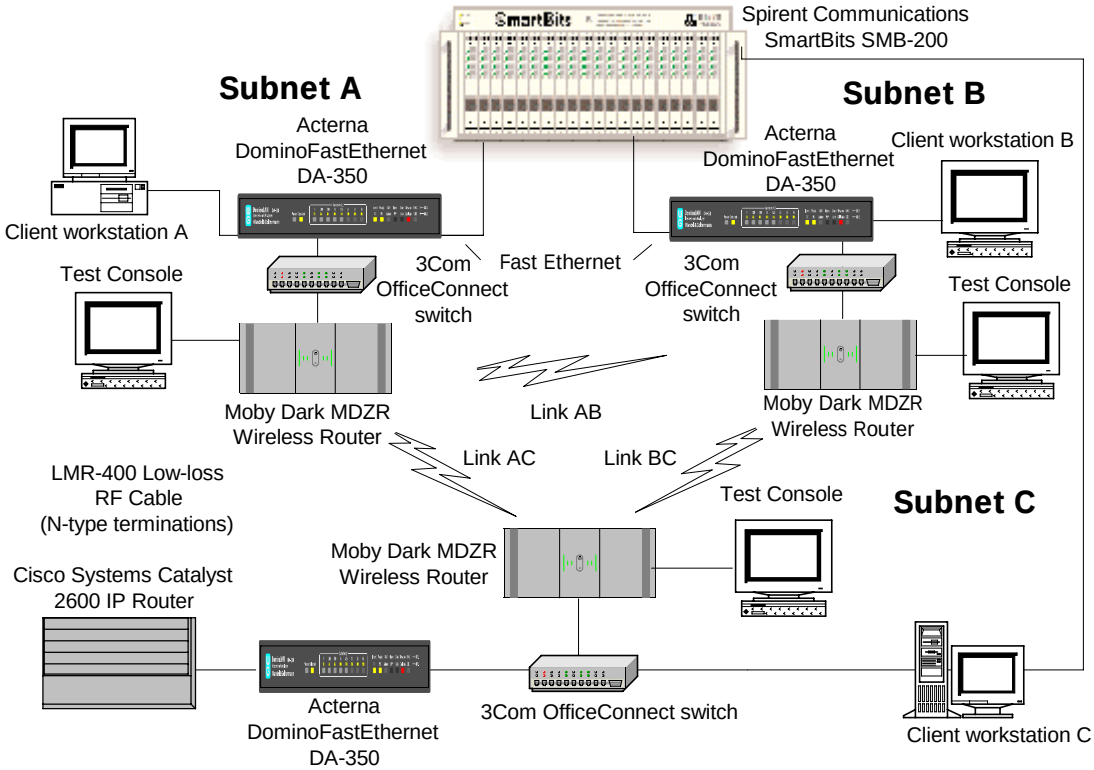
Source: The Tolly Group, December 2000 *Figure 2*

Test Configuration and Methodology

Protocol Interoperability

For interoperability tests, The Tolly

Interoperability Test Bed Diagram



Source: The Tolly Group, December 2000 *Figure 3*

Group engineers used three Moby Dark Inc. MDZR Wireless Routers all running MobyBSD v. 0.34 and Moby Dark Router Traffic Controller (MRTC) v. 0.07. Each device had two 2.4-GHz ports equipped with Lucent WaveLAN Wireless Adapters and one 100Base-TX Fast Ethernet port. These devices were interconnected via RF (radio frequency) cable between the wireless ports. These ports had N type connectors and were linked by the use of miniature flat panel antennas with 6dBi gain.

The wireless ports were configured to use Moby Dark's Open Shortest Path First (OSPF) implementation.

The Tolly Group engineers tested the MDZR Wireless Routers interoperability with a Cisco Systems, Inc. Catalyst 2600 IP Router v. IOS 12.0 (3) T3. This Cisco router was configured for TCP/IP traffic over 100Base-TX Fast Ethernet and configured for RIP v. 2 (Routing Information Protocol), OSPF v. 2 (Open Shortest Path First), and BGP v. 4 (Border Gateway Protocol). Each MDZR Wireless Router was connected to a subnet via 100Base-TX Fast Ethernet. One of these subnets attached to the Cisco router.

The MDZR Wireless Routers in each subnet connected to a 3Com Corp. OfficeConnect dual-speed switch that connected to a PC clone simulating a client workstation and a Spirent Communications SmartBits SMB-200 Advanced Multiport Performance Tester/Analyzer/Simulator equipped with four ML-7710 10/100 Mbit/s interfaces. An Acterna DominoFastEthernet DA-350 In-line Network Analyzer running Acterna DominoCore v. 2.5 was also connected to each subnet and was configured for 100Base-TX, full duplex.

Each MDZR Wireless Router was also connected to a console (PC clone) for monitoring its configuration and operational status. The SmartBits SMB-200 chassis connected to a console running Spirent Communications SmartWindows version 7.0.

To test interoperability, engineers generated application traffic from SmartBits at a rate of one packet per second through the network. One MDZR Wireless Router exchanged routing information with the Cisco router. The Tolly Group then simulated a device failure of the Cisco router and verified that the routing tables in the MDZR Wireless Router were purged. Finally, Tolly engineers reconnected the Cisco router and the DominoFastEthernet captured the exchanges on the link between the Cisco router and the MDZR Wireless Router to verify that the routing tables were being updated via the protocol under test. The interoperability tests were conducted using RIP v. 2, OSPF v. 2 and BGP v. 4. See figure 3.

Route Path Selection

To test route path selection, engineers configured a similar test bed outlined above but did not include the Cisco router. The Tolly Group simulated an antenna failure scenario to demonstrate the MDZR Wireless Router's potential for recovery. At first Tolly engineers tried to construct a scenario in a controlled environment that simulated an MDZR Wireless Router losing an interface due to external antenna damage such as the result of a lightning bolt. Due to the excessive bleed resulting from the internal antennas of the Lucent WaveLAN cards used in these tests, Tolly engineers were unable to construct a valid test bed.

Instead, The Tolly Group set up a test outdoor of their testing facility where some variables such as noise and interference could not be controlled. Each MDZR Wireless Router was approximately 200 to 250 feet apart. After Tolly engineers successfully completed the setup and validation of the test bed, The Tolly Group purposely failed an antenna while passing traffic over the wireless network generated from the SmartBits SMB-200 traffic generator. Within a 30 second time frame, engineers noted that the routing tables on the MDZR Wireless Router had been updated (validated via the console port on the router) and traffic was successfully passing again.

The routers were again interconnected via 2.4-GHz wireless ports. The Tolly Group engineers configured SmartBits SMB-200 to generate streams of 1,500-byte packets at 0.5 Mbit/s unidirectionally. Attenuation was added in dB:60dB.

The Tolly Group engineers demonstrated what happens to the route selected by the router when the signal strength degrades excessively, such as in the case of this

Moby Dark, Inc.

MDZR Wireless Router

Performance Evaluation

Moby Dark, Inc.
MDZR Wireless Router
Product Specifications*

- Multi-point high-speed wireless connectivity supported with enhanced dynamic IP routing protocols adapted and tuned for wireless environments
  - Static
  - RIP/RIP2
  - OSPF
  - BGP4+
- Support for multiple radio cards
- Premium TCP/IP features
  - Traffic shaper/bandwidth management
  - IP packet filtering
  - IP Network Address Translation (NAT)
- Network processing optimized operating system, MobyBSD
- Wireless data encrypted with WEP, optional 1,024-bit module
- Link level support for PPP, HDLC and Ethernet
- Configuration via telnet and console
- Three year warranty
- Open architecture, CSA, FCCb, 2U rack-mount chassis
- Supports ISA, PCI, PCMCIA wireless, IEEE 802.11b, as well as a variety of wireline network interface cards

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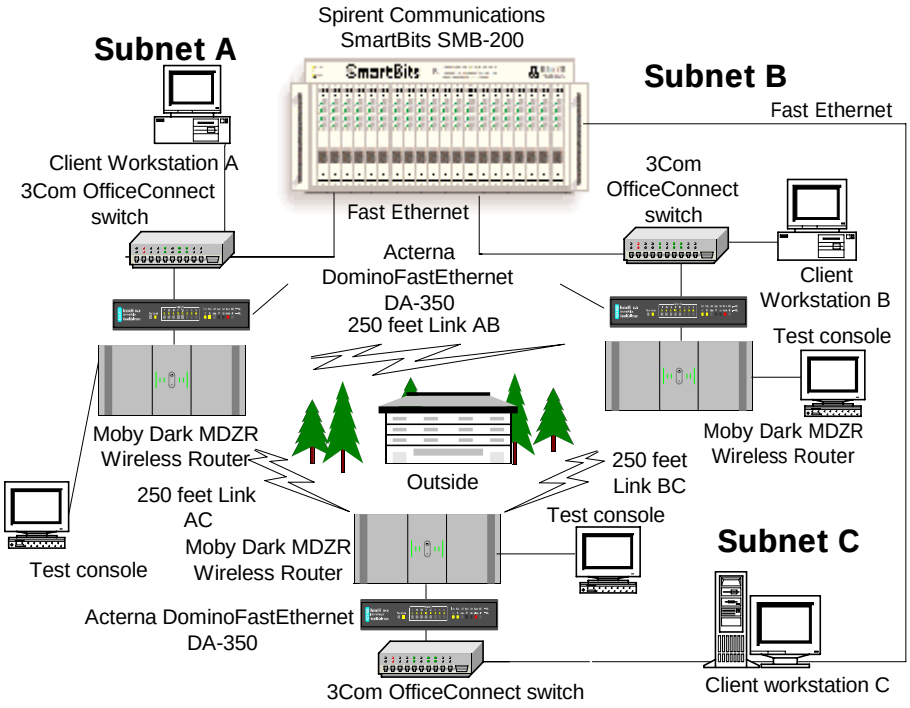
**Vendor-supplied information not verified by The Tolly Group*

test, through excessive attenuation. To establish a baseline, engineers benchmarked signal strength in the "open air" using miniature flat panel external antennas, without any attenuation present, just the uncontrollable variables inherent with open air devices. The Tolly Group recorded the signal strength of 25% from the console of the system under test and noted the paths from the routing tables. The external antenna was disconnected from one router and in-line attenuators were added, 10dB at a time. After each 10dB of attenuation was added, the signal strength and route tables were verified. Though the signal strength remained fairly constant, down in the single digits, when 60dB of attenuation was present, the signal was degraded to such an extent that the connection failed over to a stronger signaled path. The route tables were updated via OSPF (Open Shortest Path First) protocol and verified by generating traffic. See figure 4.

Interoperability Test Bed Diagram



Source: The Tolly Group, December 2000 *Figure 4*

The Tolly Group gratefully acknowledges the providers of test equipment used in this project.

Vendor	Product	Web address
Acterna Corp.	DominoFastEthernet DA-350	http://www.acterna.com
Spirent Communications	SmartBits SMB-200	http://www.spirentcom.com

Since its inception, The Tolly Group has produced high-quality tests that meet three overarching criteria: All tests are objective, fully documented and repeatable.

We endeavor to provide complete disclosure of information concerning individual product tests, and multiparty competitive product evaluations.

As an independent organization, The Tolly Group does not accept retainer contracts from vendors, nor does it endorse products or suppliers. This open and honest environment assures vendors they are treated fairly, and with the necessary care to guarantee all parties that the results of these tests are accurate and valid. The Tolly Group has codified this into the Fair Testing Charter, which may be viewed at http://www.tolly.com.

Project Profile

Sponsor: Moby Dark, Inc.
Document number: 200229
Product Class: Wireless router
Products under test:

- MDZR Wireless Router

Testing window: September and October 2000
Software versions tested:

- MobyBSD v. 0.34
- Moby Dark Router Traffic Controller (MRTC) v. 0.07

For more information on this document, or other services offered by The Tolly Group, visit our World Wide Web site at http://www.tolly.com, send E-mail to info@tolly.com, call (800) 933-1699 or (732) 528-3300.

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