Experiences Using IEEE 802.11b for Service Discovery

Michael S. Thompson
Scott F. Midkiff
{stuboy, midkiff}@vt.edu
Virginia Tech, USA
Overview

- Introduction
- Motivation
- IEEE 802.11b performance
- Low-traffic performance
- High-traffic performance
- Conclusion
Introduction

Goal:

– Present “real-world” performance data for IEEE 802.11b in ad hoc mode

Useful to:

– Anyone designing protocols or applications specifically for ad hoc IEEE 802.11b
Motivation

Purpose for conducting this work:

– Designing a service discovery solution

– Observing the pitfalls and nuances of IEEE 802.11b in ad hoc mode using unicast and multicast addressing (frames)

– Testing low and high traffic volume scenarios
Experimental Setup

Hardware:

- Compaq iPAQ 3850 (200MHz StrongARM, 64MB memory, Dual PC Card slot sleeve)
- Xircom CWE1130 IEEE 802.11b PC card

Software:

- Pocket PC 2002
- .NET Compact Framework v1 and C#
- Ethereal and Network Instruments’ Observer
Test 1: Low Traffic

Simulation of service discovery queries:
- Message generation, random (1-10 secs)
- Broadcast flooding delivery
- With and without forwarding delay (0-200 ms)
- Single and multihop configurations
- 1 and 30 mW transmit power
- Close proximity of nodes

Observing: packet loss
The Results

Multicast delivery probability
With and without delay
Transmit power of 1 mW or 30 mW
Analysis

Why is there variation in the delay scenario?
- Large standard deviation between points caused by a small number of tests

Observations:
- No delay scenario, missed packets were missed by all nodes
- Delay scenario, missed packets were missed by only one node
Other Results

Using two nodes and unicast delivery, no packets were lost

A small number of multihop tests were also conducted

<table>
<thead>
<tr>
<th>Multihop Results</th>
<th>Run1</th>
<th>Run 2</th>
<th>Run3</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique sends</td>
<td>417</td>
<td>428</td>
<td>413</td>
<td>419.33</td>
</tr>
<tr>
<td>Avg. misses / node</td>
<td>132.88</td>
<td>155.77</td>
<td>156</td>
<td>148.33</td>
</tr>
<tr>
<td>Avg. miss % / node</td>
<td>31.86</td>
<td>36.39</td>
<td>35.77</td>
<td>35.34</td>
</tr>
<tr>
<td>Avg. node degree</td>
<td>2.77</td>
<td>2.88</td>
<td>3.11</td>
<td>2.92</td>
</tr>
</tbody>
</table>
Analysis

Why is there variation in multicast and unicast delivery?

- IEEE 802.11b employs an ACK mechanism for unicast frames (but not multicast)

Observations:

- Neighbor degree increased across the tests, nodes did not move
- As neighbor degree increased, the miss percentage, also, increased
Test 2: High Traffic

Intrigued by the low traffic results, we wanted to see the performance in high traffic environments.

– Traffic generator to send packets with little or no delay to a traffic sink
– Packet size varied from 50 bytes and 100 bytes to 1600 bytes in 100-byte intervals
– Interpacket delay of 0, 1, and 2 ms
– High and low interference environments
Results

Percent of Packets Received (Multicast & Unicast)

No Delay

1ms Delay

Mar. 17, 2006
Analysis

Unicast:
- IEEE 802.11 MAC acknowledgements cause loss

Multicast:
- High loss for smaller packets
- Likely due to hardware resource limitations

2 ms delay scenario showed no loss difference between multicast and unicast
Conclusion

Observed IEEE 802.11b performance in:

- A low traffic scenario with varying transmit power and forwarding delay
- A low traffic, multihop scenario
- A high traffic scenario comparing unicast and multicast performance

Conclusion: IEEE 802.11b offers different levels of delivery probability based on the deliver type

Questions? Thanks!