Trends and Implications for Unlicensed Wireless Networks

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Trends: Market Size

- Shear volume
  - Scalability & automation
- Laptop vs. desktop sales
  - 54% to 46%
  - Common case vs. exception
- Rapid deployment of new technology
  - New ideas may be easily deployed
  - Highly dynamic environment
  - Must accommodate new/unexpected technologies

### Staggering Market Statistics

- 9 million hotspot users in 2003 (30 million in 2004)
- Approx 4.5 million WiFi access points sold in 3Q04
- Market will triple by 2009
- Many more non-802.11 devices

<table>
<thead>
<tr>
<th>Total</th>
<th>667</th>
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<tbody>
<tr>
<td>Classified</td>
<td>472</td>
</tr>
<tr>
<td>802.11b</td>
<td>379</td>
</tr>
<tr>
<td>802.11g</td>
<td>93</td>
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</tbody>
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7/2004 wardrive (802.11g standardized in 6/2003)
Densities of unlicensed devices already high
- Limits performance due to scarce spectrum
- Need more spectrum or more efficient use
Trends: Density & Management

- Densities of unlicensed devices already high
  - Limits performance due to scarce spectrum
  - Need more spectrum or more efficient use

- Channel allocation suggests poor management
  - Makes problems such as interference worse
  - Security management probably worse
  - Won’t get better → need automation

<table>
<thead>
<tr>
<th>Channel</th>
<th>%</th>
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<tbody>
<tr>
<td>6</td>
<td>41.2</td>
</tr>
<tr>
<td>2</td>
<td>12.3</td>
</tr>
<tr>
<td>11</td>
<td>11.5</td>
</tr>
<tr>
<td>3</td>
<td>3.6</td>
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Diversity

- Deployment styles
  - Home networks
  - Airport networks
  - Campus network
  - Infrastructure/municipal network

- Device types
  - Laptops, PDAs, sensors, audio/video equipment, appliances

- Must accommodate different optimization goals
  - Power, performance, coverage, capacity
Opportunities & Challenges

- Types of solutions
  - Modify only wireless network equipment
  - Benefit from using the Internet
  - Make key changes to the Internet

- Ubiquitous high-speed Internet access
  - Challenge: overcoming existing acceptable use policies
  - May need Internet standards for billing, accounting, routing and discovery (of access links)

- Location support
  - Place Lab shows that localization within 20 feet is possible today
    - Will improve in the future
  - May need Internet standards for location information, service discovery
Opportunities & Challenges

- Spectrum is scarce → will get worse
  - Improve spectrum utilization (currently 10%)
  - Can the Internet help manage spectrum better?

- Incentives/policing
  - Spectrum management → dynamic re-use of spectrum → fair allocation
    - Different optimization goals → difficult to reason about behavior
    - Need to monitor spectrum to ensure fair-play
  - Can the Internet help in policing spectrum?

- Non-IP devices will play a significant role
  - What can the Internet do for them?