Using License Exempt Spectrum for Wireless Broadband

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Note: The views expressed in this presentation are those of the author and may not necessarily represent the views of the Federal Communications Commission
Unlicensed Devices: Part 15

- Part 15 provides for operation of low power radio transmitters without a license

Operating conditions:
- May not cause harmful interference
- Must accept any interference received

Part 15 minimizes likelihood of interference by:
- Permit operation in non-restricted frequency bands
- Limiting power to very low levels
- Requiring equipment approval to ensure compliance
Technical Requirements

- Almost any spectrum can be used except certain restricted frequency bands (Ref. Section 15.205)

- On most frequencies, operation is limited to < 100 mW; duty cycle applies in some cases

- Three (ISM) bands allow 1 W transmitter power:
  - 902-928 MHz
  - 2400-2483 MHz
  - 5725 – 5875 MHz
  - Power reduction for antenna gain > 6 dB
More Spectrum Made Available for Unlicensed Operation

- FCC has recently made available an additional 255 MHz of spectrum for anticipated Wi-Fi growth

- Provides A Total of 555 MHz of Spectrum for unlicensed operations

<table>
<thead>
<tr>
<th>Link Indoor Devices</th>
<th>Link Devices to Nodes</th>
<th>Link Nodes (Campus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mW</td>
<td>250 mW</td>
<td>250 mW</td>
</tr>
<tr>
<td>Existing</td>
<td>Existing</td>
<td>New</td>
</tr>
</tbody>
</table>

Frequency (MHz)

5150 5250 5350 5470 5725 5825
Equipment Authorization Required

- Equipment must be authorized by FCC or telecommunications certification body.
- Equipment may not be imported or marketed until certificated.
- Check label for FCC ID.
- Grants of certification available on FCC web site.

See
http://www.fcc.gov/oet/ea/

FCC Id: XXXYYYY
IEEE Committee 802.11 developed a family of standards for unlicensed wireless data networks within the framework of the Part 15 rules.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Frequency Band</th>
<th>Modulation</th>
<th>Data Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.11(b)</td>
<td>2.4 GHz</td>
<td>DSS</td>
<td>11 Mb/s</td>
</tr>
<tr>
<td>802.11(g)</td>
<td>2.4 GHz</td>
<td>OFDM</td>
<td>54 Mb/s</td>
</tr>
<tr>
<td>802.11(a)</td>
<td>5.8 GHz</td>
<td>OFDM</td>
<td>54 MB/s</td>
</tr>
</tbody>
</table>
Wi-Fi: MiMo Technology

MIMO: Multiple Input Multiple Output
- New generation of consumer products
- Based on IEEE 802.11 standard
- Allows greater range and data throughput
Wi-Fi Applications

Home & Business networking

“Hot Spots” at coffee shops, hotels, airports, etc.

Metropolitan & Community Networks – WISPs
Basic Network Architecture

- High Gain Antenna
- Fixed Radio Transceiver
- Internet Connection
- Licensed: Wi-Max or other technology
- Unlicensed: Wi-Fi; Canopy or other technology

20 – 40 Miles

- Fixed Radio Transceiver
- High Gain Antenna

100 meters per LAN
Or integrated to network
Wi-Fi Mesh Networks

Mesh networks use each transmitter/receiver as a relay point to provide wide service areas. They are self-forming and provide numerous communication paths—same principle as the Internet.
Mesh Network Coverage

Conventional Network

Mesh Network

Adequate Signal

Inadequate Signal at Remote Locations

Signals are relayed to remote locations

Adequate Signal
Example of a Mesh Network

- City of Chaska, Minnesota
- 2000 Wi-Fi subscribers over an area of 16 square miles
- Provided by routers mounted on lampposts - 15 minute install time
- Consumer data speeds of to 1.2 MB/s
- See [www.Chaska.net](http://www.Chaska.net)
WISP Resources

- Search: Wireless Internet Service Providers
- WISPA.Org – Includes information on how to establish a WISP
- Part-15.org
- Vendor web sites
Integrating Licensed & Unlicensed

WiMAX technology can operate in licensed or unlicensed spectrum:

- Directly to Indoor Modem
- Business Access & Backhaul
- Portable Devices
- Hotspot Backhaul
- Wi-Fi

802.11

W-Fi
Conclusion

Thank you!

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