Antenna Selection for Wi-Fi Deployments

Topics:
- Antenna functionality
- Antenna specifications
- Antenna types
- Internal vs. external
- Coverage patterns
- Bridge links
Understanding Antennas

Antennas both radiate and receive electromagnetic waves. They radiate the waves as the electromagnetic signal escapes from the antenna. They receive waves as the energy is captured by the antenna.

Electromagnetic Waves

Antennas radiate electromagnetic waves into the air
Active vs. Passive Gain

Passive gain uses no extra amplification and relies fully on the directionality of the antenna for increased RF energy in a desired direction.

Active gain uses an RF amplifier to increase the signal strength. The amplifier is placed in path between the AP and antenna or between the radio and antenna.
SISO vs. MIMO

Single Input/Single Output

Multiple Input/Multiple Output
Gain compared to an isotropic radiator (dBi)

-50 dB point

-48 dB point

-50 dB point

2 dBi Antenna

Isotropic Radiator

Gain compared to an isotropic radiator (dBi)
## Antenna Specifications

<table>
<thead>
<tr>
<th>Antenna type</th>
<th>Dipole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating frequency range</td>
<td>2402-2495 MHz</td>
</tr>
<tr>
<td>Nominal input impedance</td>
<td>50 Ohms</td>
</tr>
<tr>
<td>2:1 VSWR bandwidth</td>
<td>2385 - 2515 Mhz</td>
</tr>
<tr>
<td>Peak gain</td>
<td>2 dBi</td>
</tr>
<tr>
<td>Polarization</td>
<td>Linear, vertical</td>
</tr>
<tr>
<td>E-Plane 3-dB beamwidth</td>
<td>70 degrees</td>
</tr>
<tr>
<td>H-Plane 3-dB beamwidth</td>
<td>Omnidirectional</td>
</tr>
<tr>
<td>Dimensions</td>
<td>5.5 in. (13 cm)</td>
</tr>
<tr>
<td>Weight</td>
<td>1 oz.</td>
</tr>
<tr>
<td>Connector type</td>
<td>RP-TNC plug</td>
</tr>
<tr>
<td>Environment</td>
<td>Indoor</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>32°F to 140°F (0°C to 60°C)</td>
</tr>
</tbody>
</table>

### Key Specifications
- Frequency
- Resistance (Ohms)
- Gain
- Connector type
- Beamwidth
RF Radiation Patterns

Patch Antenna

Omni Antenna

Internal AP Antenna
Antenna Charts

Elevation (Vertical)  Azimuth (Horizontal)
Elevation and Azimuth Charts Illustrated

Elevation (Vertical)  Azimuth (Horizontal)
Antenna Types

- Omnidirectional
- Patch
  Semi-Directional
- Dish
  Highly Directional
Internal vs. External Antennas

Internal antennas work well for common office space deployments.

External antennas work well for coverage of large areas or when directionality is needed.
Environmental Impact on Radiation Patterns

Materials and objects in the environment will change the radiation pattern in actual space from that specified for the antenna.
WLAN Coverage

Coverage factors:
- Radiation patterns
- Output power
- RF behaviors
Outdoor Coverage

Semi-directional antennas are used in this case to radiate out from the building.
Bridge Links

Factors:
- Link Budget
- Required Data Rate
- Link Quality

Free Space Path Loss

Line of Sight Clearance