

## How to Select the Correct Wi-Fi Antenna When Designing High-Density Networks

### What is a High-Density network?

High-Density networks convert traditional coverage-oriented Wi-Fi to capacity-oriented Wi-Fi that will meet the demands of high densities of Wi-Fi users, such as those found in universities and corporate campuses, stadiums, trade shows and convention centers.

### Why is the traditional Wi-Fi network inadequate for high densities of Wi-Fi users?

Today's Wi-Fi network is considerably more powerful and robust than anything large venue IT network owners could have even dreamed of a decade ago. Additionally, network performance demands continue to increase as mobile devices are becoming more and more prevalent, and the applications they are using require more and more bandwidth. What's even more challenging about the BYOD phenomenon for IT network designers is that users now have on average two or even three devices that they expect high quality internet connectivity to anywhere they happen to be. In addition, the applications their devices are running vary wildly in bandwidth demand and many, like video, require enough bandwidth to transmit huge files. As a result, conventional networks can be overwhelmed when large concentrations of users attempt to access the network simultaneously. When the number of user devices and their application throughput requirements exceed the available capacity of the traditional Wi-Fi network, the High Density network is the solution. Increasingly, High-Density networks are becoming the "reality check" of the present for IT network owners.

### What are the differences between conventional Wi-Fi networks and High-Density networks?

The focus for conventional Wi-Fi networks has been to provide adequate coverage in all areas where the network has been implemented. High-Density networks ensure adequate capacity (higher data rates) by "mapping" clients into smaller radio frequency (RF) cells of operation. These narrower cells are created by using narrow-band antennas connected to the AP that minimize channel-to channel interference, which is the most significant cause of limited performance in a Wi-Fi network. This translates to fewer users per AP than on the traditionally designed network which, in turn, maximizes the use of available spectral capacity.

### What factors must be considered when designing a High Density network?

Critical design variables that must be considered in High-Density network design include total coverage area, channel utilization, frequency of reuse, interference, signal strength, spectral capacity and regulatory requirements.

Designing the High-Density network begins with a comprehensive analysis of existing client infrastructure capabilities, the number of users/clients, the number of Wi-Fi enabled devices per user, the user application requirements, the physical facility characteristics, and a careful determination of the appropriate number and placement of access points. After the AP is selected, a site survey, or plan, is designed which determines how many, as well as where, the APs and High-Density antennas will be installed throughout the area. Finally, testing is performed and adjustments are made to refine the design for the highest capacity with the least amount of interference.

Using the example of a college campus environment, the number of clients and client devices that will be supported in the location (classroom) must be determined. Client device capabilities and application throughput requirements are then used to determine overall capacity necessary for deployment. Typical application throughput requirements for campus environments include conducting research on the internet, accessing email and viewing shared online classroom resources. Once the AP is selected, a site survey, or plan, is designed

which determines how, how many, as well as where, the APs and their HD antennas will be located and installed throughout the classroom.

### What are the High-Density antennas used in High-Density network design?

To design High Density networks, narrow beamwidth directional antennas are an absolute necessity. Higher data rates are inversely proportional to greater coverage. That is, the greater the data rate, the smaller the coverage area. Generally, speaking the narrower the beamwidth of the antenna, the better it is for the HD network. The specifications of the HD antenna are integral to the HD network performance.

Two key specifications that define High-Density antennas are beamwidth and gain. Beamwidth is measured at two frequency ranges for Wi-Fi (2.5 and 5 GHz) and two directions (horizontal and vertical). To choose the beamwidth needed, a network designer needs to calculate the required capacity per client device in a given area while taking into account co-channel interference.

The other key specification of High Density Antennas is gain. Traditional antenna gain ranges from 2 to 6 dBi. High Density antenna gain begins at 4 dBi, and can increase to 14 dBi or higher. Lower gain antennas are used to minimize floor-to-floor interference in venues such as classroom buildings. Higher gain antennas are beneficial in large venue deployments where the distance the RF signal must propagate from the antenna to the users is much greater, such as large outdoor public events and stadiums or indoor venues such as concert halls or train stations.

Wi-Fi Network Design	Traditional Networks	High Density Networks
Vertical Beamwidth	55° - 120°	18° - 60°
Horizontal Beamwidth	100° - 360°	35° - 100°
Gain (dBi)	2 - 6	4 - 14+

Ventev, the leading manufacturer of high-density products and solutions, offers a suite of TerraWave High Density antennas designed to specifically address the entire range of HD deployments from stadiums, convention centers and campuses, to city centers, corporate centers and manufacturing facilities. These external antennas utilize narrow beam patterns to focus RF into small cells that enable stronger, more reliable Wi-Fi signals, reduce channel-to-channel interference, and increase capacity. A variety of mounting options including ceiling, wall, mast/pole, and under-the-seat ensure the highest possible network performance and user experience, which are hallmarks of a good High Density network design.

TerraWave High-Density Antennas and Mounts are designed to be used with access points from a variety of industry-leading manufacturers, including Aruba, Cisco, Juniper, Meru, Motorola, and more.

**Resources and References**

[http://www.cisco.com/c/en/us/products/collateral/wireless/aironet-1250-series/design\\_guide\\_c07-693245.html#wp9001157](http://www.cisco.com/c/en/us/products/collateral/wireless/aironet-1250-series/design_guide_c07-693245.html#wp9001157)

<http://www.ruckuswireless.com/carriers/high-density>

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