Understanding Wireless Performance and Coverage

Wireless networking is a broad topic with a lot of considerations, which can make a wireless network difficult to understand and optimize. This article covers a number of core concepts of wireless networking, especially as they apply to the Meraki MR product line.

Signal Propagation

Cisco Meraki wireless propagation varies based on the model. Factors like number of radios, frequencies used, and antenna type can change the signal (dBi). The signal is measured in dBi, decibels relative to isotropic. Isotropic radiation is a fictional perfect 360 degree Omni-directional signal that wireless technologies are compared to for measuring dBi. Cisco Meraki Indoor Access Points use di-pole antennas that have a “doughnut shaped” signal propagation where most of the signal is focused on the horizontal plane outward facing. Access point placement is important for maximizing the signal strength of wireless clients see this article for range information. The signal propagation below is related to the horizontal (azimuth) and vertical (elevation) planes of the signal during testing. The azimuth is related to the horizontal plane measuring the entire x-y around the access points and the elevation plane measures the y-z plane which is orthogonal to the x-y plane.

MR24 Signal Propagation:

![Signal Coverage Patterns](image)

Cisco Meraki Outdoor Access Points use externally connected antennas, which are directional or di-poles. Directional antennas focus the signal in a concentrated plane making it ideal for point-to-point implementations.

External 11dBi Antenna:
External 14dBi Antenna:

External 802.11n Omni:

**Signal Coverage Pattern**

Wireless radio waves are affected by “Path Loss,” or absorption, reflection, diffraction, and multipath. Absorption occurs when the radio waves cannot penetrate a specific material. Diffraction loss is caused by the signal passing through a material, but the signal is adversely affected. Reflection is caused by the signal bouncing off materials such as glass, whiteboards, and plastic. This is related to multipath.
Below is a depiction of multipath. Each color is the same signal being sent out different paths. Some signals are diffracted (dashed line), others are absorbed, and others reach the client device. Depending on the number of radios that the client device has, handling all of these transmissions simultaneously can cause decreased performance.

Maximizing Throughput

If possible it is ideal to have all MR access points functioning in Gateway mode, where the access points are connected to the wired LAN. When using the access point in Repeater mode the throughput is reduced by 50% for every hop that the data has to take to get to a Gateway causing reduced speeds and increased potential for dropped packets. The difference between a Gateway and Repeater can be seen in this article.

Channel Utilization

Channel Utilization will vary based on the environment of the access points. Factors that affect the utilization are:

- Other wireless networks.
- Users associated on that channel.
- Radio frequency being used.
- Overlapping vs. non-overlapping channels.

For example if the environment is a shared office building with multiple floors, it is likely other wireless networks exist nearby. Depending on what frequency and channel their access points are using it could interfere with your production network.

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**Additional Resources**

For more information about wireless and the MR platform, please refer to the following additional resources:

- [Channel Planning Best Practices](#)
- [MR Family Datasheet](#)
- [Troubleshooting a Faulty AP](#)