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Analysis of high gain dual loop antenna for Wi-Fi connectivity

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ABSTRACT

The technology has been extended to use the multiple antennas at both transmitter and receiver such as system is called Multiple input multiple output (MIMO). The antenna will enhance signal quality of the radio-based system and increase frequency reuse. A compact dipole antenna with parabolic reflector antenna with enhanced setup is presented in this paper. The proposed antenna has dipole with parabolic reflector the coverage area of the access point is improved upto 300 – 350 feet indoor and 450 feet in outdoor. The signal strength is also improved, so the number of users is five times more than existing system and the gain is about -72dbm at 300feet. In addition, this antenna has parabolic reflector which provide good radiation pattern and gain. The antenna is fabricated for demonstration and testing and the results were obtained.

K EYWORD: Omnidirectional, dipole antenna, Multiple input multiple output, parabolic reflector, radiation pattern

I. Introduction

Wireless networks uses smart antennas to achieve higher network capacity. It provides better range or coverage by focusing the energy in a particular direction. Good quality and powerful Wi-Fi signal amplifiers can increase the signal strength threefold. Bidirectional Wi-Fi signal boosters increase the strength of transmitted, as well as received signals. Thus the Wi-Fi booster antenna is used in improving the signal strength by considering the above mentioned points. It is basically effective in locations where there is coverage problem in case of mobile or when the signal strength becomes less as the distance increases.

II. Dipole Antenna

Dipole antenna with two quarter wavelength has become more popular in different application. It increases the coverage area of the wireless access points with increased gain and throughput. However, dipole antenna combined with parabolic reflector is fabricated for testing. Dipole antenna has side length of 30 mm and beam width about 70 degrees, gain about 10-12 dBi. Polarization of the antenna is 90 degrees from the horizontal position of orientation. The geometry of the antenna is shown in the fig.1. The dipole antenna with ¼ wavelengths is made from 2mm thick copper wire bent into appropriate shape. The dimension of the antenna is 123 * 76.8 mm.

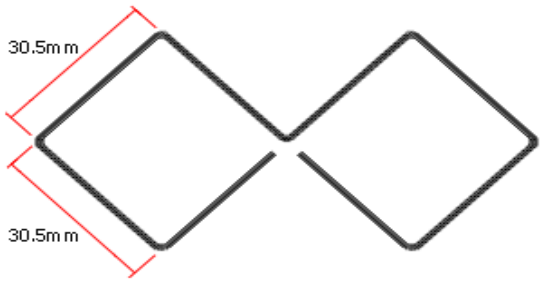

Fig 1: Dipole antenna

III. Simulation Analysis and measurements of Dipole antenna

The radiation pattern of the dipole Antenna was first simulated on the program 4NEC2X. The radiation pattern expands out omnidirectionally.

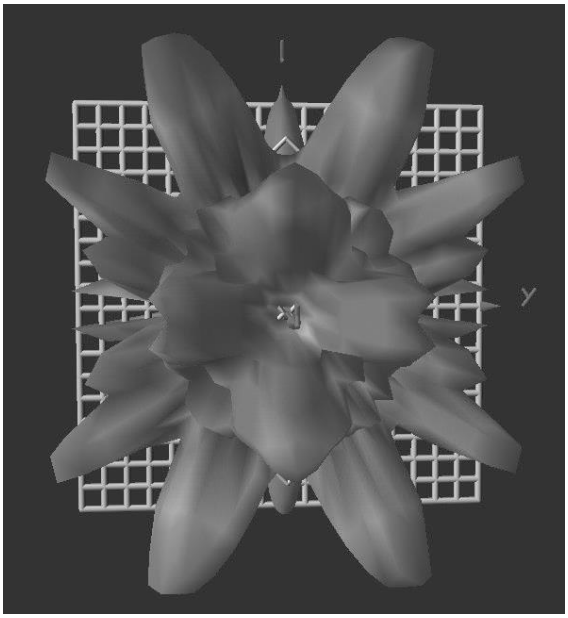

Fig 2. Simulation of dipole antenna

The figure 3 below is the measured azimuth radiation pattern of the dipole antenna showing the basic directionality of it.

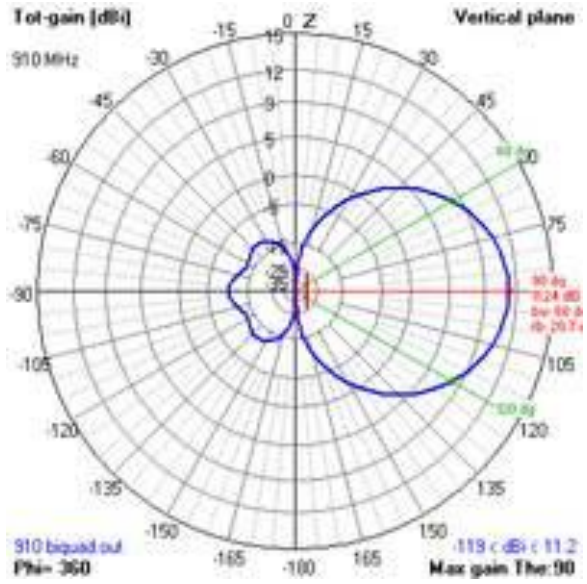

Figure 3: Radiation Pattern of dipole antenna

IV. PARABOLIC REFLECTOR

Parabolic reflectors are used as a feeder in this experiment. It collects energy and brings it to the focal length. It converts spherical wave fronts into planar waves which reduces scattering and increases the signal strength. It has signal strength of 48% and speed up to 54Mbps. Bidirectional WI- FI can be used to increase signal strength in both transmitter and receiver end. They boost signal strength as much 600%. This is more effective in locations were signal strength become decreases when distance increases. The precision to which a parabolic dish must be made to focus energy about $\frac{1}{20}$ of a wavelength. The wavelength range of visible light is between about 400 and 700 nanometers (nm), so in order to focus all visible light well, a reflector must be correct to within about 20 nm.

V. RESULT AND DISCUSSION

Omni directional antenna coverage and gain is measured at different distance. Then diploe antenna is combined with parabolic reflector to obtain more coverage and gain.

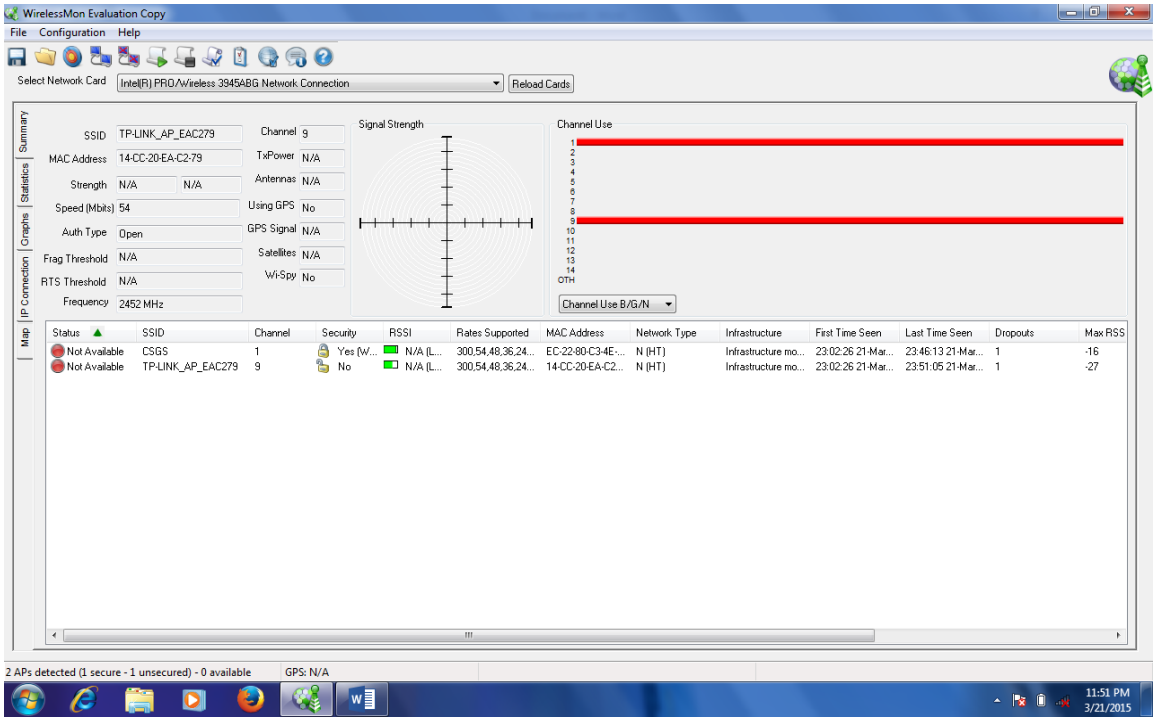

Fig 4: Omnidirectional antenna above 100 feet

The fig 4. shows that network signal is not available for omnidirectional antenna above the distance of 100 feet. This show that the coverage area of omni directional antenna is very less.

The fig 5 shows when omnidirectional antenna is replaced dipole antenna the network signal is available at the distance of 300feet. And the gain is about -72dbm at 300feet.

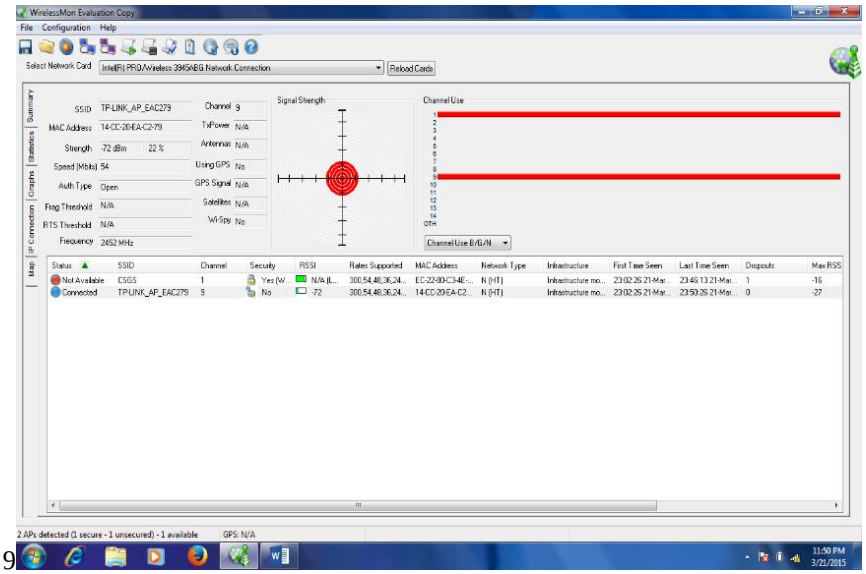

Fig 5: Result of dipole antenna at 300 feet

The fig 6 shows when the dipole antenna is combined with the parabolic reflector the coverage is above 300feet with increased signal gain. This increase in coverage and signal gain because the dipole antenna's wider beamwidth and parabolic reflector's highly directivity.

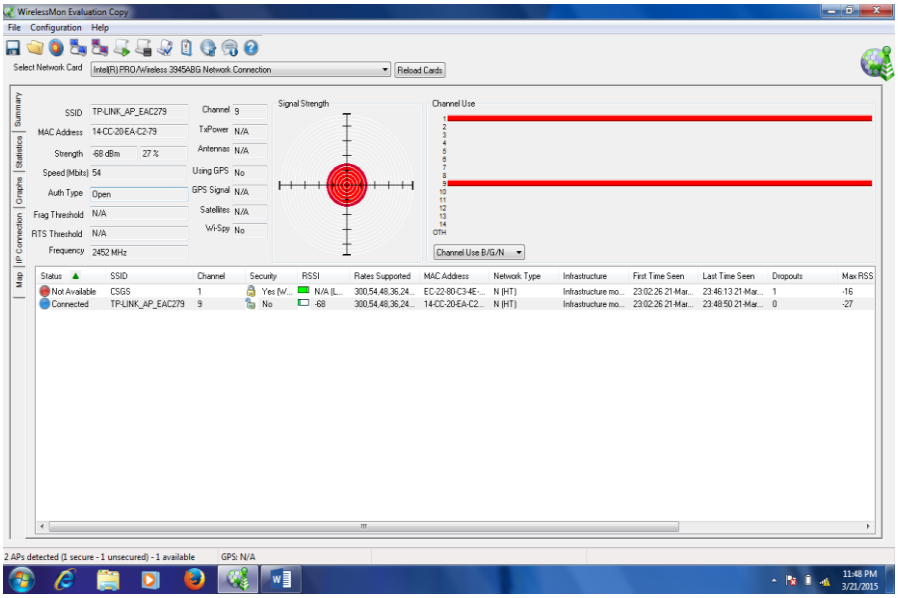

Fig 6: Result of Dipole antenna with parabolic reflector at 300 feet

The tabular column shows the comparison of the wireless network signal availability and gain of the three different methodology at different distance from the access point. From the tabular column it is clearly explain that Omni directional antenna has coverage only below 100 feet. Whereas dipole antenna provide coverage around 300 feet with high gain. Combining parabolic reflector boot the signal strength and increasing the gain.

Table 1: Comparison of existing system and proposed systems

COVERAGE AREA (in feet)	**OMNI DIRECTIONAL ANTENNA GAIN** (in dbm)	**BI-QUAD ANTENNA GAIN** (in dbm)	**BI-QUAD ANTENNA WITH PARABOLIC REFLECTOR GAIN** (in dbm)
0	-43	-21	-18
25	-67	-45	-37
50	-79	-52	-47
75	-80	-57	-51
100	-84	-60	-54
125	N/A	-61	-56
150	N/A	-63	-58
200	N/A	65	-60
250	N/A	-69	-64
300	N/A	-72	-68

VI. Conclusion

Antenna signal strength reduces with the increase in distance between the antenna and the Wi-Fi access point. It includes designing of manually build booster antenna by following the above-mentioned steps and testing the performance in the real environment where the signal strength is low.

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