

Performance Effective Design of Bi-Quad Antenna with Parabolic Reflector over Traditional Omni Directional Antenna with Wireless Fidelity (Wi-Fi)

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ABSTRACT: LAN has been changed very drastically in today's technological world. In present scenario Wireless (WLAN) offers tangible & excellent benefits over traditional wired networking. WI-FI (Wireless Fidelity) is a generic term that refers to the IEEE 802.11x standard which uses radio waves to provide wireless high speed internet. The WI-FI modes are Ad hoc, Infrastructure and Extended modes. Ad hoc does not use any access points because it is point to point communication. The other two modes uses access point as interface between wireless clients. Single access point can support up to 30 users that is range of 100-150 feet indoors and 300 feet outdoors. The coverage area depends on location where Access Point is being placed. The Access point has traditional Omni directional antenna. The main aim of this project is to increase the coverage area of Access point by replacing Omni directional antenna by Bi-Quad antenna with parabolic reflector. Bi-quad antenna operating frequency is 2.4GHz. It's designed since 2.4GHz comes under the unlicensed wireless band usually used in WLAN.

Keywords - Access points, Bi-Quad Antenna, parabolic reflectors, Radiation Pattern, WI-FI Technology.

1. INTRODUCTION

Wireless Technology is one of the main areas of research in the world of communication systems today and a study of communication systems is incomplete without an understanding of the operation and fabrication of antennas. Wireless Communication has been done through air medium by electromagnetic (radio) signals. The WI-FI made possible wireless communication to communicate in Wireless Local Area Network (WLAN). WI-FI Technology provides

wireless internet access through transmission of electromagnetic carrier waves. While increasing the distance from source signals get weakened. But in wired networks, increasing distance can be matched by

increasing cable length, but in wireless communication this is not possible. The signal strength will be reduced as distance of source increases from WI-FI. Signal strength will be lesser as we go far from center of the access point and connectivity become difficult. But it is difficult to optimize WI-FI within limited range, so one can use WI-FI in their predefined range. To overcome this situation, an alternate solution is to use a WI-FI signal booster. Signal booster boosts the signal and increase the reach of weak signal. It enlarges the bandwidth of reach around the WI-FI router. Hence the signal strength increased in WI-FI range using WI-FI Signal booster.

2. WI-FI

Wi-Fi is a technology for WLAN based on the IEEE 802.11 (a,b,g) specifications. Wireless fidelity is a popular technology that exchanges data's through wireless networks with access point. An access point is similar to a network HUB transmitting data's between connected wireless devices and a connected wired device, like an Ethernet hub or switch. The distance covered by one or more inter-connected access point (hotspots) can extend from an area of few meters to as large as many kilometers. Coverage in the larger area may require a group of access points with overlapping coverage. An access point (AP) broadcasts its SSID (Service Set Identifier, "Network name") through packets broadcasted every 100 ms at 1 Mbit/s.

2.1 WI-FI ACCESS POINT AND SIGNAL BOOSTER

The wireless network is formed by connecting all wireless clients to the access point (AP). Access points are important for providing heightened wireless security and for extending the physical range of service a wireless user can access by using WEP and WAP. The range of the WI-FI can be increased by repositioning the router or access point (AP) to avoid obstructions and radio interference. The range can also be increased

by adding another access point (or router). Ad hoc does not use any intermediary device such as Access Point. Infra Structure and Extended modes use Access Point as interface between wireless clients. WI-FI signal boosters are WI-FI amplifiers that are attached to access point or routers.

This booster boosts the signal strength to 600%. The need for reliability, uninterrupted and seamless communication is one of the top priorities of every house. Repeaters should be used for better performance and high resolution. Repeaters are the networking devices that help to repeat the signal or increase the reach of existing wireless network; this can be used in remote place where signal strength is too low and unreachable.

2.2 DEMERITS OF EXISTING SYSTEM

In the existing system, Omni-directional antennas can be used in access point to access internet. Omni directional antenna can be accessible in all directions of 3600. It is also called the "non-directional" antenna because it does not favor any particular direction. Omni directional antenna provides access range up to 100-300 feet indoor and 500 feet outdoor. Antennas are electrical conductors that radiate electromagnetic energy into space. By using Omni directional antenna coverage area become smaller as it can be accessible in all directions. The output of Omni directional antenna for above 100m range is given in the following figure.

2.3 PROPOSED BI-QUAD ANTENNA DESIGN

Bi-quad antenna is simple to design and offers high directivity and gain for point to communication. Bi-quad antenna consists of two quads of same $\lambda/4$ wavelength with metallic plate or grid used as reflector. It has beam width of 700 and gain in order of 10-12dBi. The Bi-Quad antenna that we made is a combination of two one wavelength square loop antennas. This antenna can be suppressed towards co-channel interference sources improving the SIR of the received signals this improves frequency reuse, distance and capacity.

The Bi-quad antenna was constructed using the following materials:

- Copper Wire with a thickness of 1.5mm
- Coaxial cable with an impedance of 50 Ohms
- A Reflector in 140 mm in diameter
- N-type connector

Feeding antenna by 30mm of the outer sheath from the end of the coaxial cable.

After designing the Bi-quad antenna the signal strength can be increased and coverage area increases up to 300-500m. The output for Bi-quad antenna in software for 300m is given in following figure. This output is obtained from software tool named wireless monitoring tool. The radiation pattern is based on its half wavelength dipoles, quad loops, the driven or feed system and a number of other antennas.

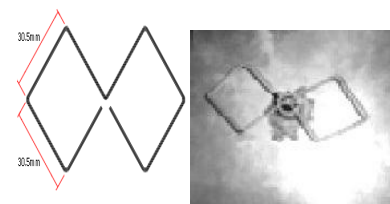


Fig.1 Design of Quad Loops

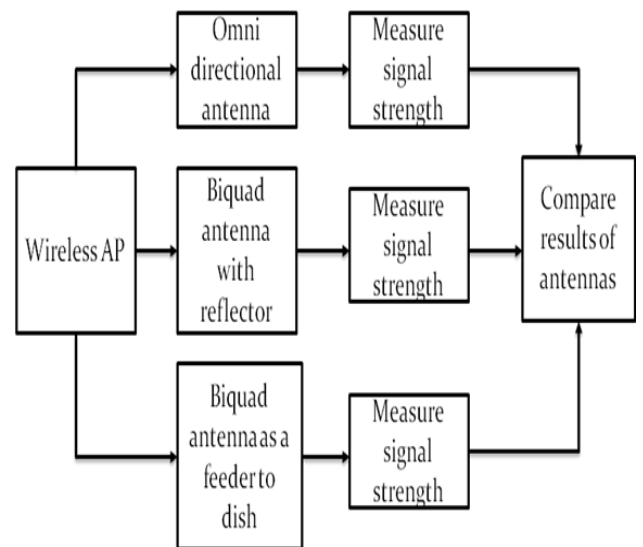


Fig.2 Design of Bi-Quad Antenna with Access points

3. DESIGN & IMPLEMENTATION OF BIQUAD ANTENNA

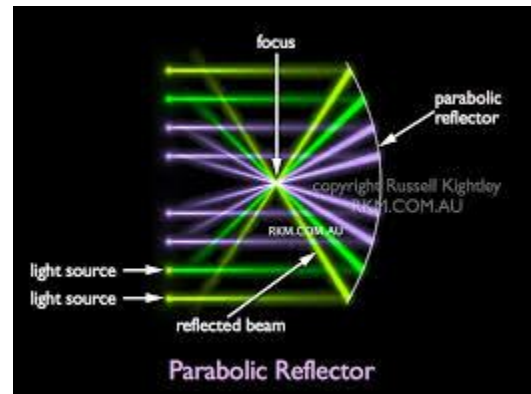
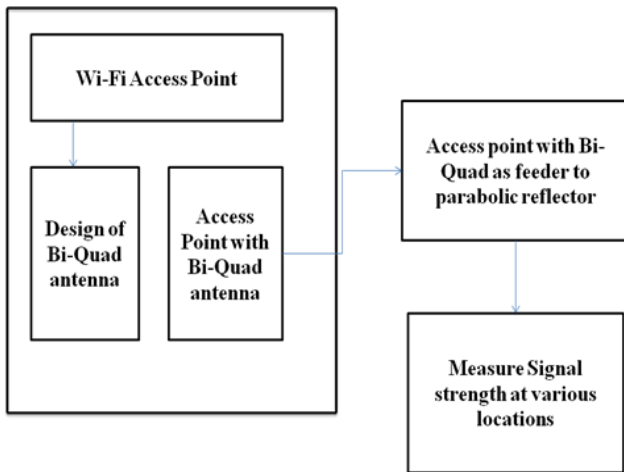


Fig: 3 Schematic Block diagram of Bi-Quad Antenna.

CALCULATION OF BI-QUAD ANTENNA WAVELENGTH

- To determine the Bi-Quad antenna wavelength :
 Assume Frequency, $F=2.450\text{GHz}$
 Velocity of light, $c=3.8 \times 10^8 \text{ ms}^{-1}$
 Wavelength, $\lambda=c/f$
 $=3.8 \times 10^8 / 2.450 \times 10^9$
 $\lambda=122\text{mm}$.
 Total wavelength of the Bi-quad antenna is
 $2 \lambda=244 \text{ mm}$

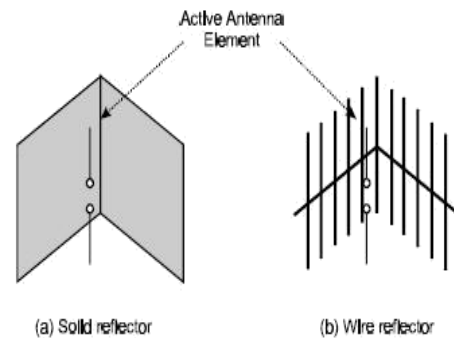


Fig.4 Various Types of Reflectors.

Table: 1 Design calculation of Antenna Parameters

4. PARABOLIC REFLECTOR

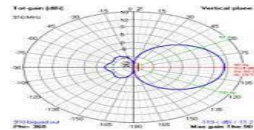
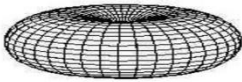
Parabolic reflectors are used as a feeder in this experiment. It collects energy and brings it to the focal length. It converts spherical wave fronts into planar waves which reduces scattering and increases the signal strength. It has signal strength of 48% and speed up to 54Mbps. Bidirectional WI-FI 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 where signal strength becomes weaker when distance increases.

5. FEATURES AND BENEFITS

FEATURES	BENEFITS
Signal gain-inputs	Better range/coverage-focusing the energy sent
Interference rejection	Increased capacity-precise control of signal quality
Spatial diversity-composite information	Multi path rejection-can reduce the effective delay spread of the channel
Power efficiency-combines the input to multipleElement	Reduced expense-lower amplifier costs, power consumption and higher reliability

6. EXPERIMENTAL RESULTS OF OMNI DIRECTIONAL AND BIQUAD ANTENNA

OMNI DIRECTIONAL ANTENNA	BI-QUAD ANTENNA
It can access to a range of distance about 100m	It can access to a range of distance about 300m
The coverage area is 360°	The coverage area is 120°
They are omni directional antennas	They are directional antennas
Radiation is spherical	Radiation is perpendicular to the quad plane
The gain is about -84dBm.	The gain is about -67dBm



7. EXPERIMENTAL RESULTS OF BIQUAD PARABOLIC ANTENNA

After implementing the bi-quad antenna as a feeder cable to parabolic reflector the signal strength can increase further and gain will be more in particular direction. Thus radiation pattern diagram for improvised gain in distance in Bi-Quad antenna is given in following figure.

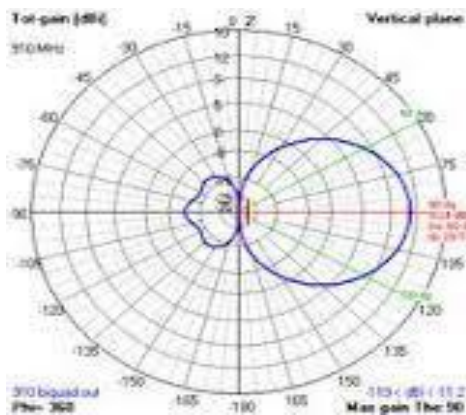


Fig 7: Simulation Result of Radiation Pattern Bi-Quad Antenna

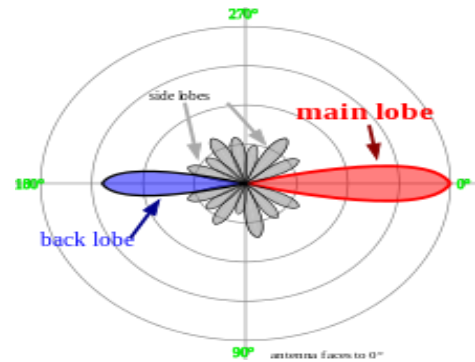


Fig 8: Simulation Result of Radiation Pattern Bi-Quad Antenna with Parabolic reflectors.

OUTPUT OF BI-QUAD ANTENNA WITH PARABOLIC REFLECTOR

DISTANCE (m)	OMNI-DIRECTIONAL ANTENNA (dBm)	BIQUAD ANTENNA (dBm)	BIQUAD WITH PARABOLIC REFLECTOR (dBm)
100	-84dbm	-52	-43
125	N/A	-64	-49
150	N/A	-73	-53
200	N/A	-73	-55
250	N/A	-73	-64
300	N/A	-73	-69

Table 2: Experimental Results & Comparison of various antennas.

8. CONCLUSION & FUTURE SCOPE

The design of Bi-quad antenna with their Wi-Fi access point is proposed. The only limitation of this project is it has directional antenna that can access only at 120 degree. It can be overcome by using three Bi-Quad antennas in a single access point. The Bi-quad antenna is probably the best overall because of its compact size, simplicity, ease of use and 12 dBi gain properties. Thus to increase the benefits and to improve gain and efficiency bi-quad antenna is used in proposed system with parabolic reflector. It helps to increase the signal strength and boost the energy signals of WI-FI. This improves the performance of WI-FI range in real

environment where signal strength is low.

In near Future designing of special signal boosters such as parabolic antenna booster and testing their performance in real environment, the signal strength can be increased with their distances.

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