Bi-Quad antenna with Parabolic Reflector for enhancing the coverage area of a Wi-Fi Access Point.

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***Abstract* - “The next decade will be the Wireless Era.” – Intel Executive Sean Maloney. Today’s network especially LAN has drastically changed. People expect that they should not be bound to the network. In this scenario, Wireless (WLAN) offers tangible benefits over traditional wired networking. Wi-Fi (Wireless Fidelity) is a generic term that refers to the IEEE 802.11 communications standard for Wireless Local Area Networks (WLANs). The wireless network is formed by connecting all the wireless clients to the Access Point (AP). Single access point can support up to 30 users and can function within a range of 100 – 150 feet indoors and up to 300 feet outdoors. The AP has the traditional Omni directional antenna. The coverage area depends upon the location where the AP is being placed. Omni directional antenna can operate over narrow bandwidth and requires tuning and phasing. Therefore by using Bi-quad antenna with parabolic reflector we can increase the coverage area of the access point. Thus the aim of this project is to increase the coverage area of an AP by replacing the traditional Omni directional antenna with Bi-quad antenna with parabolic reflector.**

Keywords: Access point (AP); Industrial, Scientific, and Medical (ISM) band; multiple-input–multiple-output (MIMO); wireless fidelity (Wi-Fi); Wireless local area network (WLAN); Bi-quad and Omni-directional antenna.

I.INTRODUCTION

Wireless fidelity (Wi-Fi) has become the *de facto* standard for wireless local area network (WLAN) communications in the 2.4 and 5-GHz industrial, scientific, and medical(ISM) bands, with the respective frequency ranges from 2.4 to 2.485 GHz as well as 5.150 – 5.350 GHz, 5.470–5.725 GHz, and 5.725–5.850 GHz. The channel bandwidth within each band varies from 5 to 20 MHz WI-Fi provides wireless network communications between computers and other portable devices by fixed access points over a short distance, typically in the order of tens of meters through WLANs. In a typical WLAN network, A Wi-Fi connection is built up through the wireless stations including fixed access points (APs) and mobile or fixed devices such as laptops, personal digital assistants, IP phones, or desktops. WLAN communication can be peer-to-peer, bridge, or wireless distribution.

As Wi-Fi continues to compliment the third-generation (3G) cellular and long-term evolution (LTE) broadband internet access, the IEEE 802.11 a/b/g/n standards have been evolved to support frequency, polarization, and spatial diversity to meet the demand for higher throughput with greater coverage. This has spurred the innovation for low-cost multiband, multi polarization and multiple input–multiple-output (MIMO) antenna technologies [1].Session II Depicts the antenna Access point, session III Explains Wi – Fi Booster Antenna, IV About Conventional Antenna Technology and VII Procedure for Antenna Testing.

II. ANTENNA ACCESS POINT

Generally, the antenna for Wi-Fi access point requires an omnidirectional radiation in order to cover a large service area with compact, low profile, and low cost configuration. Furthermore, dual- or multiband antennas are preferred to cover the 2.4- and 5-GHz WLAN bands. A variety of omnidirectional antennas have been reported for WLAN access point applications. These antennas include printed dipole antenna array printed monopole antenna, collinear patch antenna and printed folded-dipole antenna. [1] It has been reported that using horizontally polarized antennas at the transmitter and receiver can achieve a 10-dB improvement in system gain as compared to vertically polarized antennas at both ends of the link. In contrast to the omnidirectional antennas, directional antennas are also utilized for indoor access point, where the antenna is mounted against a ceiling or wall. Some of the reported antennas include the pin-patch antenna and cavity backed slot antenna.

Currently, many 802.11n products have adopted the MIMO technology, where multiple transmit and/or receive antennas are used to increase data throughput without any additional spectrum, and use the multipath propagation to improve signal quality and reliability.

III. Wi – Fi BOOSTER ANTENNA

A wireless local area network (WLAN) is a network of computers linked without any wires and connected by transmission of electromagnetic (radio) signals. Wi-Fi is the technology that has made it possible. Wi-Fi technology provides wireless internet access through the transmission of radio frequency carrier waves. However, electromagnetic signals weaken with increasing distance from the source. In wired networks, one can simply access far away points by bringing in longer connecting cables, but in wireless networks that is not possible. The signal strength reduces as we go away from Wi-Fi transmission. Imagine a sphere around a Wi-Fi transmission router. As we go away from centre of the sphere, signal strength goes down and connectivity becomes difficult. With Wi-Fi internet access facility installed in a house, the range of Internet accessibility is compromised by the walls and the interiors of the house. It is difficult to find an optimum position for a Wi-Fi antenna with a limited range, so that one can gain access easily in the whole house. To remedy this situation and overcome this limitation of reach, one alternative is to use a wireless signal booster. As the name of the device suggests, it boosts the Wi-Fi signals and increases reach of these signals. It enlarges the sphere of reach around the Wi-Fi router.

Wi-Fi signal booster antennas, also called Wi-Fi signal amplifiers are attached to routers or access points to boost the signal. 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. That is, they work both ways. They boost signal strength by as much as 600%. They can be used as laptop Wi-Fi signal boosters and extend range of Internet access far beyond your home. It provides seamless, uninterrupted and reliable communication. The Repeater is a networking device which, as the name suggests, repeats the signal or increases the reach of the existing wireless network. Very often, it happens that a device has to be connected to an existing wireless network, but it is away in a remote place in the house or a building, where the signal strength is too low or unreachable. A wireless repeater is used in such cases to boost the signal strength or simply repeat the signal so that the computer comes under the coverage area.

IV. CONVENTIONAL ANTENNA TECHNOLOGY

A. Smart Antenna Technology

Smart Antenna Technology Basically consists of Switched-beam and Adaptive Array Antennas. Switched-beam systems have several available fixed beam patterns. A decision is made as to which beam to access, at any given point in time, based upon the requirements of the system. Adaptive arrays allow the antenna to steer the beam to any direction of interest while simultaneously nulling interfering signals. Smart antenna systems are also a defining characteristic of MIMO systems, such as the IEEE 802.11n standard. Conventionally, a smart antenna is a unit of a wireless communication system and performs spatial signal processing with multiple antennas [6]. Multiple antennas can be used at either the transmitter or receiver. Recently, the technology has been extended to use the multiple antennas at both the transmitter and receiver; such a system is called a multiple-input multiple-output (MIMO) system. As extended Smart Antenna technology, MIMO supports spatial information processing. Smart antenna provides some drawbacks such as: The higher number of antenna elements making up the small base station antenna array, the higher the available gain, the larger the size and higher the price. Lower gain results in reduced size and price.

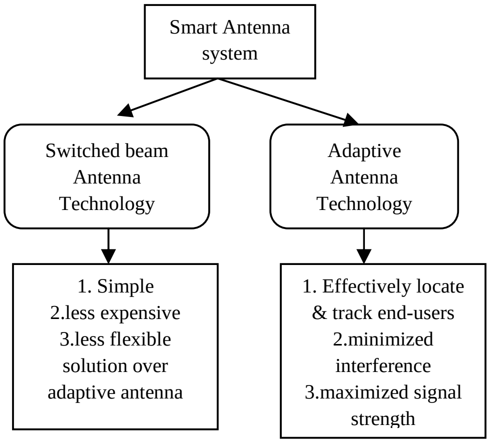

Figure 1: Antenna Comparison

B. Parabolic Antenna

A parabolic antenna is a high-gain reflector antenna used for radio, television and data communications, and also for radiolocation (radar), on the UHF and SHF parts of the electromagnetic spectrum. The relatively short wavelength of electromagnetic radiation at these frequencies allows reasonably sized reflectors to exhibit the desired highly directional response for both receiving and transmitting.

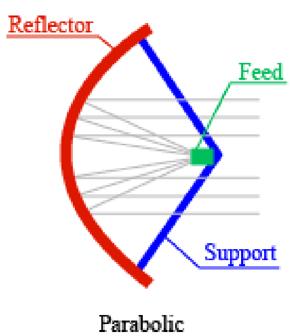

Fig 2: Parabolic Reflector

C. Biquad Antenna

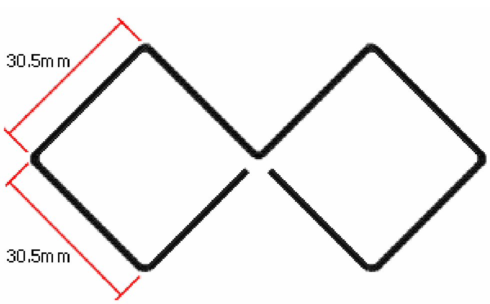

Fig 3:Proposed Antenna

The Biquad antenna is simple to build and offers good directivity and gain for Point-to-Point communications. It consists of a two squares of the same size of 1/4 wavelength as a radiating element and of a metallic plate or grid as reflector. This antenna has a beam width of about 70 degrees and a gain in the order of 10-12 db. It can be used as stand-alone antenna or as feeder for a Parabolic Dish. The polarization is such that looking at the antenna from the front, if the squares are placed side by side the polarization is vertical.

V. PROCEDURE FOR Bi - QUAD ANTENNA

The Aim is to design a Biquad Wi-Fi booster antenna and analyze the performance to improve the signal strength for long distance. To overcome drawbacks of existing technology such as :

- *The High Cost of booster Antennas available in the market.*
- *The reduced Wi-Fi signal strength for long distance.*

For this, the objective is to use homemade Wi-Fi booster antenna. Homemade antennas solve the purpose of cost, making it cost effective. It provides us with improved signal strength.

The proposed plans of work for booster antennas include:

- ➢ To Design Biquad booster antenna and then analyze its performance to increase the signal strength
- ➢ Test Biquad booster antenna by measuring the signal strength using Wireless Monitoring software.
- ➢ Test Biquad antenna by using it as a feeder to the parabolic dish and measure signal strength.

VI. FLOW OF EXECUTION

The flowchart shows the process of execution. The research work is mainly focused on the reducing the cost of the booster antenna by manual building and increasing the signal strength. Antennas basically are of the two type's omnidirectional antennas and directional antennas. The research work is basically processed by enhancing some of the features of the antennas so that it could be able to effectively increase the signal strength. These booster antennas are then tested by developing a software coding and hence the result will be analyzed.

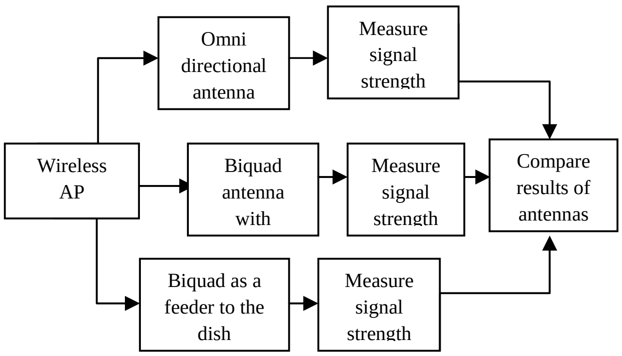

Fig 4: Flow of execution

VII. ANTENNA TESTING

The Antenna testing is basically done on a desktop. The requirements for testing are:

1. Wi-Fi access point
2. Antenna
3. LAN card
4. Wireless software for wireless connectivity

The LAN card is fitted in the CPU and then an antenna is attached to it .The wireless software installation is done for enabling the wireless connectivity. By using wireless monitoring software we can measure the strength of signal in dB which shows the accuracy in how much signal strength exactly we are getting.

VIII. CONCLUSION

Wireless networks has clear benefits (mobility, flexibility, ease of installation, low maintenance cost, and scalability) but also has some disadvantages (use demanding equipments for operating parameters such as humidity, temperature etc). Smart Antennas can be used to achieve different benefits [4]. The most important is 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. That is, they work both ways. They boost signal strength by as much as 600%. 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. Thus we conclude that, on testing the antenna the signal strength reduces with the increase in the 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. Testing of the antenna on the desktop as well as laptop. Future work also includes the manual designing of other booster antennas such as parabolic antenna booster and antenna and testing their performance in real environment. Testing comparison with antenna and manual build booster antenna. The performance of the antenna could be better tested on laptops, where the signal strength could be easily observed going high or less as the distance increases.

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