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Economic Solution to Signal Fading in WiFi Arena

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Abstract: ***Wi-Fi which is mostly pronounced wye-fye is a wireless technology brand. It is owned by the organization called Wi-Fi Alliance. They are intended to improve the interoperability based on IEEE 802.11 of wireless local area network products. Most Common applications that are assigned to Wi-Fi include Internet and VoIP phone access. Also gaming, and network connectivity for consumer electronics such as televisions, DVD players, and digital cameras is other area. Is has gained numerous applications and widespread acceptance in all areas. This paper is an effort to deploy wifi in working environment and to make it economic and having maximum signal in all areas.***

Keywords: Wi-Fi, Signal Fading, Wireless Networks, Network Optimization, Cost-Efficiency

1. Introduction

Wireless communications have become very persistent. With the advancement in the field of communications and networking there is a need to break free from the mesh of wires and let devices exchange data via air. Wireless communication has made it possible. Recent technologies in laptop computers and wireless data communication devices like modems, wireless LANs, PDAs (Personal Digital Assistants) etc have further aided the process of fast development. The two best reasons for enjoying the rapid growth of wireless computing are it leads to drop of prices against higher data rates. The emerging Wireless technology gives freedom for accession of information and services electronically, in spite of geographical positioning in an efficient way [9] [10] [11].

No one had dreamt about that, till 1985, when winner of Nobel Prize Laureate Marconi had discovered that the electric signals can be transmitted through air. It was due to his efforts, the people of 19th century saw the birth of telegraphy or radio through those electrical signals which was known as wireless communications [1]. And now is the stage where wireless technology is in mainstream, this fact can be supported by the fact that a billion of people are using Wi-Fi enabled devices in daily life. The best examples of these are mobile phones to smart phone devices. The rapid growth in the Wi-Fi enabled devices is a clear indicator that the technology gained the popularity in the computing industry along with day to day life from radio, TV with remote(infrared operations), keyless entries to car, using wireless zones, mobile phone, and hotspots created by smart phones to access internet facility. Along with these facilities the wireless networks has gained tremendous growth in the mobility of the professionals, electronic media provides the access of information and services through wireless communications, travelling around the world in spite of their geographic positions.

In last two decades, the hardware for the mobile hosts and wireless networks(WN) gained a fabulous popularity so why become widely available. The extensive research has been done recently by integrating these into traditional networks like Internet. The main reasons behind the avoiding of the wired networks by the different segment users are hassles as well as expenses and delays. As per the throughput gain in, while the WN remains unlicensed and affordable, it still helped their exponential growth in every environment such as homes, communities and open spaces and businesses environment.[1] That's why, it gained tremendous growth in WN world and this helped in providing high-speed Internet facility to the travellers all over the world.

Besides these facts, There are some issues with wireless networks like

1) Security
2) Performance
3) Reliability
4) Consistency
5) Cost
6) Policies of Government
7) Zero-Zone

This paper has been designed to take care of zero zone concept with a proposed scheme. Rest of the paper is organized as Section II describes zero zone, section III gives proposed plan and future aspects are described in last section.

2. Zero-Zone in wireless networking

Mobile wireless networks have two variations. The infrastructure networks and the infrastructure less mobile network or ad-hoc network [2]. This **infrastructure** networks are composed of **wired** base stations which acts as gateways between the wireless networks and internet, and **fixed** wireless relays. A mobile unit connects with the nearest base station which one is available within its communication radius, and communicates with it. Office WLANs (wireless local area networks) are typical example of this type of networks. While, the infrastructure less mobile network or ***mobile ad hoc networks*** are an autonomous connected system of mobile hosts and routers of wireless links which are free to move around randomly and organize themselves arbitrarily.[2] . In infrastructural wireless network apart of all issues there is a main issue of **Zero-Zone**. Figure 1 gives a glimpse of the idea under consideration. Before discussing further, term zone-zero will be described here is :Zero-Zone is the area of wireless network where there is no signals or very poor signals(unable to use for communication) of the surrounding wireless access points (Figure 1). Normally this area is approx. 50 meters to 200 meters. There is always been a

problem when wireless implementation made for some areas in between of the network remained without wireless signals. These areas are left due to interferences in the surrounding environment, cost of the additional access point's implementation and vision of the administration at the time of implementation of the network etc.

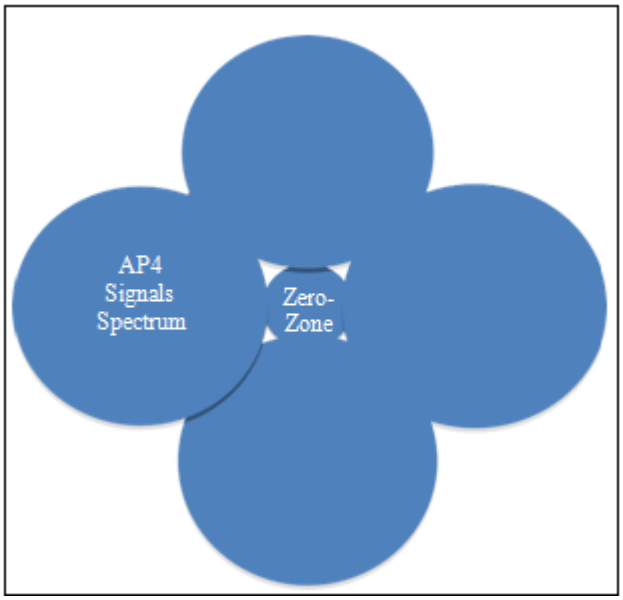


Figure 1: Zero-Zone

Zero-Zone is a very big problem for wireless networks. Every small company to big organization everybody is facing this problem. An effort has been made to solve this issue with the alternative options and select the best and low cost option.

3. Proposed Plan

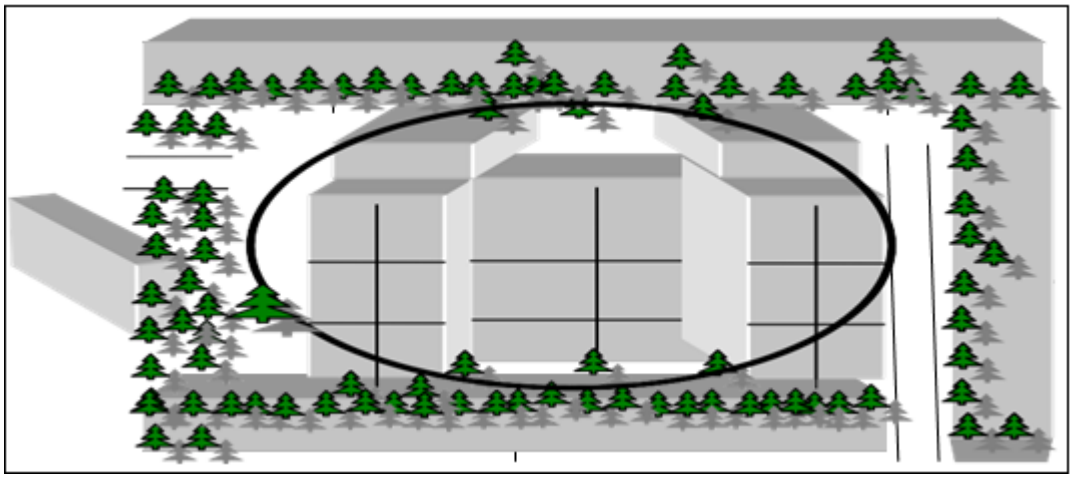
Take the case of the mobile 2G/3G network which is infrastructural network and common problem is that at some place no signal exist in the mobile. Similarly, in surroundings wherever wireless networks are, everybody is facing this problem, and removal of zero-zone involved a very high cost in the existing systems with infrastructural networks. Work has been carried out on a University campus wireless network.

a) Existing: The network is installed with Motorola AP's backed with fibre optics network almost 3 years back. Problems with existing structure
b) At the time of installation this was just centred about buildings not about open spaces and also some buildings were left without network and some are new buildings those don't have Wi-Fi facility.

Idea of backbone network and other options were considered but these suggestion were not considered because these areas are not so dense populated and the cost benefit analysis show that the cost of this type of network will be very high. Idea behind this study was how Wi-Fi facility will be provided to the population who are falling in the Zero-Zone and above said left areas. Some of the critical aspects taken are:

- Extend the infrastructural network : Executer of this network made an assumption that for giving the internet facility to the users those don't have, extend the infrastructural network from the nearby fixed station. Main problem to execute this is time and very high cost involved.
- Change the AP + Antenna with high gain of the surroundings : Change of AP +antenna always involved a very high cost.
- Connect Motorola Access Points in Bridging mode with Addition AP with high gain Panel antennas : This can be done immediately but The cost involved in this is again very high.
- Installation of Point to Point Antenna's : This may be used but feasibility is low due to cost involved.

Considering all the above issues a new strategy was suggested as : Installation of Range Extenders : This will be the best solution, installation of range extenders is a good solution and cost effective.



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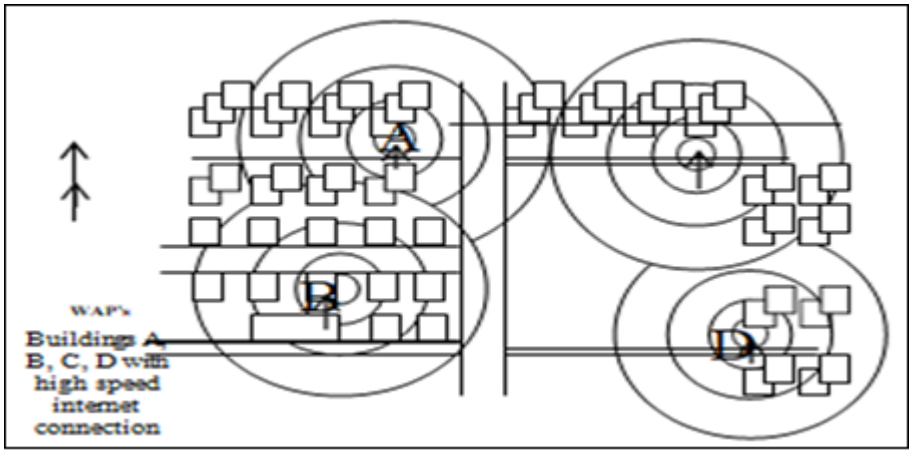

Figure 2: Area from building A to B

Above is shown a case study picture of a block , because whole site's picture couldn't be taken so making a model for the site is shown in Figure 2. At the time of installation of the existing project this building (shown in circle in the figure) was not there this is constructed after the implementation of the project, this building is not known as left areas because in the surroundings there are 3 to 4 access points and they are spreading the broken signals nearby the building. Due to dense buildings walls, trees and electrical wires are around the building, residents are not getting these weak signals So started experimenting that how signals can send to the surroundings so population without the network can access the network at minimized cost.

Steps Taken

Initially, started with the option to change of the WAP of the surrounding areas so they can send the signals there where are Zero-Zone. The experiment worked to some extent but the cost involved in replacing them was again high

In second step, some new access points with the help of bridging facility were installed (inbuilt in the Motorola AP) but again there is much cost involved.

Approximate cost of removing one black hole was around Rs. 20000 to Rs. 50000/-. Finally after searching AP was available which is low cost as Rs. 2500/- and experiment was done with this AP in range extender mode and found excellent result.

One example of the new constructed building has 12 houses in two floors in an area of 100 meters. The residents there facing a very big problem with the network and only cornered houses were getting a very low wireless range of surrounding access points. One AP was installed as range extender mode (inbuilt facility) and found that range extended of the nearby access points by the AP to excellent Wi-Fi range. Not only in the house where this Access point installed but also in surrounding and left. After a week resident's feedback was taken and found that all were now satisfied users of the wireless networks. So the net gain was that only in Rs. 2500/- the job was achieved of Rs. 20000/-(8 times lesser). The Friis equation has been used here and it can easily be said that it is mostly used formula for calculating free space path loss and is represented as:

"Lossinerms of dB = 96.6 + 20 Log10 (distance in miles) + 20 Log10" (frequency in GHz) 1

Since the area under consideration is residential and consists of brick and mortar walls, the attenuation of signal through the brick/concrete walls also need to be considered. This can be best described by MWF modelsas shown in the following equation (2).

$$L_{MWF} = L_0 + 10\log(d) + \sum_{i=1}^{I} \sum_{k=1}^{K_{wi}} L_{wik} + \sum_{j=1}^{J} \sum_{k=1}^{K_{fj}} L_{fjk} \quad \text{-----2}$$

L0 = Path loss calculated at 1m distance n= index used for power decay
d= transmitter and receiver distance
Lwik= It is attenuation of wall type and Also added is kth tranversed wall
Lfjk = attenuation of floor type j and also added is kth traversed floor
I= wall types numbers j= floor types numbers
Kwi= Traversed walls of category I in terms of numbers
Kfj= Traversed floors of category j in terms of numbers.

4. Achievements

If implementation made as per experiments and results the following are main advantages

- Removal of Zero-zones : After execution
- Facility to the left population of the campus wide network
- Quick Installation of the range extenders
- Cost involved is negligible

5. Conclusion

This will result in the quick and low cost solution of the Zero- Zone of campus wide wireless networks which is the main problems of the wireless networks. The plan will be extended to the areas of some hostels and the some departments who are facing the problems of wi-fi signals of the network. The proposal is that one can enhance the wi-fi network signals and facilitate to the population only in Rs.

2500/- to Rs. 10000/- per Zero-Zone which is a very much low cost in comparison to Rs. 20000/- to 50000/-.

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