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PROPOSAL FOR LOW COST WIRELESS NETWORKING

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ABSTRACT

Wireless communication has become increasingly popular in the computing industry as well as in our daily life. The technology, with the emergence of cross vendor industry standards has shaped a number of popular and cost-effective wireless solutions for business and educational purposes. In this paper an effort has been made to create low cost wireless local area network. Using the case study it has been established that the proposed strategy is one of the best strategy keeping in mind the budget and short implementation time with some minor constraints.

1.0 Introduction

Nobody even dreamt about what Nobel Prize Laureate Marconi had done by his discovery that electric signals can be transmitted through air. It was because of his efforts in 1895, the 19th century thus saw the birth of wireless communications in the form of telegraphy or radio.[1,2] Today's wireless communication has become increasingly popular in the computing industry as well as in our daily life such as listening to the radio, operating TV with remote, locking and unlocking cars, mobile phone, and

using wireless zones to access internet facility. In addition to this the adoption of wireless networks has rapidly increased the mobility of the professionals, to access information and services via electronic media, traveling around the world without taking into the account their geographic position. Within the past two decades, mobile hosts and wireless networking hardware are becoming widely available, and extensive work has been done recently in integrating these elements into traditional networks such as the Internet. Basic reason for avoiding the wired networks are hassles, expenses and delays, even the enterprises and homeowners are avoiding installing them. Along with increase in throughput, wireless networks remain unlicensed and affordable. This has further helped their exponential growth in businesses, homes, communities and open spaces.[2] That's why, wireless networks have taken the world by storm and high-speed Internet facility is enjoyed by travelers all over the places worldwide. There are currently two variations of mobile wireless networks. The first is known as infrastructure networks and the second one is known the infrastructure less mobile network, commonly known as ad-hoc network.[3,4] This **infrastructure** will be composed of **wired** base stations and **fixed** wireless relays. Base stations act as **gateways** between the Internet and the wireless **network.** In these networks a mobile unit connects to nearest base station which is available

within its communication radius, and communicates with it. Typical applications of this type of network include office wireless local area networks (WLANs). Whereas, a *mobile ad hoc network* is an autonomous connected system of mobile hosts and routers of wireless links which are free to move around randomly and organize themselves arbitrarily.[2,4] While wireless networks are well known in the home user markets, commonly reported and easily broken security measures in the standard security system have diminutive effect on WLAN deployment rate. However, there may be many misconceptions about wireless networks being less secure than their wired counter parts, the upsurge in WLANs deployments can be gauzed from the fact that a research fact put up by the Gartner Group which in nutshell says that with current shipments on enroute WLAN deployments to double in two years. Such mammoth growth can be attributed with:

- Companies are enjoying the benefits of rapid deployment
- Lower infrastructure costs
- Improved productivity

With rushing implementations comes a caution that says there are security issues that should be identified and addressed. Now the big question is of security. It is true that increasing popularity of any technology is directly

proportional to increasing security attacks. With the wireless nature of WLANs, the security issues aggravate and the reason for that lies in the open nature of transmission of wireless networks and lack of infrastructure.

2.0 Existing methods to create wireless network

The term wireless networking refers to technology that enables two or more computers to communicate using standard network protocols, but without network cabling[5]. The technology, with the emergence of cross vendor industry standards such as IEEE 802.11, has shaped a number of popular and cost-effective wireless solutions for business and schools as well as sophisticated applications where installing wired network is impossible, such as in warehousing or point-of-sale handheld equipment. Figure 1 to Figure 3 are representation for various types of wireless networks.

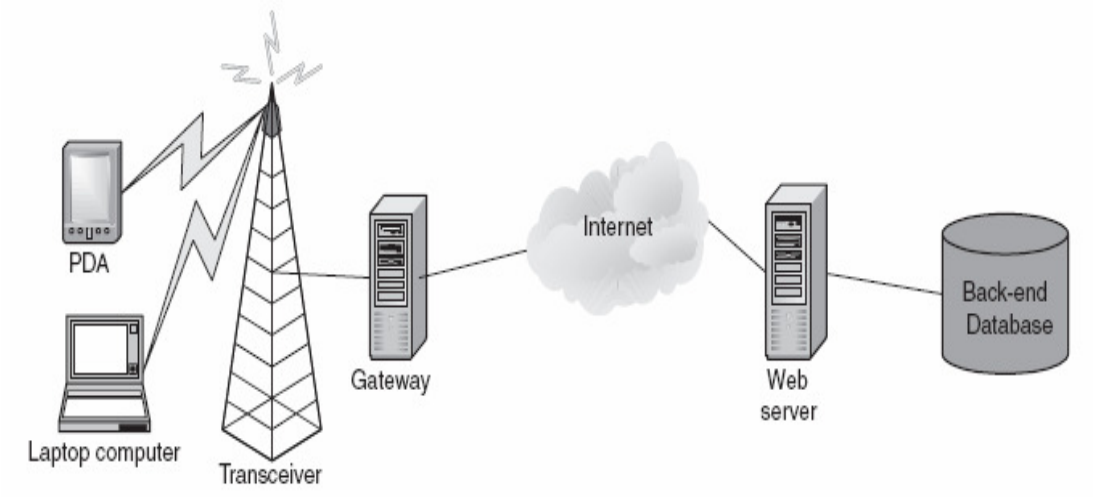


FIGURE 1: *A typical high-level wireless system*[6]

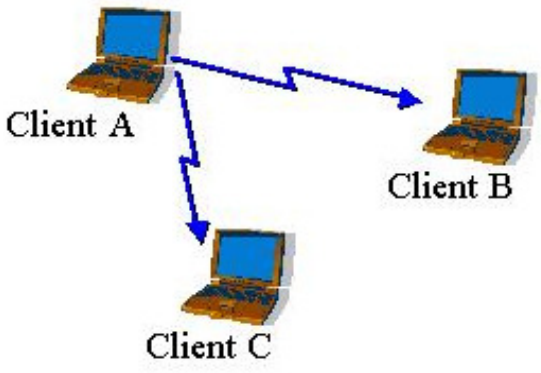
Wireless networks operate in one of the following two modes[7]:

- Ad-hoc [IEEE name : Independent Basic Service Set (IBSS)]
- infrastructure [IEEE name : Basic Service Set (BSS)]

In ad-hoc mode, each client communicates directly with the other clients within the network.

The main design consideration in Ad-hoc mode is that only the clients with in transmission range (with in the same cell) of each other can communicate. If a client in an ad-hoc network wishes to communicate outside of the cell, a member of the cell must operate as a gateway and perform routing[8].

In infrastructure mode, there is a need of Wireless access point(WAP) because each client sends all of it's communications to a central station, or access point (AP). The access point acts as an Ethernet bridge and forwards the communications onto the appropriate network– either the wired network, or the wireless network[9].



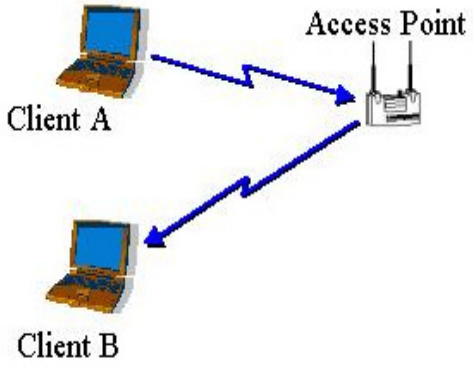


FIGURE 2: *Wireless network (ad-hoc mode)*[8] FIGURE 3: *Wireless network (infrastructure mode)*[8]

3. Proposed Scheme for Creation of Low Cost Wireless Network

In the proposed paper an effort has been made to create low cost wireless local area network of a residential area with a population of 500 people, i.e around 100 flats (2-3 floors) and bungalows. This effort covers providing the Internet connection to all the population for there laptops and desktops

wirelessly from a existing high speed internet connection at a very low cost(40000/-50000/- (INR)/800-1000 USD). To provide wired connection to the same area costs approx 3-4 lacs (7000 USD, in addition to other hassles including provisioning for wiring etc. The detailed layout of the residential area is shown in Figure-4. In this residential area all the obstacle are there like trees, electrical poles, walls etc. The Computer Centre building is the core with a high speed internet connection. From there, this connection will be distributed to the neighboring residential buildings with in 500-1000 meter area. Establishing this network requires Five Wireless Access points (WAP) with omni antennas(A,B,C,D,E) and Two Directional (X and Y) are taken.

In the Computer Centre building one Wireless Access Point has been installed with Two Antennas (one Directional and another Omni). Directional antenna(X) is communicating with another directional antenna(Y) and also supporting in between Omni antenna(B). Through these antennas corresponding WAP are communicating. The line of sight in between these antennas is clear. Now in this network all the antennas are communicating through one or another antenna so communicating Access points at A, B, C, D and E(and working in repeater mode). As seen in the above figure each access point provides the signals to computers and laptops or the other wireless devices in the range. If one

access points signals are weak for any sector the other access point supports it and provides access to the user.

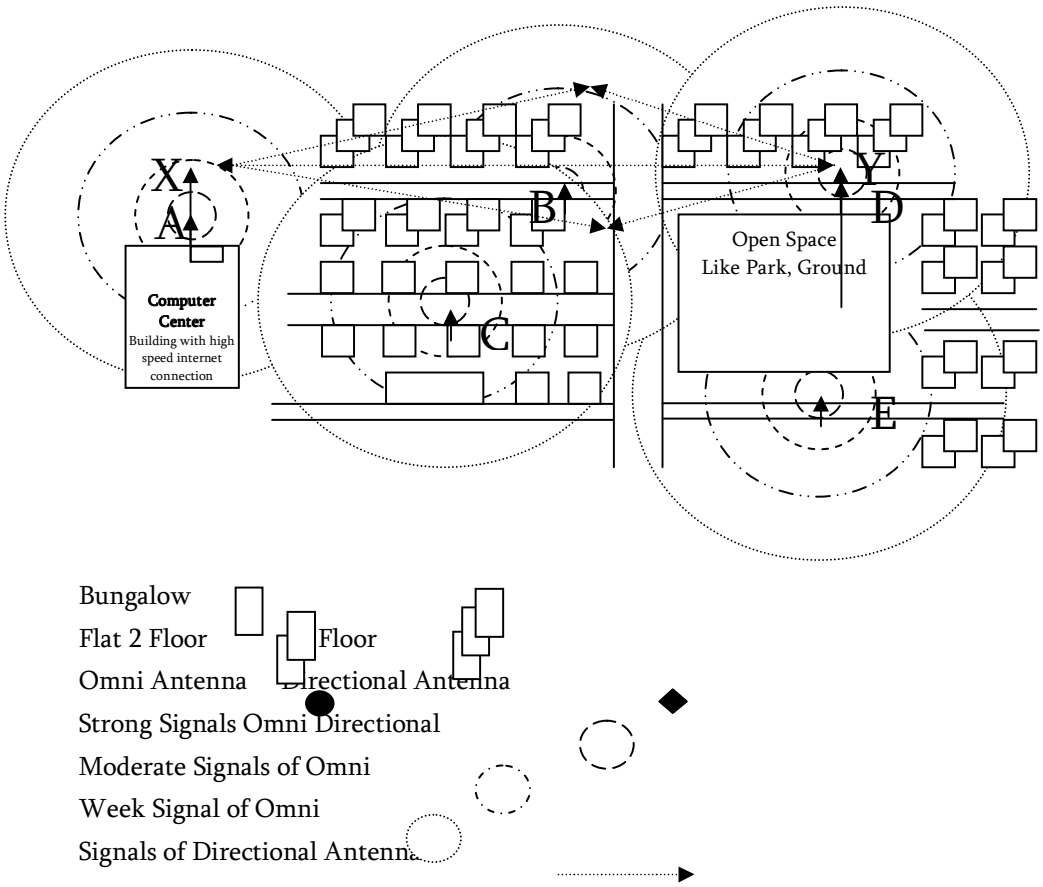


Figure 4 : An example for setup

Once the area was properly understood and Wi-Fi locations were identified, a detailed market survey was done to find the products with maximum cost-benefit ratio and the expectations. The make and model of the equipments have been purposely removed from table-1.

S. No.	Item	Qty	Approx. Rate In Rs.	Total
1	Wireless Access Point(WAP) 2.5Ghz	5	1800/-	9000.00
2.	Omni Antenna with pigtail	5	4800/-	24000.00
3.	Antenna Directional with pigtail	2	5000/-	10000.00

4.	Pipe(for Height to Antenna)	5	400/-	2000.00
5.	Weather Box(Housing)	5	400/-	2000.00
6.	Installation Cost	5	500/-	2500.00
	Total Cost Involved			49500

Table-1: approx. price of requisite equipments, after extensive market survey at Delhi (rates may vary from place to place).

In an alternative strategy, a wired network can be maintained as a backbone connecting each of the WAP. In this process laying of Wired network is a costly affair. Fiber optics may be used for increasing bandwidth of the network. Besides, an array of WAP with low gain antennas may be positioned to cover just covering 2-4 neighboring houses in the network.

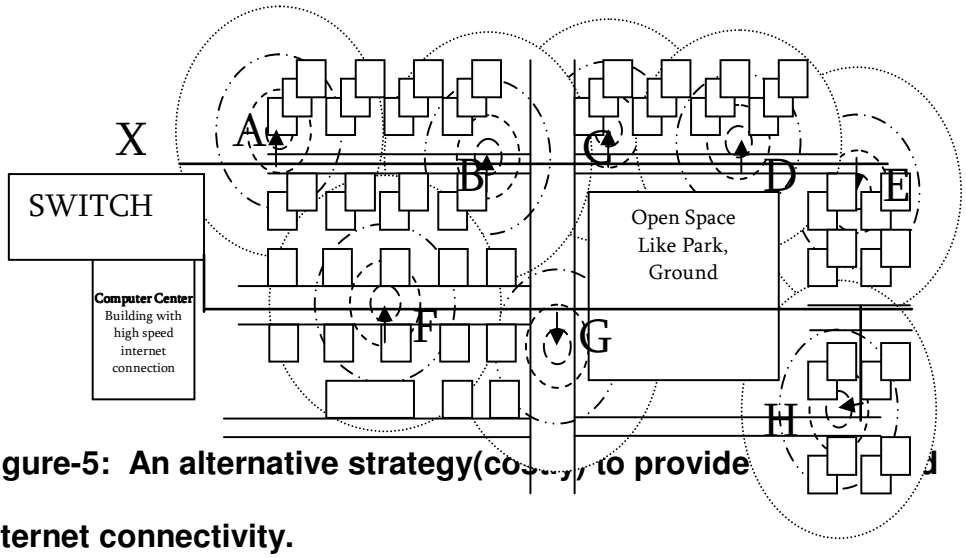


Figure-5: An alternative strategy(cost...) to provide ... Internet connectivity.

After a detailed market survey, and trying to make it cost benefit, the approximate cost of various equipments is expressed in Table-2.

S. No.	Item	Qty	Approx. Rate In Rs.	Total
1	Fiber Optics Wired Network	750(m)	1,00,000	100000.00
2	WAP 2.5 Ghz	7	1800/-	12600.00
3.	Antenna Omni with pigtail	7	4800/-	33600.00

4.	Pipe(for Height to Antenna)	7	400/-	2800.00
5.	Weather Box	7	400/-	2800.00
6.	Installation Cost	7	500/-	3500.00
	Total Cost Involved			155300

Table-2: Cost of equipments for alternative(costly) design

4.0 Conclusion

The implementation of the network using the proposed strategy took approximately one week's time. The actual cost of implementation came even lesser than what was proposed initially. A weekly feedback was taken from the users of the area for a) Fine tuning the network, (b) Educating the users about the way to use it and (c) Pacifying the users for what they were getting at the cost of investments.

The whole network has been installed in real and test bed has been used for results. The network was continuously monitored for fine tunings. The outcome of Network monitoring and users' feedback are as follows.

1. Though the Wi-Fi is signals are available in each house, but they are limited to the rooms facing the antenna only. In order to solve this problem, powerful radio with higher gains could have been installed, but the budget restricted in doing so.

2. Since all users were on a common shared bandwidth, during the day time, when very few users are using the Wi-Fi system, each user used to get a very good throughput. But in the evening/night time, in the presence of around 100 users, throughput was a problem. This problem can be easily solved with the help of a Linux based (freeware) bandwidth manager, where separate time based bandwidth pools can be created and each user would have been allocated a specific pool. In order to optimize the bandwidth usage, all users would be allocated on the common pool during day time (when the users are very few). This all required an investment in man hours in developing, configuring and fine tuning of the bandwidth manager. The process is yet to be carried out in practical situation.

It can still be concluded that, after a month of analysis and feedbacks, a little more investment in the network with the proposed strategy can be the most economical way to network a section of area with desired results.

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