Interconnecting Villages of Pusad Taluka Through Wi-Fi / Wi-MAX

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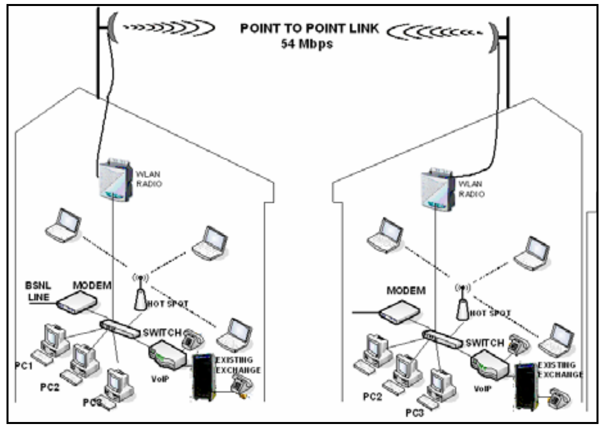
ABSTRACT
India's buoyant service sector signifies the technological progress the country has made during the last decade. The advancement has been so effective that it has had cascading influence on people's life. However, much needs to be done to apply technology for the betterment of people's lives, especially of those in rural areas so that they are not denied the benefits of technology. **"Interconnecting Villages of Pusad Taluka Through Wi-Fi / Wi-MAX"** is the platform to transform rural lives in Pusad Taluka by applying technology and bridge the gap dichotomous growth could create in a society. The project aims at providing people in rural area of Pusad timely access to an array of high quality services using the virtual delivery platform. The Foundation uses the platform to take state-of-the-art expertise to the rural people. For instance, patients in remote areas requiring specialized care can get treatment from medical experts virtually from anywhere in the country or abroad. Similarly, a farmer can have the advantage of his crop being monitored by the best in class expert from an agricultural institution.

1 INTRODUCTION

1.1 Wi-Fi
The Institute of Electrical and Electronics Engineers Inc. (IEEE) is the organization responsible for setting the standards on how technology and products work, communicate and operate. The 802.11 technology standards, better known as Wi-Fi technology, is being deployed into Broadband Wireless Access (BWA) equipment and Local Area Network (LAN) access points to quickly and efficiently connect computers to internet service providers and to LAN's respectively.

Wireless communication has a few problems that plague this service. These include data rate, distance and reliability. All three of these problems can be directly linked to one major issue. The congested air waves and lack of Federal Communication Commission (FCC) regulations on transmission etiquette lead to the one major downfall of wireless communications interference. However, the FCC does mandate that equipment must use one of two types of transmitting schemes using the 802.11 standard: Frequency Hopping Spread Spectrum (FHSS) or Direct Sequence Spread Spectrum (DSSS).



1.2 FHSS
The FCC mandates that BWA equipment use either FHSS or DSSS. The FHSS signal is the easier of the two to understand. "The FHSS carrier will hop on predetermined; pseudo random pattern defined using a pool of 1 MHz sub-channels defined across the entire band. The FCC requires the band to be divided into at least 75 sub-channels" The amount of time that an FHSS radio can stay on one band, also known as dwell time, is 400 microseconds. After the 400 microsecond dwell time, the FHSS Broadband wireless access equipment will "hop" to the next predetermined, pseudo-random band. The equipment will then have to re-synchronize before the data transmission can resume. If there is interference on a certain band in the frequency, the equipment will hop to the next predetermined band and resend the transmission after the re-synchronization takes place. According to the FCC regulations the band that contains the interference cannot be excluded from the pattern. Since the power regulation is 1 MHz per sub-channel across the entire band, the BWA equipment that uses the FHSS transmission scheme can transmit data at a maximum of 1 Mbps. There is degradation of the signal as the distance from the end user's BWA equipment to the access point on the tower increases. "The intent of the pseudo-random hopping pattern is to avoid interfering signals by not spending very much time on any specific frequency". This hopping ability creates additional security for FHSS. It is very difficult for any unauthorized retrieval of the data that is being transmitted to occur because FHSS stays on a certain band in the frequency for a maximum of 400 microseconds and then hops randomly to the next band for another 400 microseconds. Retrieval by unauthorized sources would require equipment capable of following the same hopping pattern as the BWA access point. Since the transmitting equipment does not broadcast the next random hop, the likelihood of external equipment being tuned

into the correct pattern is quite low. On the other hand, the maximum dwell time of 400 microseconds creates a problem with the overhead required to transmit data. The Institute of Electrical and Electronics Engineers Inc. recommends the maximum packet size to be only 400 bytes for FHSS equipment. The overall overhead of the FHSS signals will be increased because of the need to send a transmission preamble and MAC header as well as fragmenting all long packets. The outdoor range of FHSS is limited to 10 km, which is approximately 6.211 miles. BWA equipment that is using the FHSS transmission scheme must also be located along a line of sight. The 6.211 miles distance is in an optimal situation. FHSS does not use processing gain, since the FHSS signal is not spread. “Processing gain, which provides the decrease in power density when a signal is processed for transmission and the increase in power density when the signal is dispread, improves the received signal’s S/N ratio (Signal to Noise ratio)”. Since the unlicensed 2.4 GHz frequency band has the same limitations of overall power the FHSS systems can’t achieve the same Signal to Noise ratio as the DSSS systems. The FHSS systems would have to increase the overall power transmitted to achieve the same S/N ratio.

1.2.1 DSSS

Direct sequence spread spectrum is the second type of spread spectrum signal transmission allowed for BWA equipment by the FCC. Direct sequence spread spectrum transmitters use power levels for transmission that are similar to narrow band transmitters. Because Spread Spectrum signals are so wide, they transmit at a much lower spectral power density than narrow band transmitters. This lower transmitted power density characteristic allows spread and narrow band signals to occupy the same band with little or no interference. This capability is the main reason for all the interest in Spread Spectrum today. Combining the lower power density with the noise-like signals of DSSS makes it quite difficult to detect the presence of a spread spectrum signal. This allows the DSSS signal to maintain an extremely secure communication link. Since the signal is spread across a large range of bands in the frequency there is a possibility of interfering signals transmitting on some of the bands. This signal redundancy helps to resist interference from other signals. Although the signal is sent multiple times, the equipment must receive only one of the signals. If there is interference in the band the DSSS equipment can take partial transmissions from any number of the redundant transmission and correctly assemble them together. This is a very valuable and reliable benefit of the DSSS signal. DSSS has a process called de-spreading that helps reduce or possibly eliminate interference. De-spreading of the DSSS signal is accomplished by rearranging the random wideband signals making them equally wide and equally random. If the original DSSS signal is stronger than the interference, the spreading of the interfering signal by the receiver's code generator is rejected in favor of the more powerful DSSS narrowed data signal. In this situation the DSSS signal has overcome the interference and 100% of the data gets through. If there is interference within the signal it will typically be a narrow high powered signal. Since DSSS uses processing gain, the interfering signal will be spread out during the de-spreading process on the receiving end. This will cause a dramatic reduction in the power density of the interfering signal making the impact of the interference significantly reduced or possibly even eliminated. The Signal to Noise ratio is better for DSSS since the de-spreading helps reduce the amount of noise being received by the equipment.

1.3 Wi-MAX

1.3.1 WHAT IS WIMAX?

Wi-MAX, or Worldwide Interoperability of Microwave Access, is a wireless Internet service designed to cover wide geographical areas serving large numbers of users at low cost. Wi-MAX is the synonym given to the IEEE 802.16 standard defining wide area wireless data networking. Wi-MAX is the standard being adopted worldwide by manufacturers to insure inter-operability of equipment. Wi-MAX is considered one of the best solutions for “last mile” distribution. In contrast, wireless local area networks (Wi-LANs) are designed to provide network access within an office environment or a home once Internet service has been delivered to that point.

1.3.2 HOW DOES WI-MAX WORK?

Wi-MAX uses microwave radio technology to connect computers to the Internet in place of wired connections such as DSL or cable modems. Wi-MAX works very much like cell phone technology in that reasonable proximity to a base station is required to establish a data

link to the Internet. Users within 3 to 5 miles of the base station will be able to establish a link using non-line-of-sight (NLOS) technology with data rates as high as 75Mbps. Users up to 30 miles away from the base station with an antenna mounted for line-of-sight (LOS) to the base station will be able to connect at data rates approaching 280Mbps. Wi-LANs, on the other hand, provide wireless network connectivity between devices within a given office or residence location. The 802.11b standard equipment can provide up to 11Mbps and 802.11g standard equipment will support data rates of up to 54Mbps.

Advantages

- A single Wi-MAX main station can serve hundreds of users.
- Endpoints install within days instead of the weeks required for wired connections.
- Data rates as high as 280Mbps and distances of 30 miles are possible.
- Users can operate mobile within 3-5 miles of a base station at data rates up to 75Mbps.
- No FCC radio licensing is required.

Disadvantages

- Line-of-sight (LOS) is required for long distance (5-30 mile) connections
- Heavy rains can disrupt the service.

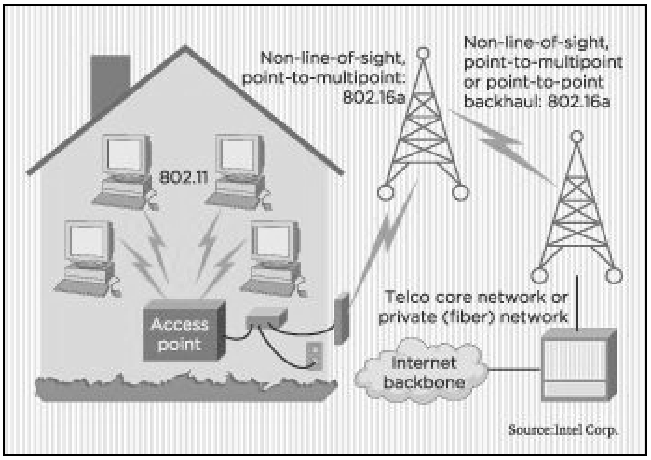


Fig 2.1 Typical Wi-MAX and Wi-lan Deployment

Table 2.1

Technology standard	Primary use	Data rates
Wi-MAX 802.16	External	75 – 250 Mbps
Wi-LAN 802.11g	Internal	Up to 54Mbps
Wi-LAN 802.11b	Internal	Up to 11Mbps

Other wireless electronics in the vicinity can interfere with the Wi-MAX connection and cause a reduction in data throughput or even a total disconnect.

1.4 IEEE Standards

IEEE 802.11 – otherwise known as the Wi-Fi standard – denotes a set of standards for wireless LANs. The original IEEE 802.11 standard, released in 1997, defines a common media access control (MAC) layer that supports the operation of all 802.11-based WLANs by performing core functions such as managing communications between radio network cards and access points. Subsequent amendments to 802.11 define specific physical (PHY) layers, such as 802.11b, 802.11g, or 802.11a. The physical layer defines the data transmission for the WLAN, using various modulation schemes. Much of the impetus for standardization has come from the Wi-Fi Alliance, an organization of technology and service companies dedicated to the adoption of a single worldwide-accepted standard for high-speed wireless local area networking.

1.4.1 802.11B

The IEEE 802.11b standard is the most popular and widely implemented of the 802.11 family standards, for reasons including its early availability and the price of supported products. 802.11b is a physical layer standard that specifies operation in the 2.4 GHz industrial, scientific, and medical (ISM) unlicensed frequency band, using the direct-sequence spread spectrum (DSSS) modulation technique. The number of channels the 2.4 GHz spectrum provides varies by country according to local regulatory restrictions. The FCC defines 11 channels for use in the US; 13 channels are available for use in most of Europe and 14 are available in for Japan. The channels overlap one another, since the centers of adjacent channels are separated by only 5 MHz. As a result, only three of the channels in the 2.4 GHz band are non-overlapping. Devices that use overlapping channels within range of each other will tend to interfere with one another's operation. Interference problems are avoided only by configuring adjacent access points to operate on non-overlapping channels.

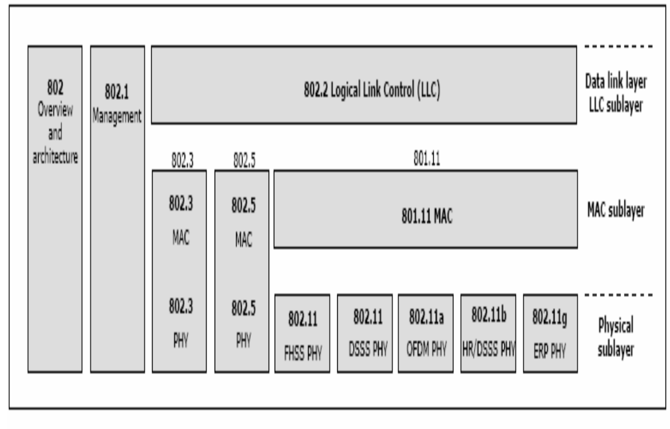


Fig 2.2 802.11 data link and physical layers

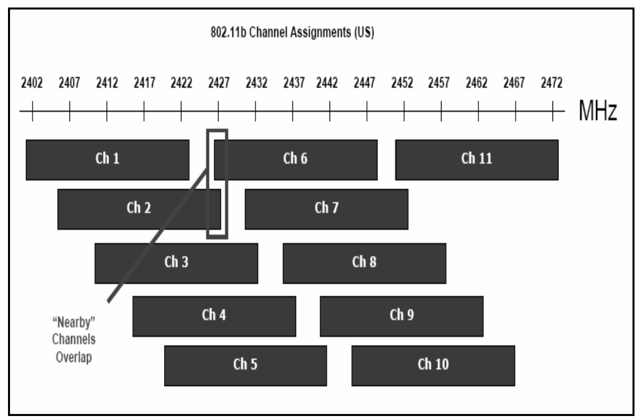


Fig 2.3 802.11b Channel Assignment

The limited number of available channels in the 2.4 GHz band places an inherent restriction on the capacity of an 802.11b network. What's more, manufacturers of other devices can use the 2.4 GHz ISM band without a license, so long as the wireless device operates within regulatory limits. Interference that can affect 802.11b devices include microwave ovens, cordless phones, Bluetooth devices, wireless headsets, garage door openers, and other appliances – all of which use the same limited 2.4 GHz range. The 802.11b standard defines a maximum data rate of 11 Mbps, which provides a realistic maximum usable throughput of about 4-6 Mbps under normal conditions When signal quality becomes an issue, the 802.11b device uses a technique called *adaptive rate selection* to scale back the rate to 5.5/2/1 Mbps. Lower data rates use less complex methods of encoding the data. Consequently, they are less likely to be corrupted by interference or signal attenuation.

1.4.2 802.11G

The IEEE 802.11g standard is a direct extension of 802.11b that extends the maximum data rate (signaling speed) to 54 Mbps, making it possible to serve up to five times as many users. The higher signaling speed is made possible by using a more efficient means of transmission called orthogonal frequency-division multiplexing (OFDM). OFDM breaks a wide-frequency channel into several sub-channels and transmits the data in parallel. 802.11g provides a realistic maximum throughput of about 20 Mbps in normal conditions. The 802.11g standard can scale back to support data rates of 48, 36, 24, 18, 12, and 9 Mbps. Because 802.11g operates at the same frequency - 2.4 GHz - as 802.11b, devices are subject to the same limitations: only three non-overlapping channels and interference from unlicensed, non-protocol equipment. On the positive side, using the same 2.4 GHz frequency means that 802.11g devices are *backward-compatible* with 802.11b access points and other devices that enterprises may already have. However, different modulation techniques prevent 802.11b and 802.11g devices from coordinating with one another to prevent collisions when using the same shared frequency. Thus the presence of an 802.11b station within range of an 802.11g access point forces the access point to invoke RTS/CTS (Request to Send/Clear to Send) or CTS-to-self *protection mechanism*. This protected mode prevents simultaneous transmission by devices using 802.11g and 802.11b (which would result in collisions and retransmissions), but it significantly reduces the throughput of the overall wireless network. In protected mode, the access point drops down to 802.11b speeds to alert the 802.11b station that an 802.11g transmission is taking control of the media. To serve the 802.11b station, the access point must use DSSS modulation (rather than OFDM), and is thus limited to the lower data rates. Running in protected mode is required by standards whenever an 802.11b station is present.

1.4.3 802.11A

The IEEE 802.11a standard provides the same 54 Mbps maximum data rate as 802.11g. But unlike 802.11b and 802.11g, the 802.11a standard operates in the 5 GHz ISM band. This means that 802.11a devices are not subject to interference that affects 802.11g and 802.11b devices, but they are still subject to interference from other products designed to use this 5 GHz ISM band. The 5 GHz band allocates up to 19 non-overlapping channels depending on local regulations. The higher data rate, coupled with more non-overlapping channels, enables greater density deployments (more access points within a given area) to accommodate more users and provide greater capacity. With its high throughput and lower range, 802.11a is ideally suited for provisioning connectivity to densely populated user environments such as computer labs, classrooms, large conference rooms, airports or convention centers. However, the 802.11a is subject to a basic rule of physics: the higher the radio frequency, the shorter the range. Because 802.11a operates in the 5 GHz band, its signal range is somewhat more limited than that of 802.11b/g, which operates at 2.4 GHz. The shorter wavelength radio signals have more difficulty penetrating walls and other obstructions. As a result, more access points are typically required to cover a given area. Without backward compatibility for the installed base of predominately 2.4 GHz-based wireless clients, 802.11a, by itself, never gained mass adoption in the business or home wireless networks. With the overall rapid industry growth of wireless and the technology advances that followed, today most mobile devices such as notebooks support both 802.11b/g and 802.11a. To follow suit, most access points also provide simultaneous 802.11b/g and 802.11a support.

1.4.4 802.11N

The draft 802.11n standard defines a new physical layer for increasing the throughput of wireless local area networks. The 802.11 Task Group n (TGn), chartered by IEEE in January 2004, has spent more than two years drafting a new amendment to the 802.11 standard to address the need for higher throughput. The task group was presented with competing proposals by two large industry groups: the WWiSE (World-Wide Spectrum Efficiency) Alliance, backed by companies including Broadcom, and TGn Sync, which was backed by Intel and Philips. In 2005, WWiSE and TGn Sync, along with a third group called MITMOT, merged their respective proposals into a joint draft. 802.11n is based on MIMO (multiple input/multiple output) OFDM technology, which allows the transmission of up to 100 Mbps over a much wider range than earlier versions. MIMO uses multiple transmitters and receivers to allow for increased throughput through spatial multiplexing and increased range. In January 2006, TGn voted unanimously to confirm selection of a joint proposal for high throughput WLANs. The 802.11n amended standard specifies methods of increasing the signaling speed of wireless LANs up to 600 Mbps – more than 40 times faster than 802.11b and near 10 times faster than 802.11a or 802.11g. It is projected that 802.11n will also offer a better operating distance than current networks. At its March 2006 meeting, the TGn group sent the 802.11n draft for a comprehensive review by more than 500 technical experts from leading technology companies, academic institutions, and government agencies. The IEEE 802.11n standards development project expects to complete its draft development work in late 2006, with final ratification and publication of the formal 802.11n amendment sometime in 2007. As wireless and related technologies continue to mature, it is more apparent than ever that well-formed standards are the most intelligent way to ensure that future products meet the needs of the marketplace. The Wi-Fi Alliance and other industry groups have advocated strongly against the introduction of “pre-N” products, arguing that there is no way to guarantee these early entry products will be compatible with the eventual standard.

2 DESIGN SCHEMATICS

2.1 Design Schematics

The B. N. Engineering College Shall be connected to all the villages in Pusad Taluka for various utility services to the villagers such as health, education, agriculture, scientific support and management of milk, sugar, agro based industries, banking and marketing supports to the villagers.

The Internet and Intranet connectivity to the all the villagers shall become available through Wi-Fi Network proposed under the scope.

2.1.1 SCOPE OF THE WORK

The project includes work to be executed as fallows.

- Understanding the need of connectivity for data, video, audio, networking and hi-tech interactive information and telecommunication based technology based applications..

- Planning the network suitable for the application identified.
- Preparing Preliminary report.
- Preparation of final report including bill of material and estimation.
- Specification drafting and project implementation plan.

2.1.2 METHODOLOGY

Reconnaissance Study

The collection of data regarding:

- The total number of villages and utilities to be connected.
- The topo-sheets of the Taluka.
- Preparation of proposed network and utility plan.
- Specific requirements detailing.
- Existing building plans, future building plans, Structural and floor plan of each building where the computer infrastructure will be housed, availability of electricity, etc.

2.1.3 PREPARATION OF PRELIMINARY PLAN

Based on the aforesaid data a preliminary report shall be prepared which will include:

- Network drawing.
- User placement plan and bandwidth requirement in time domain.
- Individual building plan including floor plan with desk top PC/ devices/ router/ switches/ cables/ routes/ servers/ modems location marked on it.
- Facilities required at each node.
- Preparation for specification of data center facility.

2.1.4 FEASIBILITY SURVEY AND LINK BUDGETING

Based on the preliminary report a feasibility survey shall be conducted by deploying the units at proposed locations and a report shall be prepared which will substantiate the link budgeting already done for the link of each location with reference to proposed Wi-Fi access point.

2.2 Village Information

The project is aimed towards Wi-Fi networking of all the villages in Pusad Taluka. Total there are 189 villages in Pusad Taluka, but due to limitation of time we have concentrated our attention on the villages which comes under the air radius area of 5Km by considering B. N. College of Engineering as a center point. So 29 villages comes under the air radius of 5Km area are listed below.

Table 3.1

Sr. No.	Village Name	Latitude	Longitude
1	Karla	19^0 52’ 2.64” N	77^0 30’ 36.54” E
2	Dhansal	19^0 52’ 51.21” N	77^0 30’ 36.34” E
3	Mansal	19^0 52’ 44.22” N	77^0 21’ 30.45” E
4	Uplanchwadi	19^0 52’ 11.73” N	77^0 30’ 15.08” E
5	Warud	19^0 57’ 5.31” N	77^0 34’ 41.77” E
6	Loni	19^0 56’ 28.72” N	77^0 35’ 44.42” E
7	Indiranagar	19^0 55’ 2.83” N	77^0 35’ 37.65” E
8	Waltur(Rwl)	19^0 55’ 48.29” N	77^0 33’ 39.09” E
9	Gaymukhnagar	19^0 55’ 35.64” N	77^0 34’ 16.64” E
10	Madhukar Nagar(Dubai)	19^0 55’ 58.16” N	77^0 34’ 11.91” E
11	Nimbi	19^0 55’ 5.50” N	77^0 32’ 1.80” E
12	Kawadipur	19^0 54’ 30.28” N	77^0 31’ 40.77” E
13	Bori(Khurd)	19^0 52’ 34.69” N	77^0 33’ 0.17” E
14	Borgadi	19^0 52’ 47.52” N	77^0 33’ 56.66” E
15	Lakshminagar	19^0 53’ 36.19” N	77^0 34’ 25.37” E
16	Chilwadi	19^0 54’ 30.57” N	77^0 31’ 40.88” E
17	Kopra(Bu)	19^0 52’ 29.26” N	77^0 35’ 15.00” E
18	Kakaddati	19^0 53’ 13.62” N	77^0 32’ 55.27” E
19	Bori Machhindar	19^0 52’ 13.56” N	77^0 33’ 41.96” E
20	Shelu	19^0 51’ 47.19” N	77^0 34’ 23.53” E
21	Krushnanagar	19^0 51’ 14.05” N	77^0 34’ 53.92” E
22	Ashwinpur	19^0 57’ 43.05” N	77^0 35’ 4.38” E

In above table latitude and longitude are used for calculating there distances between villages. The specific places to be connected in a village include the grampanchayat, schools, agricultural offices, health center and other important places.

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Fig 3.1 Map of Pusad Taluka

3 SITE SURVEY

One of the key factors in determining the success of a wireless LAN deployment is a site survey. Before deploying or expanding your wireless LAN, you need to understand the needs of users in the current environment. By performing a site survey, you can identify the appropriate technologies to apply; obstacles to avoid, eliminate, or work around; coverage patterns to adopt; and amount of capacity needed. Site survey should yield a network design document that describes the location of each access point, its coverage area, and the 802.11 a, b, or g channel selections for the access point. The network design document should also provide a complete Bill of Materials, indicating the WLAN equipment and supplies, infrastructure equipment and supplies to provide Power over Ethernet (PoE), and additional switch ports, and should include a vendor description of each WLAN component.

3.1 User Survey

The project starts with the understanding the topo-sheet, which gives the idea about the physical structure of Pusad Taluka. The major points to cover from topo-sheet are location of villages, boundary of Pusad Taluka and MSL of various location. The topo-sheet that shows this arrangement for Pusad Taluka is given below in fig. 4.1

As mentioned previously totally there are 189 villages in Pusad Taluka out of which, we have visited 29 villages. The data collected under survey from these villages is as listed in Appendix B.

After survey of villages as listed in above table we have taken the top view of those villages for marking the locations in the village where to put nodes (computers) in the network. The top views also helps to identify the location for locating the access point and radios used for networking, air distance between the villages. Some of the top views are given below and remaining are given in Appendix A.

Fig 4.1 Topo -Sheet

3.2 Obstacles to Signal Strength

The major obstacles observed during survey are Hills since the Wi-fi radio signals can not penetrate to hills hence one of the substitute is to increase the height of towers so as to get uninterrupted Fresenal Zone but as increasing the height of tower causes heavy financial load and hence proper designing is required. Some of the other obstacles are listed below,

- **Walls** – especially if the wall is composed of heavier construction materials, such as concrete. Also note any firewalls in the area.
- **Ceiling tiles** – particularly if they are made of material such as metal.
- **Furniture** – especially pieces that are largely made of metal.
- **Natural elements** – such as water, trees, and bushes – not only outdoors, but also in many lobbies, courtyards or other interior public spaces.
- **Coated glass** – transparent glass generally does not greatly degrade signal strength. But it may do so if it is coated with a metalized film or has a wire mesh embedded in it.

Following figure shows the scattering of signal due to the obstacles like trees and water.

Fig4.3 VILLAGE: KARLA

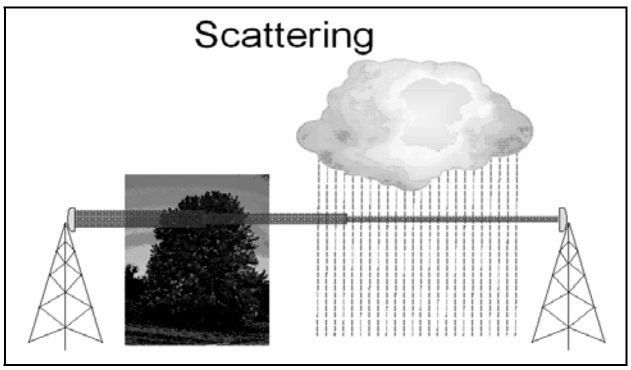


Fig 4.6 Obstacle to Signal

4 DESIGN

One of the first considerations facing the enterprise that wants to deploy wireless networking is – which wireless technologies to adopt and when? We also look at two wireless LAN (WLAN) architectures – standalone access points and centrally controlled coordinated access points – and discuss implementation considerations that can help decide which architectures to adopt in our environment.

To help decide which standards-based products to implement, we want to perform a site survey that identifies the most appropriate wireless technologies and architectures for our environment. Before delving into the more technical details, let's examine what's involved in planning and conducting a site survey.

4.1 Site Survey

One of the key factors in determining the success of a wireless LAN deployment is a site survey. Before deploying or expanding your wireless LAN, you need to understand the needs of users in the current environment. By performing a site survey, you can identify the appropriate technologies to apply; obstacles to avoid, eliminate, or work around; coverage patterns to adopt; and amount of capacity needed. Your site survey should yield a network design document that describes the location of each access point, its coverage area, and the 802.11 a, b, or g channel selections for the access point.

4.1.1 USER SURVEY

What do users need? What are their expectations? What applications are they using? What traffic types (bursty vs. continuous or streaming) and traffic volumes are present? How densely or sparsely situated are the users? How far will they be from likely access point locations?

Now the bandwidth requirement for particular users according to their use can be found from table below:

Table 5.2 Application Bandwidth requirement

Sr No.	Applications	Bandwidth Required	Options
1	DATA	>/= 16Kbps	
2	INTERNET	>/= 16Kbps	
3	AUDIO	>/= 28.8Kbps	
4	VIDEO	>/= 128.0Kbps	
5	VPN	>/= 128.8Kbps TO 155 Mbps	FIXED/ DIALUP
6	TV CHANNEL	>/= 512.8Kbps	
7	SCADA	>/= 256.8Kbps	
8	SURVIELLANCE	>/= 512.8Kbps	
9	Video Conferencing	</=512kbps	

4.1.2 SIGNAL STRENGTH

In general, objects absorb or reflect signal strength and degrade or block the signal. Identify any potential obstacles or impediments in the area to be served. For example:

- Walls – especially if the wall is composed of heavier construction materials, such as concrete. Also note any firewalls in the area.
- Furniture – especially pieces that are largely made of metal.
- Natural elements – such as water, trees, and bushes – not only outdoors, but also in many lobbies, courtyards or other interior public spaces.By considering these Obstacles, we decided to use mesh topology as it will support the communication with particular village if one of the link connecting to it get disturb still another exist.

4.2 Security considerations

The inherently open nature of wireless access – compared to the wired world – creates significant security concerns, chief among them, user authentication and rights enforcement, and data encryption. Broadcast signals often travel into public areas that can be accessed by "eavesdropping" individuals who have not passed through any type of authentication process to validate their presence at the site. The site survey should identify the security status of all locations considered for wireless access. The security solution must control network access in different ways for different types of users who may be in the same location.

In selecting networking equipment, it is essential to choose access points that provide a comprehensive range of industry-proven security capabilities which integrate easily into any network design**. Your networking equipment should provide standards-based** authentication and encryption methods that satisfactorily address security concerns such as data privacy, authentication, and access control.

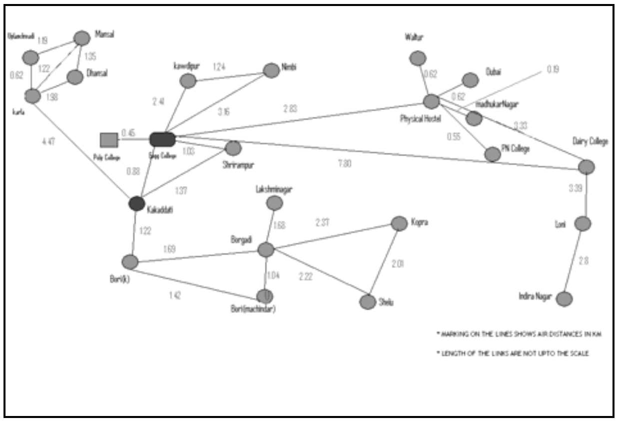


Fig 5.1 Village Connectivity Diagram

For the physical security consideration, we consider all the data centers to be centrally loaded at Engineering college at Pusad.

4.3 Radiation pattern requirements and special antennas

Identify any odd-shaped buildings, corridors, aisles, and similar limitations that might affect the placement of access points and antennas. Through proper selection and placement of antennas, you can extend coverage into desired areas, overcoming physical obstacles and multipath interference.

4.4 OBSERVATION

The great obstacle for our network design was hills and the only possible solution to overcome it was to use Mesh Topology, due to which if any link breaks to reach to particular place ,another link still exist to serve as shown in fig 5.1

4.5 Implementation Considerations

Which type of wireless network: centrally coordinated or standalone AP? Both the standalone and centrally coordinated architectures have advantages and disadvantages, depending on the age of the wired infrastructure, deployment area, building architecture, and types of applications that you want to support. Regardless which approach you choose, it is essential that your architecture provide you with a way to manage your network efficiently and effectively. A standalone access point WLAN is particularly well suited in environments where:

- There is a smaller isolated wireless coverage area that requires only one or a few access points.
- There is a need for wireless bridging from a main site building to a branch office or to a remote portable or temporary building such as a portable classroom.

However, the operational overhead to manage and maintain a wireless LAN increases with the size of the wireless LAN deployment. Wireless LAN management tools like ProCurve Manager and Airwave Management Platform help simplify configuration and monitoring of the LAN, but the inherent "independence" of these access points presents a challenge in addressing security, configuration control, bandwidth predictability, and reliability, as users and applications become dependent on an always available and reliable wireless LAN connection.

A centrally coordinated WLAN is well suited to deployments where:

- There are one or more large wireless coverage areas that require multiple radio ports possibly accompanied by several smaller isolated coverage areas.
- RF network self-healing is required.
- A redundant stateful-failover solution is required.

4.6 Benefits of centrally coordinated network

- Lower operational costs. Centralized management facilitates ease of deployment and ongoing management.
- Greater availability. In this architecture, it's easier to respond in real-time to changes in the network performance and spikes in user demand.

4.7 Estimating coverage and equipment needs

The following tables can be used prior to having the wireless survey results to estimate the number of ProCurve access points or radio ports that you might need to cover a given area. The tables show typical distances you might find in a cubicle type office environment using the internal antennas for the ProCurve Access Point 530 and the ProCurve Radio Port 230. Many factors will determine effective range including the Tx power and Rx sensitivity of the wireless stations that will use the access point, obstacles to the RF signal, radio port mounting location, etc. However, the numbers below should yield an acceptable budgetary estimate of how many access points are required. Of course, in addition to RF performance, your choice of access point mounting location is likely to be influenced by factors such as aesthetics, physical security and other factors.

4.8 Tower Height Calculation

The tables given below are used to find the tower heights at different villages. The calculations are made from the worksheet which includes the following tables. The MSL at different locations can be found from the topo sheet. Following tables are used for finding the fresenal zone.

5 CONCLUSION

In our project we have studied the concept of Wi-Fi and Wi-Max, Wireless network details .We have also studied how much bandwidth is required and hot areas where more end user's works on simultaneously. Considering all this fields we have designed the Wi-Fi network for various villages in Pusad Taluka. We have given requirements, device specification etc and we have also marked the location of AP at proper place on the maps.

If implemented this project will definitely improve the livelihood of villages. But the actual implementation of this project is yet to be done. So there is scope to the upcoming batch to study this project and carry on it to make this project a reality.

6 REFERENCES

[1] "Architecting Next Generation Networks", Produced exclusively for broadcom by realtimepublishers.com, PP 37-42.

[2] "Understanding Wi-Fi ", January 2002, PP 4-9.

[3] Rob Flickenger,"Building Wireless Community Network" by O'REILLY, first edition January 2002, PP 1-44.

[4] "Planning a Wireless Network", ProCurve Networking by HP 2006 Hewlett-Packard Development Company, PP 1-17.

[5] Prof. Randy H. Katz "294-7: Radio Propagation", CS Division University of California, Berkeley. PP 1-20.

[6] http://en.wikipedia.org/wiki/Complementary_code_keying

[7] http://www.bbwexchange.com/howto/1_broadband_wireless_isp_overview.asp

[8] http://www.wi-fiplanet.com/news/article.php/3406611

[9] "Ashwini project on rural Wi-Fi", http://www.byrrajufoundation.org/html/supportmodulae.php?cat=s2

[10] FEASIBILITY STUDY OF SPATIAL REUSE IN AN 802.11 ACCESS NETWORK

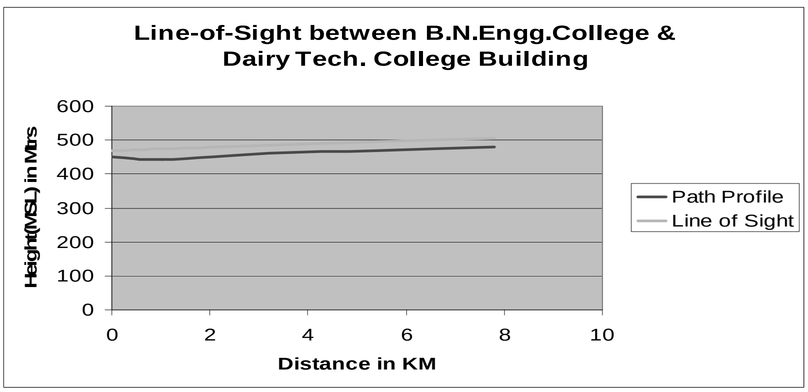
Appendixes:

	(Dairy tech college)	Location C	Location B	Location A	Location (Engg College)	Remark
Distance	7.8	5.4	3.2	1.03	0	IN KM
tower height	25				20	
Height	480	470	460	444	450	MSL in Mtrs
Height considering towers at both the ends	505	470	460	444	470	-35
difference of Elevation w.r.t .The MSL of A Location	30	20	10	-6	0	in Mtrs
difference of Elevation w.r.t. The MSL of A Location considering tower height at both the ends	35	0	-10	-26	0	
Gradient with reference to normal MSL at each Location	3.84615385	3.703704	3.125	-5.82524	0	Diff. of ele. In mtrs/distance in KM
Gradient with reference to normal MSL at each Location Considering Tower heights at Both the Locations	4.48717949	0	-3.125	-25.2427	0	Diff. of ele. In mtrs/distance in KM Considering Mast at Both the ends
LOS with tower height added at both the Locations	35	24.23077	14.35897	4.621795	0	in Mtrs
Actual LOS	505	494.2308	484.359	474.6218	470	in Mtrs
with Fresenal Zone radius(-)	505	494.2308	475.3	474.6218	470	in Mtrs
with Fresenal Zone radius(+)	505	494.2308	493.4179	474.6218	470	in Mtrs

1. Sample example for calculation of Tower height:

Free Space Loss=32.45+20LogF+20LogD						
Distance in KM		LogF(Freq. in MHz)		LogD(Distance in KMs)	Free space Loss	
1	20	3.380211	20	0	100.0542	dBm
7.8	20	3.380211	20	0.892095	117.8961	dBm

First Fresenal Zone								
D in ft	D in km	F1 in Mtrs	D1	D2	a	Bulge(B)	D1 in ft	D2 in ft
25591.8	7.8	15.09823	3.2	4.6	6510	0.001508	10499.2	15092.6
		F1 in Feet						
		49.53729933						
		60%F1 in Mtrs						
		9.058939225						



LOSS CALCULATIONS FOR LINK								
Trans Power in dBm	Cable Loss	Connector Loss	Antenna Gain	Free Space Loss	Antenna Gain	Connector Loss	Cable Loss	Receive Level in dB
26	-0.134	-0.75	24	-117.896	24	-0.75	-0.134	-45.6641
	Cable Loss Per 100Mtr in dBm						Cable Loss Per 100Mtr in dBm	
	26.8						26.8	
	Lenth of Cable						Lenth of Cable	
	0.5						0.5	