WIRELESS NETWORK DESIGN FOR TELECENTER

IN RURAL AREA

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UNIVERSITY UTARA MALAYSIA

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IN RURAL AREA

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By

SATEA HIKMAT ABOUD

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ABSTRACT

Information and communication technology (ICT) employment and dissemination assists many countries in incorporating many goals of digital divide most importantly by opening telecenters in rural areas. Many telecenter projects have been implemented in Malaysia for example in the last ten years. Deployment of the projects usually, is subjected to so many problems due to inadequate infrastructure and appropriate design. This project aimed at the selection of an effective design of the network with a budget cost estimate, by using a system program which subsequently includes smart questions that would contribute to the solution. The research questions stated are: How to use the technology that fit telecenter project in rural areas? What is the estimated cost of the basic requirements for the design of network infrastructure and the deployment in this area? It was then found that Wi-Fi technology can be adopted as a viable technology in terms of cost for rural areas connectivity by connecting community centers to each other and to the Internet.
ACKNOWLEDGEMENT

By the Name of Allah, the Most Gracious and the Most Merciful

First, I would like to express my appreciation to Allah, the Most Merciful and, the Most Compassionate who has granted me the ability and willing to start and complete this study. I do pray to His Greatness to inspire and enable me to continue the work for the benefits of humanity my most profound thankfulness goes to my supervisor Assoc. Prof. Dr. Wan Rozaini Sheik Osman for her creativity, encouragement, and guidance. I am also thankful to all staff, my colleagues and friends at UUM, especially academic staff from the College of Arts and Science for their help and support, with whom I shared pleasant times.

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CHAPTER 1

Introduction

1.0 Introduction

Increasing the efficiency of information and communication technology increases the
development of a country. Employing the ICT information and technology and its
dissemination help many countries in incorporating the goals of digital divide most
importantly by opening telecenters in rural areas (Khushchu, 2008).

According to Shamsudin & Arshad (1997) the rural sector is vital to the growth of
the country's economic social and political sector (Hilam, 2007). The main focus of
the Department of Energy, Water and Communications, Malaysia or KTTA
(Kementerian Tenaga Air Dan Komunikasi) like the rest of the world is in the
development of infrastructure and services that encourage the development of
information and communication technology, part of this is to provide infrastructure
facilities for telecommunications and Internet services in rural areas.

The facilities for telecommunications should clarify the roll of telecenter Telecenter
is a facility that offers community members the ability to use ICT (information and
communication technologies) in a public place. Telecenter often provide the only
connectivity available to many community members, and their services may be
offered with or without a fee (Mathew, 2002).

In general, according to Hayakawa et al. (2007) telecommunications is where people
are able to access computers, the Internet and other techniques that help in the
collection of information and communication at the same time as they to participate
develop digital skills.
1.1 Problem Background

The deployment of telecommunications networks particularly in rural areas face challenges because of inadequate infrastructure and appropriate design that represents a major obstacle for many professionals and others interested in designing and building networks even government institutions.

A wireless network faces technical constraints (Best, Burnes, Escobedo and Shakeel 2001), many challenges and difficulties that must be overcome in order to link these areas with each other and with the outside world. The spacing between the regions is one of the most important challenges facing the proliferation of these networks. Problems that confronted the previous proposal made it necessary to obtain realistic solutions and process for the design of telecommunications networks. Thus, this stands as a strong motivation to minimize the challenges facing those interested in the establishment (telecenter). Where the proliferation of communications has become an urgent need for institutions to follow up this matter seriously and find the best suitable solutions.

The ITU-UUM ASP CoE for Rural ICT Development (International Telecommunication Union-University Utara Malaysia Asia Pacific Center of Excellence). Provide high quality training for executives access Asia Pacific and as well is involved in community outreach programme. According to the Director of ITU-UUM, there is need to implement a pilot study of telecenter to train the villagers in a site at Kampong Tradisi – Changlun, because of the request from the community to help them to improve their ICT awareness. However, due to limited funds; there are costs issues to setup the telecenter in this village.

This study will focus on Kampung (Kg) Tradisi, which is 5Km from UUM. Currently Kg Tradisi has a telecenter called Perpustakaan Desa (PD). The PD has a few PCs and has Internet access to get library resources using VSAT, but does not provide training to the villagers.

The community leaders of the Kg Tradisi want to implement another telecenter in the village that can provide training for the community. As ITU-UUM has been given some PCs from SKMM, ITU-UUM wants to find an effective and least cost design to build the new telecenter in this location.
1.2 Problem Statement

The stakeholder of telecenter is facing problems and challenges in identifying the needs necessary for the proper design of communication networks, especially in rural areas.

Stakeholders need more time and effort to find this solution; the real challenge is to provide appropriate solutions concurrent with low-income community.

This proposal is to assist the stakeholders of Telecenter to provide proper design of wireless networks and to determine the estimated cost of the project (Muiulu et al., 2004). This will reduce the time and effort to provide the technology available in rural areas.

The selection of the effective design of the network with a budget cost estimate, using the system program which includes smart questions that would contribute to the solution.

1.3 Research Questions

The research questions of this study are:

1. How to use the technology that fit telecenter and determined the cost of project in rural areas?

2. What is the estimated cost of the basic requirements for the design of network infrastructure and the deployment in this area?

1.4 Research Objective

This study attempts to achieve the following objectives:

1. To design a practical and effective wireless network design for telecenter in rural area.

2. To determine estimate cost needed for telecenter and network project.

3. To evaluate the design through expert review.
1.5 Scope and Limitation

This research focused on the selection of an appropriate network design for a telecenter in a Malaysian rural setting in Kg Tradisi - Changlun, and the estimate cost for the selected network design, a VB (Visual Basic) application program was used.

1.6 Significance of Study

The findings of this study would have profound effect on so many areas. Other issues found to be significant with this research report are in the issue of time management, effort and cost in the implementation of projects in rural areas. The study would also be beneficial to the information and communication sector especially in the sense that it will:

a. Support government organization or stakeholder of telecenter to the deployment for the world.

b. People living in these areas: and through the development of telecommunications service and communicate with the civilized world and to facilitate their living conditions and linking them with others areas.

c. The owners of the project: the provision of adequate and appropriate designs for their own communications network with the most appropriate requirements in the implementation to be constructive for the best design of an appropriate and suitable for communications networks, this means decreased costs.

1.7 Organization of the Report

This study is presented in six chapters. An overview of the content of the following chapters is as follows:

Chapter Two presents the review of the literature on digital divide in rural areas, the role of Telecaster in this area, the design techniques in wireless networks and a cost in determining the appropriate design of the project.
Chapter Three describes the research methodology used in this study.

Chapter Four provides discussion of the requirements of system and describes the design for the system which included use case diagram, sequence diagrams and activity diagrams design.

Chapter Five discusses the findings of this study based on the results of implementing the proposed system using the methodology described in the previous chapter.

Chapter Six concludes the study with conclusion, problems, recommendations, and future work.

1.8 Summary

This chapter presented the background of the study and research in solving the problem and the direction that gives the stimulant for this study.

The aim of this study is to facilitate the work of the Communications Center "telecenter" also determine the requirements preliminary design among the determinants of the cost.

The next chapter reviews the relevant literature.
CHAPTER 2

Literature Review

2.1 Introduction

According to Intelecon (2004), the information and technology gap related inequities between industrialized and developing nations are widening: a new type of information poverty looms. In fact the most developing countries especially the least developed countries are not sharing in the communications revolution. The global digital divide threatens to deprive a key many people from the development and progress can be achieved through information and communication technology. The service policies are more commonly found in developed countries also universal service is aimed at increasing the number of individual residences with telecommunications services and providing telecommunications services to all households within a country including those in rural and high cost locations, in the same case of universal service policies also focus on ensuring that the cost of telephone services remains affordable to individual users or to targeted groups of users (e.g. low-income families, people living in uneconomic areas).

Information and technology gap is the main focus of Ministry of Energy, Water and Communications, Malaysia-KTAK is the development of key infrastructure and services that will propel the development of ICT. Under the 6th National Policy Objective of CMA 1998, KTAK will ensure a suitable provision of affordable services over ubiquitous national infrastructure. Part of this infrastructure is the provisioning of Internet facilities and services in the rural areas (Halim, 2008).

In information and communication technology (ICT) there are the two issues relevant to explore ICT which are the participation and communication between cultures. The repeated use of the term digital divide and cultures can be seen as a real attempt by the community leaders and elites to reduce the digital gap and the
extension of the world's poorest communities through the establishment of telecenters (Colle et al., 2000).

The people that live in rural areas lacked the possession of their PCs this is common in developing countries (Upadhaya, 2002). However, international aid agencies, governments and non-governmental organizations are striving to provide the potential for development of rural community-based call centers.

2.1.1 Telecenter

Telecenter is shared premises on where the public can access information and communication technologies (Colle & Roman, 1999). Telecenter have been a hot topic among policymakers and development aid organizations wishing to connect people in developing countries particularly where rural communities with little or no access to information are concerned (Colle et al., 2000).

2.1.2 Vision: A knowledge Society from the Ground Up

According to (telecenter.org, 2006) telecenter are part of a global movement for the community use of technology that removes barriers of geographic isolation and poverty. Telecenters offers learning programs to help people find jobs or start businesses and provide access to e-health and e-government. They exist as a common space where people meet and deal with technology as a community teaching each other how to create media or program computers, inventing new business ideas and organizing community development campaigns. Most importantly, telecenters give people a voice service in their own futures by adapting the tools of the knowledge society to suit their real needs. In this world, telecenters are vibrant local hubs where the social economy of a community revolves. People can gather to learn and experiment using technology.

According to (telecenter.org, 2006) people have been building telecenter for over 20 years. Originally the focus was on access to computers and other basic technologies, but in recent years the focus has evolved to include a wide variety of
communications content and community development services. Figure 2.1 illustrates telecenter specifications.

Figure 2.1: Telecenter specifications (telecenter.org, 2006).

Telecenter specifications focus on the use of technology to strengthen communities (telecenter.org, 2006). Figure 2.1 illustrates that Telecenter offers people a place to learn about computers, provide villages access to government services, allow isolated communities to bridge the education, health gap and open up economic opportunity for small entrepreneurs.

2.1.3 Telecasters in Malaysia

According to (Harris, 2007) many telecenter projects have been implemented in Malaysia in the last ten years. The implementation of telecenters contributed to a wealth of operational experience relating to the use of ICTs for community development. Presently there are several nationwide programs to establish telecenters for shared access to ICT. Each program consists of about 50 implementations. Some of the programs includes; the Pusat Internet Desa (PID) program, operated by the Ministry of Energy, Water and Communications (MEWC) and the Medan InfoDesa (MID) program operated by the Ministry of Rural and Regional development. The Malaysian Communications and Multimedia Commission (MCMC) also sponsored series of Kedai.com Internet shops.
Telecenter in the current status become the main points of access to ICT. Table 2.1 illustrates the number of Telecenters in Malaysia.

Table 2.1: Illustrates The Number Of Telecenters In Malaysia (Harris, 2007).

<table>
<thead>
<tr>
<th>Service</th>
<th>Number</th>
</tr>
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<tbody>
<tr>
<td>Universal Provision (USP)</td>
<td>1588</td>
</tr>
<tr>
<td>Rural Internet Center (RIC)</td>
<td>42</td>
</tr>
<tr>
<td>Medan Infodesa (MID)</td>
<td>42</td>
</tr>
<tr>
<td>USP Communications Center (UCC)</td>
<td>12</td>
</tr>
<tr>
<td>Rural Broadband Library</td>
<td>44</td>
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</tbody>
</table>

There are five categories that assessed the overall service Governance, Center for Rural Internet (RIC), the Medan Infodesa (MID), USP broadband in rural areas (CRC) and the Library of the communications Center (UCC) (Harris, 2007).

2.1.4 Challenges toward Telecenter Sustainability in Rural Areas

Osman (2008) discussed the main challenges that face telecenter implementation in rural area.

The challenges are:

- Remoteness leading to high startup cost
- Low population density leading to limited usage
- High operating cost
• Technology moves fast
• Need proper business model

2.1.5 Telecaster Networks

The present and future telecenters are networked. Networking the telecenters is important because telecenters are not operating independently, but as members of a network (Proenza, 2005).

2.2 Rural Connectivity

According to (Proenza et al., 2005) connectivity of telecenters in rural area has been aided by the rapid developments in wireless technology. Therefore it has been possible to overcome physical hurdles such as distance and topography at reasonable cost. The physical huddles have since limited the development of telecommunications infrastructure in rural areas of Latin America and the Caribbean. Investment in telecommunication infrastructure has the benefit of providing Internet services and not only rural telephony. Shared access to Internet services through telecenter can increase the development of rural areas. In remote and sparsely populated areas market incentives will often provide insufficient stimulus to private investment and government subsidies will be required.

2.2.1 Wireless is Important for Rural Service

Wireless network equipment is important to the development of ICT in rural area; the author illustrates the advantage for using this technique, especially when implementing telecenter in rural area:

1. Cost advantages for rural service:
   • Easy to deployment
   • Easily scalable to meet demand requirements as these rise.
• Cost advantage serving disperse populations, distance from one access point to the other does not affect cost of service).

2. Suited to meet rural demand

• Low income rural Communities do not need to start with High Bandwidth. (Proenza, 2005).

2.3 Wireless Networks and Community Development

According to (Bar & Galperin), the expansion of internet connectivity to communities in the developing world, includes reduce the costs and benefits balance. The price of access to the internet should be a balance with low-income communities. At the same time, the gains derived from it must be linked to good enough to continue in the long term. Costs models associated with the deployment of access solutions to fixed and often proved to be inadequate to address this problem.

2.3.1 IEEE 802 Wireless Standards

1-IEEE 802.11a/b/g Wi-Fi

802.11b is a refined standard for the original IEEE 802.11 and was successful due to its high data rates. 802.11b is the most widely deployed wireless network within the 802.11 wireless families. 802.11b supports data rates of up to 11Mbps and uses the DSSS modulation technique that is more reliable than the FHSS (Kurose & Ross, 2008).

On other hand, the IEEE 802.11a operates in the 5 GHz band with a maximum data rate of 54Mbps. This standard was ratified almost at the same time as 802.11b (Winget et al., 2003). The 802.11a hardware was only made available in 2001 due to lack of availability of the frequency band components. The major disadvantage in deploying 802.11a with the other 802.11 standards b and g is that they cannot co-exist, as they operate on different frequency bands. 802.11b/g operates on the 2.4 GHz spectrum (Mathew, 2002).
There are some wireless card and access points which are compatible to all the three standards thereby supporting the 2.4GHz and 5GHz frequencies e.g. Orinoco 11a/b/g (HP, 2006).

The IEEE 802.11g wireless standard also operates on the 2.4 GHz band and has similar range and characteristics as the 802.11b. It has a raw data rate of 54Mbps. The 802.11g has backward compatibility with 802.11b and differs only on the modulation technique; it uses Orthogonal Frequency Division Multiplexing (OFDM). This then makes the 802.11b devices not able to pick the signal from the 802.11g devices (Marrow, 2004).

2-IEEE 802.11n Wi-Fi

According to (TeraBeam, 2004), the 802.11n Wi-Fi standard uses the second generation of Wi-Fi technology to deliver high data throughput. The Wi-Fi 802.11n technology established through multiple-input/multiple-output MI-MO radio technologies is a promising technology and a major technical breakthrough for Wi-Fi networking. It is important to increase data rates and throughput. This technology will change the way Wi-Fi networking is done in the workplace. However, it is also a complicated technology that introduces a set of issues whether it is deployed in a brand new environment or as a migration from an existing legacy 802.11a/b/g network. If not properly planned, configured, and managed, 802.11n can quickly turn into a dissatisfying waste of an organization’s time and resources while failing to achieve the promised benefits. To avoid this and fully realize the benefits of a seamless, robust, always-on wireless network, a fully featured sophisticated wireless network management tool is essential.

3-IEEE 802.16 WiMAX

WiMAX IEEE 802.16 is based on IP technology and broadband wireless networks, the performance of 802.11/Wi-Fi in addition to the coverage and QOS (Quality of Service) of cellular networks. In the other hand the WiMAX is also an acronym of “Worldwide Interoperability for Microwave Access (WiMAX). The major
characteristics of WiMAX are standards for processing the adoption of advanced radio features in a unified manner and reduce costs for all of the radios made by companies. The WiMAX Forum is a body was set up to ensure interoperability of standard through testing. The long-term evolution (LTE) standard describes a similar parallel to the term WiMAX technology being developed by vendors and carriers (Ohtrtman, 2009).

2.3.2 WiMAX and Wi-Fi Together: Synergies for Next-Generation Broadband

WiMAX extends the benefits of Wi-Fi networks to deliver the first generation of truly mobile broadband Internet. The integration of WiMAX and Wi-Fi promises convenient and affordable broadband connectivity that brings new deployment models for service providers, as well as new usage models for subscribers. The ability to be connected to the Internet and to have access to real-time information in more places is of high value to business professionals and consumers alike. The advantages of coupling WiMAX and Wi-Fi enable service providers to offer compelling new service offerings with both WiMAX and Wi-Fi capabilities and to take advantage of device cost savings enabled by the synergies between the two technologies. These capabilities and synergies position service providers to be more competitive and profitable as the new face of broadband emerges (Intel, 2008).

2.4 VSAT technology

According to in case of technology can use in rural area clarify the VSAT specification, the VSAT are small earth stations (normally 1.4 - 2.4 meters) that are utilized for reliable transmission of data, voice and fax via satellite. VSAT Terminal Equipment consists of two units - an indoor unit and an outdoor unit. The outdoor unit is placed outdoors for a line-of-sight to the satellite and the indoor unit interfaces with the user's communications device (e.g. data terminal equipment). The outdoor unit consists of a small antenna, mount and electronics for signal reception and transmission. The indoor unit consists of a satellite modem and demodulator(s)
and a network access device to interface with data LANs and PBXs (TM Global, 2008).

The aims of the use this technique is:

1. Satellite communication offers borderless communication within the satellite coverage area.
2. Reachable to remote areas with digital transmission
3. Rapid deployment for new sites - Rapid commissioning of new sites within an existing network
4. Cost effective - The pricing is distance independent. No matter how far your location is, the pricing is still the same.
5. Flexibility and efficiency - Network configuration changes such as bandwidth, interfaces, data rates, etc. can be performed remotely from the central network management system (TM Global, 2008).

- Implementation of VSAT technology in Malaysia

Many projects had started and implemented by providers such as Telekom and Maxis. Figure 2.3 displays E-BARIO projects execution in Malaysia (TM Global, 2008).

- E-BARIO Synthesis

The project objective was to define the opportunities for social development which are available from the deployment of Information and Communication Technologies (ICT) within remote rural communities in Sarawak, this project has shown the following results and impacts.
Figure 2.2: E-Bario network diagram (TM Global, 2008).

- Internet access is to be provided by the national telecommunications carrier, Telekom Malaysia, who has installed satellite dishes and VSAT equipment for the connections to the telecenter and the school.

- Malaysians are aware of the capability of the technology, therefore the agenda for development activities are based on improved technology-driven information delivery.

2.5. Coverage Is More than Distance

The WiMAX base station is primarily intended to deliver very high bandwidth to a relatively small number of endpoints. WiMAX bandwidth and distances covered vary inversely are both significantly impacted by local topology. The high speeds and long distances claimed for WiMAX are primarily for line-of-sight installations (Mesh Dynamics, 2007).

On the other hand practical installations must deal with hills, tree, and other obstructions. For this reason it is often necessary to use larger numbers of wireless
nodes to provide continuous coverage in the desired area. Wi-Fi wireless mesh nodes offer an easily-installed way to provide wider coverage using the unlicensed spectrum (Mesh Dynamics, 2007).

2.6 Economic Analysis of Networking Technologies for Rural Developing Regions

The economy roll with technologies that provide connectivity to rural areas in the developing world is an economically challenging problem especially with low income levels and low population density in rural areas (Mishra et al., 2005).

Many existing communication technologies with high deployment costs limit the ability of establishing a telecenter. The Akshaya Network located in Kerala, India was used to study a particular case. It was discovered that the use of a wireless network with Wi-Fi backhaul CDMA450 gives the lowest cost of deployment. However if we are expected to include the cost of spectrum licenses CDMA450 a network with lease exempt spectrum for the use of Wi-Fi and WiMAX Backhaul access is the most attractive option economically (Mishra et al., 2005).

2.6.1 Daknet Provides Extraordinarily Low-Cost Digital communication

The IEEE 802.11 standards have led to huge commercial success and low pricing for broadband networks. While these networks are viewed as mainly for offices or for hotspots in urban areas, they can provide broadband access to even the most remote areas at a low price (Pentlaad, 2004).

Data wireless networks based on the IEEE 802.11 or Wi-Fi standard are perhaps the most promising of the wireless technologies. The forces driving the standardization and proliferation of Wi-Fi in the developed world have resulted in features that can stimulate the communications market in the developing world. These features include ease to setup, use and maintenance. And most importantly relatively low cost for both users and providers.
As one demonstration of the practicality of this new technology for rural connectivity researchers from the Indian Institute of technology at Kanpur, working with Media Lab Asia (www.medialabasia.org), have “unwired” a 100-square km area of the Gangetic Plain in central India.

The project by (Pentland, 2004) provides broadband connectivity along a corridor with almost one million residents, at a projected one-time cost of about $40 per subscriber. Other experiments have shown the practicality of the technology in mountainous terrain and in city centers. Indeed, several cities in the US have begun to deploy free Internet connectivity using IEEE 802.11b.

Even with advances such as those demonstrated in the Digital Gangetic Plain project the cost of real-time, circuit-switched communications is sufficiently high that it may not be the appropriate starting point for rural connectivity in developing nations.

Market data for information and communication technology (ICT) services in rural India strongly implies that asynchronous service voice messaging like e-mail and so on may be a more cost-effective starting point for rural connectivity projects (Pentland, 2004).

2.7 Building Wireless Mesh Networks in Rural Area

To provide connectivity in rural areas comes with challenges such as the high cost of installation equipment, lack of reliable power and high cost of providing internet connectivity. The recent emergence of low-cost wireless 802.11 device and the utilization of mesh networking enables connectivity in rural areas.

Low-cost of wireless rural networks in Africa shows encouraging results in which houses, schools and clinics are connected on shoestring budgets. There are many community-based wireless networks which are emerging in rural developing area around the globe.

Some examples of these networks are the Dharamsala Community Wireless Mesh Network (Gohnson, & Roux, 2007). The mesh networks being set up by CUW in Ghana and long distance wireless networks being set up in Rwanda, Ghana and
Guinea Bissau by the TIER group at University of California, Berkeley. (Bicket et al., 2005). There is also a pattern emerging where wireless mesh networking technology is honed and fine tuned in highly skilled urban areas and later used in rural areas with great success such as the MIT roof net project.

2.8 Bandwidth Management

2.8.1 Definitions of Bandwidth

Bandwidth is often used as a synonym for data transfer rate - the amount of data that can be carried from one point to another in a given time period. This kind of bandwidth is usually expressed in bits (of data) per second (bps) (SearchEnterpriseWan.com, 2009).

In electronic communication, bandwidth is the width of the range (or band) of frequencies that an electronic signal uses on a given transmission medium. In this usage, bandwidth is expressed in terms of the difference between the highest-frequency signal component and the lowest-frequency signal component (SearchEnterpriseWan.com, 2009).

2.8.2 How to Calculate Network Bandwidth Requirements

Network bandwidth is one of the most important factors in the design and maintenance of a functional LAN or WAN. Unlike a server, which can be configured and reconfigured throughout the life of the network, bandwidth is one of those elements of network design that is usually optimized best by configuring the required network bandwidth correctly from the beginning (SearchEnterpriseWan.com, 2009).

The bandwidth refers to the data rate that is supported by the network connection or the interfaces that connect to the network. It is usually expressed in terms of bits per second (bps), or sometimes in bytes per second (Bps). Network bandwidth represents the capacity of the network connection (SearchEnterpriseWan.com, 2009).
2.9 Key Factors Affected In Design Network Wireless

The factors that affect the network design should clarify Fresnel Clearance Zone. According to the concept of Fresnel zone clearance use to analyze interference by obstacles near the path of a radio beam. The first zone must be kept largely free from obstructions to avoid interfering with the radio reception. However, some obstruction of the Fresnel Zones can often be tolerated, as a rule of thumb the maximum obstruction allowed is 40%, but the recommended obstruction is 20% or less (TeraBeam, 2004).

The radius of the Fresnel Zone at its widest point can be calculated by the formula listed in fig 2.3. Where d is the link distance in Kilometers, f is the frequency in GHz; r is the radius of the center line of the link in feet. In fact the Fresnel Zone is the area around the visual line-of-sight that radio waves spread out after leaving the antenna.

![Diagram of Fresnel Zone](image)

**Figure 2.3: Example of How The Fresnel Zone Can Be Disrupted (TeraBeam, 2004).**

Typically, 20% Fresnel Zone blockage introduces little signal loss to the link. Beyond 40% blockage, signal loss will become significant. This calculation is based on a flat earth. It does not take the curvature of the earth into consideration. The effect of this is to budge the earth in the middle of the link. It is recommended for long links to have a microwave path analysis done that takes this and the topography into account.
of the terrain into account. The equation to determining the radius of the widest point of the Fresnel zone is:

\[(17.32 \times \text{square root of } (d/4f))\]

Where \(d\) is the distance (in kilometers) between the two antennas and \(f\) is the frequency (in GHz) (Mishra, 2005).
CHAPTER 3

Methodology

3.1 Introduction

This chapter presents the methodology adapted in this study. The methodology chosen was an acceptable way, excellent choice, and described and accepted among experts in the design of information system for research (Vaishnavi & Kuechler, 2004).

The study focused on methods, techniques and methods used by researchers at the time to complete the study, data collection, for example, technology, data processing, and techniques and tools. The methodology includes key steps which are: awareness of the problem, the proposal, development, evaluation and conclusion, which shows the research method (Vaishnavi & Kuechler, 2004).

Figure 3.1 below illustrates the main stages in the research, design and methodology used.

![Diagram](Diagram.png)

Figure3.1: The General Methodology (Vaishnavi & Kuechler, 2004).
3.2 Awareness of Problem

The first stage of this method is to understand the objectives and the scope of this study, as well as the problems which are required to be solved. There is need for data collection to have a better understanding of the problem. The information obtained will assist the telecenter owner or person in charge of the project to select a fitting design and estimates the cost balancing.

This stage, of the methodology examines the development of procedures for the establishment of a mutual understanding of the project objectives, requirements and evaluation of the project's feasibility.

3.3 Suggestion

This study proposes a best design on the wireless networks in rural area, which enable the owner or executive to provide the appropriate model in the design, and in the second phase to establish a system to facilitate the identification of the cost of the project, which aims composition, and can be adapted to the requirements without any complication. The output of this stage is a temporary Marxist Leninist, which consists of graphic design appropriate for the network with the dock and the necessary requirements, Marxist Leninist common use of graphs, consisting of the status of painting, and the use of specifications and the issue of follow-up charts.

3.4 Development

The initial design and implementation technique for implementation has been done. The project architecture follows the step-by-step approach in building the model. At this stage application model is develop and systems appropriately calculated the estimated costs of the project assigned to them with the note, and take into account the necessary requirements.

The third phase of the methodology involves the transfer of analysis that has been done in the previous phase into implementation. The proposed design is
accomplished and the second objective interprets the application to target the estimated cost.

3.5 Evaluation

The evaluation was conducted to determine the value of efficiency and the use of the system after the system has been developed, it was tested through questionnaires and interviews in the Appendix C. The respondents are professionals working in the field of networks and competence, as well as Master students of (IT and ICT), who are studying in CCNA courses in UUM.

For the purpose of developing procedures that have been developed and the formation of a common understanding of the goals with the needs of users simultaneously, the feasibility of the project was evaluated through a number of the interview.

3.6 Conclusion

In conclusion, the outcome of the above stated methodology can be used in the future to implement the design of wireless networks, especially in rural areas.
CHAPTER 4

System Development and Prototype

4.0 Introduction

This chapter covers two phases, the first stage deals with the selection of the appropriate and adequate design for the wireless network that can be use in rural areas.

The second stage covers the W.N.D.R.T\(^1\) (wireless network design for telecenter) which is program of computer system, used by the researcher to estimate the total costs requirements for wireless network telecenter establishment.

The researcher followed the design and user interface graphics system model to design the prototype and came up with application framework of the system as shown below.

\(^1\) This symbol (W.N.D.R.T) to signal name of the project.
4.1 Selecting the Appropriate Network Wireless Design for Telecenter

Information and communication technology as an innovation it plays an increasingly and much more prominent role in the rural areas. Performance and innovation varied widely among regions and are much lower in the rural areas. Increasing requirements for the development of modern applications and services depends on increasing access to broadband and wireless services in rural areas.
According to (Pun, 2008), the most important technical characteristics of the communications network are the key to be reliable, accessible and easy to deploy. They are cost-effective, of which the cost structure for these special equipments that can connect the networks are high. The value of the price to users in the market and the possibility of paying the price show that the technology is not economically feasible in rural areas in developing countries. The economy and telecommunications distribution in rural areas cannot get enough return on investment for this reason of the planning and design of such kinds of network in the first phase of the costs for the establishment of the centers and the formation of Telecenter in rural areas.

That gives strong evidence that proliferation of networks depend entirely on the adoption of cost and the possibility the community to accept the price, despite the urgent need for the availability of community services.

4.1.2 Justification to Use Wi-Fi 802.11 in Telecenter Wireless Network

There are many related studies carried out on the telecenter in the rural areas in many countries, such as in Bhagwat et al. (2003), including the Ganges River in the plains of digital, (IW3C2) Manoj, Zhou. Rao, (2008), (DGP) Mishra et al. (2008), (Aravind) Greensfelder (2006), (Nepal and wireless) (Pun, 2008), (DjurslandS.Net) Konvert (2004), the results of these studies concluded that bringing the Internet to rural areas increases development and prosperity to developing countries requirements. They also assert that checking prices on the balance sheet well would help make available of telecenter for low-income areas. It is also found that 802.11 Wi-Fi technologies is most suitable in terms quality of equipment, ease of use and most importantly they can be used without license,

DGP project Mishra et al. (2008), CorDECT Mishra et al. (2008) and WiMAX Greensfelder (2006) aimed at low-cost technology to reach out to rural areas. However, the waves of CorDECT achieve much lower (about 70 Kbps), and despite the promises of WiMAX broadband speeds, it is not clear until now, if they have achieve the same cost of a Wi-Fi.
1. According to Saga (2004), the Advantages of Wi-Fi for rural information infrastructure include:

- Economic efficiency
- Low cost in establishment and operation
- Easy to set-up and use.

In the study of Saga (2004), he further stated some projects currently being implemented using Wi-Fi technology to provide wireless network in rural area such as:

- India: Digital Gangetic Plan: Media Lab Asia (Garai & Shadrach, 2006).
- Lao: Remote IT Village: Jhai Foundation (Surman & Diceman, 2003).
- Tele-center (VSAT +WI-FI +VoIP) project (Nepal) Saga (2004).

2. In another development (Intel, 2008), opines that the process of integrating technology Wi-Fi and WiMAX opens new hopes to the more rapid deployment of networks, thus increasing the support for rural areas.
The review at the findings from these studies shows that discussion through the ideas and facts which have been obtained from these researches / projects should be tabulated below:

Table 4.1: Illustrate Projects And Studies Which Rely Upon To Determine The Appropriate Design.

<table>
<thead>
<tr>
<th>Ref</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raman &amp; Chebrolu, 2005</td>
<td>Established the possibility of using 802.11 in long-distance networking</td>
</tr>
<tr>
<td>Raman &amp; Chebrolu, 2005</td>
<td>802.11-based long-distance networks have been proposed as a cost-effective option to provide Internet connectivity to rural areas in developing regions,</td>
</tr>
<tr>
<td>Brewer et al. 2005</td>
<td>802.11-based long-distance networks are the set of antenna towers.</td>
</tr>
<tr>
<td>Konvert 2004</td>
<td>Developed countries have been utilizing long-distance Wi-Fi links to extend network in remote areas.</td>
</tr>
<tr>
<td>Asia, 2005</td>
<td>Developed countries have been utilizing long-distance Wi-Fi links to extend network in remote areas.</td>
</tr>
<tr>
<td>Mishra et al. 2008</td>
<td>Digital Gangetic Plains (DGP).</td>
</tr>
<tr>
<td>TM Global, 2008</td>
<td>A good example is the system known as DakNet, which combines Wi-Fi with a mobile access point mounted on and powered by a public bus to provide email and video message capabilities to rural villages in India.</td>
</tr>
<tr>
<td>(Intel, 2008)</td>
<td>Intel, WiMAX extends the benefits of Wi-Fi networks to deliver the first generation of truly</td>
</tr>
</tbody>
</table>
(Intel, 2008) Mobile, broadband Internet. The integration of WiMAX and Wi-Fi promises convenient and affordable broadband connectivity that brings new deployment models for service providers.

4.1.3 Characteristics of Wireless Link Standards

One of the first considerations facing the institution that wants to deploy wireless networks which are compatible with the standards is to select the appropriate method of implementation. The goal of this discussion is not to prove that Wi-Fi is alternative to the choice of WiMAX but to identify a problem of cost that has played a key role in reducing the digital divide. The questions in this case are whether it is sufficient and whether techniques serve the purpose of the current use.

Why it is in most countries in the world are still trying to find appropriate solutions in rural areas with regards to the expansion and the deployment of telecommunication networks? Of course, there are other factors existing not less important but the cost of publishing a priority plays an important point to note when selecting and use of such networks in many countries in the world especially in developing countries. This is how to take the advantage of technical progress in the field of Wi-Fi.

The 802.11 technological advances the modern techniques up to several kilometers that helped to use Wi-Fi alternative in rural area (those areas referred to in previous studies) and deployment costs and the possibility of using the Wi-Fi alternative to the licensing of the rest because of the ease of use. On the basis of the successful projects implemented and also those which are currently being implemented in some countries with the possibility of using Wi-Fi in a distance of up to tens of kilometers. This is surely a huge development in the techniques used in wireless networks.
devices at the present time where available (antenna and access point) to several kilometers are available.

4.1.4 Choose the appropriate technique from during the previous conclusions

Through previous studies, it was noted that the selection of appropriate technical and deployment in rural areas comes simultaneously with the event in terms of cost choice of technology as Wi-Fi despite the difficulties in publishing for the short term. We cannot forget the availability of techniques for the quality of the largest and more efficient deployment such as WiMAX.

The following shows the cost factor as well as the community acceptance use. The Wi-Fi 802.11 equipments are available and cheap, easy to use and do not need a license to use compared with WiMAX. According to Intel (2008), as stated in its report submitted as a proposal for the inclusion of Wi-Fi and WiMAX technology to work together to take advantage of the rapid and effective deployment of telecommunications in a broader context and this is an incentive to make these countries particularly developing countries a preference Wi-Fi for the use of this technology in rural areas. The above-mentioned projects successful and effective in serving the community of these areas.

IEEE Wi-Fi technology option is now available within the limits of acceptability compared to the technical specifications of the WiMAX broadband, the reason is for the deployment of last mile which includes the cost of the user and cannot deny the benefits and capabilities of WiMAX but the goal in this case cheap cost choice for rural areas also to support the effectiveness of WiMAX technology in increasing the proliferation and expansion of sync with Wi-Fi.
4.1.5 Analysis Models Design Choice for Telecenter Network

The design choices are dependent on these goals:

a) Determine desired goals.

b) Technology choices.

c) Budget (estimate cost).

d) Environment obstacle (hill, tree).

The role of the telecenter as the initial sole provider of services can be enhanced by using the core communication network to distribute access and connectivity to the surrounding community. That is using the telecenter to broadcast coverage to the houses and businesses around the TC.

In case of resources services, the telecenter receive the service from three resources (see figure 4.2):

1) Through the Wi-Fi technology in the short distance between the centers of service and Telecenter.

2) Through WiMAX technology in the broadband access in the event that a telecenter is beyond the scope of coverage of Wi-Fi and WiMAX for possession of a broader scope of delivery.

3) In remote areas that are difficult to deliver WiMAX deployment because of the high cost equipment, license to use and environment obstacle (hills, trees etc) that faces deployment implementation, in this case the best option is VSAT to such specific remote area (Raman, 2004).Figure 4.2 illustrate the initial sources to provide internet access to the telecenter.
This issue highlights an important point that the telecenter has become a point of connection between the network core and the rural areas.

The significant location for telecenter make too much of organizations also the governments' to donate and exaggerates interest and perfect support.

### 4.1.5.1 Wireless Networking Protocols

#### 4.1.5.1.1 Typical Models for Wireless Networks Design.

The primary technology used for building low-cost wireless network currently the 802.11 family of protocols (see figure 4.3), also known in many circles as Wi-Fi.
Figure 4.3: Wireless standards IEEE Family (Kurose, J., & Ross, K. (2008)).

Figure 4.3 presents the different types of IEEE 802 families; this form facilitates the comparison between the techniques-coverage and the speed of data transmission on the network. This study focuses specifically on IEEE 802.11 and the employment of this technology for use exclusively in rural areas.

4.1.5.2 Wi-Fi Specifications

Technology and specifications of the form (Wi-Fi 802.11) found that it has the coverage of a few (200 to 300) meters. This feature is small compared with the 802.16 WiMAX. To support the Wi-Fi technology 802-11 and increase its coverage distance the use of multi-hop (from point to point) is necessary (see figure 4.4). It has a wide range using this method of up to 20 kilometers, which makes access to the distance with the lower cost of deployment, especially in the last mile. This
technique has been deployed in a number of places in all parts of the world (Bhaskar, 2005 and Raman, 2004).

4.1.5.2.1 Wi-Fi 802.11

Telecommunications service received by WiMAX will be available within the region and can extended when deploy with Wi-Fi (Djursland.net, 2004).

According to Bhaskar (2005), the integration of WiMAX and Wi-Fi promises convenient and affordable broadband connectivity that brings new deployment models for service providers.

![Diagram of Wi-Fi range extension](image)

Figure 4.4: Extend Distance Wi-Fi 802.11, Reliance To (Kurose, J., & Ross, K., 2008).

The Figure 4.4 explains how we can extend the distance. Wi-Fi 802.11 can be extended to obtain a large link needed to link nearby rural area that get linked up to 20 km in some cases more than that distance with a high quality equipment using point-to-point access link to the desired target.
4.1.6 Wireless Network Design Components of Telecenter Project

In the context of explaining the project, components will be assumed that telecenter is equipped with Internet service through three sources: VSAT, broadband WiMAX and Wi-Fi.

Benefit from the cost estimate is an important criterion for the deployment of technology in developing regions. While the IEEE 802.11-based networks over long distances may provide a cost for this option to link remote villages.

The telecenter and the style of wireless network implemented to serve rural areas is an important and sensitive issue in terms of the cost, which was examined during this study.

The wireless network components for (telecenter) can be divided into three main parts:

- Stage I: the reception and provision of telecommunications service to the (telecenter).
- Stage II: the components and contents (telecenter) internal
- Stage III: the deployment of communications and broadcasting service in the rural area surrounding (telecenter).

4.1.6.1 Simulation Design for Telecenter Wireless Network.

The main stages of the wireless network design of telecenter clearer in Figure 4.5, this design illustrate the basic steps to implement a project of telecenter in rural areas.

This design is divided into several basic phases each one of these phases includes several steps and a duty to implement it. The implementation of the telecenter project depends on the proper planning and technical implementation. The following figure explains the necessary requirements; also the appropriate mechanism for implementation of would be clarified in the next steps.
4.1.6.1.1 VSAT component technology

4.1.6.1.1.1 VSAT technology

VSAT very small aperture transmission is the best choice of internet connection for most of the worlds, the skillfulness to connect remote and rural communities, as well as urban and rural areas with inadequate or unreliable telecommunications infrastructure, is unmatched by virtually any other technology in terms of feasibility, cost and ease of implementation in the fight to bridge the digital divide.

VSAT is small earth stations (normally 1.4 - 2.4 meters) which are used to transport data, voice and fax via satellite; the terminal equipment is including two units - a unit of internal and external. The outdoor unit is in the open air to the line of sight with satellite and the indoor units with a user interface that unable user to obtain
service communications Figure 4.6 clarify VSAT architecture with main devices in kg Tradisi telecenter.

Figure 4.6: Reliance to VSAT System Architecture in Kanpong Tradisi --Changlun

4.1.6.1.1.2 Basic components of VSAT technology:

Table 4.2: VSAT component technology

<table>
<thead>
<tr>
<th>Class antenna</th>
<th>Portion antenna with a diameter of 0.6 meters to 2.4 meters, and sometimes prefer to use large dishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor unit (ODU)</td>
<td>Outdoer unit ODU microwave electronic circuits.</td>
</tr>
<tr>
<td>Internal unit (IDU)</td>
<td>Internal unit (IDU) containing the special services of key reference before it is loaded on the carrier (carrier wave).</td>
</tr>
</tbody>
</table>
4.1.6.1.2 Internal Equipment for Telecenter

"Telecenter", as a wireless internet service provider (ISP) in rural areas.

1- Receive Internet service through a VSAT terminal.
2 - The distribution of service to rural areas through the Wi-Fi.

Telecenter in this situation became the part of the network, this new task for telecenter that played should be focus and monitoring carefully because the telecenter shifting out from its action work.

After compilation setup the terminal VSAT system (linking the VSAT through satellite with main station) in this case telecenter ready to provide the internet service rural areas.

Next step description of the basic components to be provided within the telecenter.

In this section will describe the basic components of the telecenter project, which can be categorized into two types:

1) Basic Components and Accessories.

The table 4.3 description of the necessary requirements should be provided within the telecenter.

<table>
<thead>
<tr>
<th>Computers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software programs</td>
</tr>
<tr>
<td>Printer</td>
</tr>
<tr>
<td>Telephone &amp; FAX</td>
</tr>
<tr>
<td>Furniture and equipment</td>
</tr>
</tbody>
</table>

Table 4.3: Basic Telecenter component in rural area

38
2) **Wireless Network Requirements For Telecenter**

Wi-Fi wireless fixed spread of the spectrum depending on the distance and quality of wireless connection. Wireless networks in this scenario to have a point to several points in the composition with the line of sight (LOS) between the regions and rural telecenters depending on the land and local sources of interference, the possibility of publishing one to ten kilometers between telecenters and composition in some circumstances it is possible to achieve longer distances using high-gain antenna.

a. First step of wireless network Base station (Bs).

Table 4.4: Telecenter wireless network component

<table>
<thead>
<tr>
<th>External antenna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access point</td>
</tr>
<tr>
<td>Router</td>
</tr>
<tr>
<td>Hub/switch</td>
</tr>
<tr>
<td>UTP&amp;STP</td>
</tr>
<tr>
<td>Main telecenter tools</td>
</tr>
</tbody>
</table>

b. Second step wireless network deployment

Table 4.5 describes the main requirements of telecenter that enable to deployment the internet service to areas neighbors. To connect the telecenter to the regions neighbors, that use Point to Point outdoor grid antenna and (Point to M. point) outdoor grid antenna to link another area.

39
The process of linking the cafe with the neighbors (villages) requires clarification of the most necessary requirements that must be provided, table 4.5 presents these requirements also shows the reliability of each type.

For the techniques and style of the link will be explained in the next paragraphs

Table 4.5: Recruitment for telecenter wireless network deployment

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point To Point</td>
<td>Depended For Distance</td>
</tr>
<tr>
<td>Outdoor Grid Ant.</td>
<td></td>
</tr>
<tr>
<td>Point To M. Point</td>
<td>Depended For No. OF Node Branch</td>
</tr>
<tr>
<td>Outdoor Grid Ant.</td>
<td></td>
</tr>
<tr>
<td>Tower &amp; Height</td>
<td>No. Of HOP. High Barrier + LOS (Fresnel Zone).</td>
</tr>
</tbody>
</table>

4.1.6.1.3 Point-To-Point To Extended The Range

Wi-Fi Systems were designed primarily for local area networks (With ranges of 300 meters or a little more) but can be used to provide coverage over relatively large areas by using enough access points to create overlapping cells of coverage or what are called “hot spots”. Wi-Fi can be used to provide connectivity from VSAT across entire institution say throughout the school or hospital grounds.

To achieve the desired goal, should be linked the telecenter with the neighbor's area (to reduce the cost rather than creating another telecenter).
This requires, first Increase the effective-range Wi-Fi technology using point-to-point equipment and selection of the appropriate antenna to provide the required coverage.

The following explanation how to link between these points also the calculation of the distance required covering to reach the goal. Will use the village instead of the target during the debate, and the goal is how to deliver telecommunications service to the nearest village of telecenter.

The Figure below, Highlights the necessary requirements to connect the two sides.

![Diagram](image)

*Figure 4.7: Linking the Telecenter to the Regions Neighbors*

To explanation how to link between these points also the calculation necessary requirements to connect, Assume the form of simultaneous coverage of the region and to be required by the telecenter that delivers Internet service to the nearest neighbors village, According to the former method shown in figure 4.2: that illustrates increase the range of Wi-Fi.

The preceding discussion highlights the key points covered and requires the examination is Theoretical calculations for this issue.
Method link use

To determine necessary requirement and the cost for equipment use this calculations method.

- Assume the range distance of (p-p) capacity (X) km (specification)
- To give values close to the truth, assuming the real capacity in the coverage 75% of the production specifications.

Discus the two cases require for the telecenter.

- **Case 1**: required to cover the direct access to neighbor’s village.
- **Case 2**: link the nearest area around telecenter using mesh network

Case 1:

Direct access distance to neighbor’s village using (p-p) antenna, Figure 4.8 illustrates telecenter linking another area using (p-p) sector direction.

![Diagram](image)

Figure 4.8: Use (P-P) To Link Telecenter with another Area (Village).

1) To determine real coverage capacity
   
   a. (BS Range *75%) = BS*coverage real distance.

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b. \((\text{P-P \ Range}) \times 75\% \approx \text{P-P} \times \text{the coverage real distance}\).

c. \((\text{BS} \times \text{Range} + \text{P-P} \times \text{Range}) = \text{CRD} \times \text{real distance cover}\)

2) To determine how much (p-p) need to cover all distance

a. \([\frac{\text{CA}}{(\text{CRD} - \text{BS \ Range})}] = \text{No. of (P-P)}\]

3) To calculate the cost of equipment deployment we need to cover the area:

a. \((\text{CD}) = [\text{set (BS \ cost} + \text{No. of (P-P) cost} + \text{(P-MP) cost}]\).

Where:

- \((\text{P-P}) = \text{Point-to-point 802.11 links using directional antennas}\)
- \((\text{P-MP}) = \text{Point-to-multi-point 802.11 links using sector antennas}\)
- \((\text{BS}) = \text{set basis station equipment range.}\)
- \((\text{BS}) \times = \text{real distance cover for set basis station}\)
- \((\text{P-P}) \times = \text{the coverage real distance}\).
- \((\text{RDC}) = \text{real distance converge area}\)
- \((\text{CD}) = \text{Cost deployment}\)
- \((\text{CA}) = \text{converge area sq km.}\)
Figure 4.9 a, b, c: illustrates the link points, P-P/P-MP antenna, between 2 sites (Telecenter arrivals to the target).

Figure 4.9 a, b, c: The Link Points Arrivals To The Target.
4.1.6.1.4 Case 2 Wireless Mesh Network

In the last step of the design of a wireless network for the telecenter the selection one of the alternatives to increase the penetration of telecommunications services in rural areas "Mesh network" based on the IEEE 802.11 a / b / g standards) can work to improve communications and support services in rural areas. The design of a wireless network is dependent on geographical location, and the distances between points that are linked to a combination of point-to-point connections over long distances (using the antenna) and there are many pilot mesh projects in different parts of the world Gohnson & Roux (2007), Bicket et al. (2005).

4.1.6.1.4.1 Wireless Mesh Node

Wireless mesh node consists of a wireless (router and an antenna). The mesh node could be installed indoors or outdoors. The antenna could be the standard indoor omni-directional antenna or it could be an externally mounted omni-directional or directional antenna. A mesh node communicates only with other wireless Mesh nodes.

4.1.6.1.4.2 Wireless Mesh Networking Principles

Communication between mesh nodes are based on Wi-Fi radios (IEEE 802.11 a/b/g) attached to directional or Omni-directional antennas Figure 4.10 illustrates that.

- Set up in ad-hoc mode (not client mode or infrastructure (access point) mode).
- Each node should be the same ESSID (name) and BSSID (number) - the BSSID should be fixed to prevent partitioning of the wireless network.
- Each IP address in this type of network should be unique to allow the computer in the network to connect to each others.

- A computer can connect to the mesh network via cables or via a wireless connection to a separate access point (hotspot) connected to the LAN side of a mesh node.

4.1.6.1.4.3 Important Considerations

The network design for a wireless mesh network will depend on the geographic area and distances between the points to be connected. A combination of point-to-point long distance links (using directional antennas) and local point-to-multipoint links (using omni-directional antennas) between mesh nodes can create a reliable mesh network. The mesh network can be created a simply and in low cost equipment, the characteristics of this technology, as well as ease of use does not need to be specialists in building this network and this feature can help community members to create their own network and published in the society.
4.1.7 Wireless Network Design for Kampong Tradisi –Changlun

In current problem (case Kg Tradisi), ITU-UUM has planned to implement telecenter in Kampong Tradisi-Changlun, this study will focus on Kg Tradisi, which 5Km from UUM. The figure 4.13 illustrates the propose design for Kg Tradisi site.

![Diagram](image)

Figure 4.11: Wireless Network Design for Perpustkaan Disa Telecenter.

The objectives of this study is to facilitate Telecenter owner’s, to use the technology that fit to telecenter and give it estimate cost of the basic requirements for project (Kg Tradisi telecenter) in rural areas. This will help stakeholders to the plan more easily, quickly, while reduce the time and effort.

This design will assist the telecenter owner of Kg Tradisi to establish anew telecenter in another area (site -2) and the main requirements need from the two sites clarify in the Figure 4.11, the sub-design for Kg Tradisi (Figure 4.11) extract from the general design that created in Figure 4.5.
The major component to implementation the design and the method link for this project, figure 4.12 illustrate the main component in these two sites in region for Kg Tradisi.

Figure 4.12: The Major Component and Method Link to Use for Kg Tradisi Telecenter

Figure 4.12 shows the proposed method to connect the second site with the Perpustkaan Disa telecenter, and the mechanism to link using Wi-Fi 802.11 for transfer the service of internet from the telecenter to the new site (proposed ITU-UUM).
The components required to implement the project as follows:

**Site 1:**

Table 4.6: Recruitments for site 1

| Wireless bridge | Modem | Router | Hub/switch | UTP&STP | Main telecenter tools |

Elements marked in the table, such as (Modem, Router, Hub/Switch) available in the telecenter, only add to the Wireless Bridge to link the site of the telecenter.

**Site 2:**

Table 4.7: Recruitments for site 2

| Wireless bridge | switch | UTP&STP | Main telecenter tools |

The basic requirements of the site 2 are shown in table 4.7; we need only to link these components with each other and through this process can receive service from site 1.
After the implementation of the connectivity and end the installation process, this has been achieved the desired goal linked the 2 site.

4.1.8 Summary

Wi-Fi technology can be adopted as a viable technology for rural and under-served connectivity solutions to connect schools, clinics, library and community centers to each other and to the Internet. This will ultimately create sustainable business models and universal access to ICT in rural and under-served areas. However, the successful implementation of this technology and the choice of usage model are also guided by an intimate knowledge of rural communities and their information and communication-related needs (Manoj, Zhou & Rao, 2008).

This study covers two important points:

- First: - the mechanism used to link the telecenter.
- Secondly: - the estimated cost of the project.

The main objective of this study is to assist owner of telecenter to selection the fit design and estimated cost of telecenter project. Mechanism and the nature of the network have been discussed previously; remaining is how to determine the estimated cost of the project.

Part 2 of this chapter will be covers the estimated cost of telecenter.
4.2 W.N.D.T.R\textsuperscript{2} System Specifications

4.2.1 System over View

This is a second part of fourth chapter; it covers the (W.N.D.T.R) system specifications, design and implementation. This part of chapter also provides the framework of the system followed by the design of the graphical user interface of the system model.

To determine the appropriate regulatory models, this section examines how to organize the actual delivery services and the price.

- What (organizational) model that most appropriate purpose?
- What are the alternatives (if any) in terms of organizational models?

(This analysis requires, in part, knowing how much of these different approaches will be a vision for financial planning). The (W.N.D.T.R) system, which will greatly help telecenter owner to understand needs for project establishment and also estimating the cost of project.

4.2.2 Software Requirement

Moving to the software requirements the system mainly needs these software products:

1) Operating System: Microsoft Windows XP Professional.
2) Microsoft Visual Basic Version (6).

The (W.N.D.T.R) system allows the owner of the project (telecenter) to identify the best conditions for building wireless communications network and to determine the total cost. This method is used in the communication facilities in rural areas.

\textsuperscript{2} Wireless network design for telecenter in rural area (Application program)
(W.N.D.T.R) system use computer application which has been proposed to solve the problem of identifying and calculating the necessary requirements to cover the cost for the owner of Telecenter, which would save time and effort.

4.2.3 Overall Flow Diagram W.N.D.T.R System.

The design of the system includes UML diagrams and a sketch of the system's framework. The UML diagrams involved are use case diagram, sequence diagrams and class diagrams. The following section illustrates the design of the system. Rational Rose 2000, UML Studio 8.0, and Microsoft Visio are used to draw necessary diagrams that help in the development stage. Use case diagram, as displayed in Figure 4.2.1 describes the overall interaction between the system and its user.
Figure 4.2.1.: Main Use Case Diagram
4.2.3 Use Case Specifications

4.2.3.1 Use Case Input Variables Set A WNDTR_UC_01:

![Diagram of Telecenter Owner and Input Variables](image)

Figure 4.2.2: Input Variable Set A

4.2.3.1.1 Brief Description:

This use case is to provide the application with the information need to compute the cost of Equipment.

Actor: Telecenter owner

4.2.3.1.2 Characteristic of activation:

Event driven by the Telecenter owner

4.2.3.1.3 Precondition:

Desire to find out the total cost of Equipment
4.2.3.1.4 Basic Flow:

The use case begins when the telecenter owner runs the wireless network required equipments for telecenter application. The first interface provides the network owner with the options to input variable Set A. This can be done in two ways. The first way is to key in the variables by typing into the text boxes in the interfaces while the second way is discussed in the alternative flow.

The variable set A includes the following:

a. BS or (AP's) range in KM and the price in RM;
b. The router Price in RM;
c. The hub/ switch Price;
d. Computer Price and its quantity needed.

4.2.3.1.5 Alternative flow:

The telecenter owner have the option to input the variable set A by clicking on the select equipment button on the interface, this displays on interface with pictures of various equipment which includes the router, switches, antenna, computers. Selecting will automatically fill in the text boxes on the interface.

4.2.3.1.6 Exceptional Flow:

Not applicable

4.2.3.1.7 Post Condition:

The application is provided with all the information needed to compute the total equipment cost.

4.2.3.1.8 Rules:

Not applicable
4.2.3.1.9 Constrains:
All the text boxes must be filled with integer or double no special characters.

4.2.3.2 Use Case Display Equipment Cost WNDTR_UC_02

![Use Case Diagram]

Figure 4.2.3: Display Equipment Cost

4.2.3.2.1 Brief Description:
This use case displays the cost of equipment on the interface for the telecenter owner

Actors: the system

4.2.3.2.2 Characteristic of activation:
Even driven by the telecenter owner

4.2.3.2.3 Precondition:
Variable set A is successfully entered in to the interface

4.2.3.2.4 Basic Flow:
This use case becomes active when the telecenter owner clicks on the Equipment costs button on the interface. The systems process the variables and display the output on the interface.
4.2.3.2.5 Alternative flow:

Not applicable

4.2.3.2.6 Exceptional Flow:

Not applicable

4.2.3.2.7 Post Condition:

The interface displays the compute equipment cost in RM on the interface.

4.2.3.2.8 Rules:

1. -Direct access distance to neighbor’s village.
   
   \[(\text{Bs Range} + \text{(P-P) Range}) \times 75\% = \text{real distance coverage.}\]

2. -To determining how many (p-p) needs to coverage all distance:

   \[
   \frac{\text{Coverage area}}{\text{(RDC} - \text{(BS Range)}) \times 75\%} = \text{No. of (P-P).}
   \]

3. -To calculate the cost of equipment deployment needs coverage area.

4. Total cost of equipment = (Bs) price + router price + switches price +
   (computer price \times quantity) + cost of equipment network wireless deployment.

   \[(\text{CD}) = \text{set (BS) cost + No. of (P-P) cost + (P-MP) cost.}\]

Where:

- (P-P) = Point-to-point 802.11 links using directional antennas.
- (P-MP) = Point-to-multi-point 802.11 links using sector antennas.
- (BS) = set basis station equipment range.
- (RDC) = real distance converge area.
- (CD) = Cost deployment.
- (CA) = converge area sq km.
4.2.3.9 Constrains:

Not applicable

4.2.3.3 Use case Calculate Fresnel Zone (WNDTR_UC_03)

![Diagram of Calculate Fresnel Zone](image)

Figure 4.2.4: Calculate Fresnel Zone

4.2.3.3.1 Brief description

This use case is calculated Fresnel zone radius in Km and 80% of the Fresnel.

4.2.3.3.2 Pre-conditions

The Tele-center wants to know the Fresnel zone due the obstructston.

4.2.3.3.3 Characteristic of activation

Event Driven (on Tele-center's demand)

4.2.3.3.4 Basic flow

This use case begins when the Tele-center owner want to calculate Fresnel zone

The Telecenter owner enters the distance between antennas in Km

The Telecenter owner enters the frequency (typically 2, 4 GHz)
The Telecenter owner then click calculate button to calculate the result.
The system will compute the result and display for the user.

4.2.3.3.5 Alternative flow

Not applicable

4.2.3.3.6 Exceptional flow

Not applicable.

4.2.3.3.7 Post-conditions

System calculate the result
System displays the Fresnel zone for Telecenter owner.

4.2.3.3.8 Rule(s)

The formula for determining the radius of the widest point of the Fresnel zone (in meters) is:

\[ 17.32 \times \text{square root of}\ (d/4f).\]

Where \(d\) is the distance (in kilometers) between the two antennas and \(f\) is the frequency (in GHz) at which transmitting.

4.2.3.3.9 Constraint(s)

Telecenter owner must enter valid number.
Telecenter owner cannot enter character like $ or #.
4.2.3.4 Use case Input Variables set C WNDTR_UC_04:

Figure 4.2.5: input variables set C

4.2.3.4.1 Brief Description:

This use case is to provide the application with the information need to compute the cost of bandwidth requirements.

**Actor**: Telecenter owner

4.2.3.4.2 Characteristic of activation:

Event driven by the Telecenter owner

4.2.3.4.3 Precondition:

User wants to find out the total cost of bandwidth requirements

4.2.3.4.4 Basic Flow:

The use case begins when the telecenter owner click on calculate bandwidth and the system will display the interface of wireless network bandwidth requirements for
telecenter application. The last interface provides the network owner with the options to input variable Set C. This can be done in two ways.

The first way is system ask the network owner if can estimate the number of the user in the network if the choice was YES the network owner will insert the number of the user while the second way is discussed in the alternative flow. The network owner will specify the Internet Service provider from drop down list and the system will display this price.

4.2.3.4.5 Alternative flow:

The telecenter owner have the option if he/she does not have an idea about the number of the user of the network to choose from drop down button the User density per Km2 between different area: Kedah, Sarawak, Selangor.

4.2.3.4.6 Exceptional Flow:

Not applicable.

4.2.3.4.7 Post Condition:

The application is provided with all the information needed to compute the bandwidth requirement cost.

4.2.3.4.8 Rules:

Not applicable.

4.2.3.4.9 Constrains:

The entire text field must be filled with integer or double no special characters.
4.2.3.5 Display Total Cost of Bandwidth WNDTR_UC_05

![Diagram](image)

Figure 4.2.6: Display Total Cost of Bandwidth

4.2.3.5.1 Brief Description:

This use case displays total cost of Bandwidth on the interface for the telecenter owner.

**Actors:** the system, telecenter owner.

4.2.3.5.2 Characteristic of activation:

Even driven by the telecenter owner.

4.2.3.5.3 Precondition:

Variable set C is successfully entered in to the interface.

4.2.3.5.4 Basic Flow:

This use case becomes active when the telecenter owner clicks on the Calculate button. The systems process the variables and display the output on the interface, and these outputs are:
1) Average number of users in the system is:

2) Average system bandwidth required:

3) Peak system bandwidth requirement:

4) Total price of the required bandwidth is:

4.2.3.5.5 Alternative flow:

Not applicable

4.2.3.5.6 Exceptional Flow:

Not applicable

4.2.3.5.7 Post Condition:

The interface displays the computed Total price of the required bandwidth in RM on the interface.

4.2.3.5.8 Rules:

Coverage area sq km = distance Km * distance Km.

User Density per sq km e.g. (Kedah = 180) see the table in. Appendix

Service penetration = 10 - 50 %

Average/peak bandwidth per user = 15 Kbps, 64 Kbps

Average number of users in the system is: ? USER (10% penetration)

? USER (50% penetration)

Coverage Average Owner Enter × Service penetration (0.1) × Density of population = No of user (10% penetration).
Coverage Average Owner Enter × Service penetration (0.5) × Density of population = No of user (50% penetration).

Average System Bandwidth Required:

? Mbps (10% penetration)

No of user (10% penetration) × 15 Kbps = ? Mbps (10% penetration)

Peak System Bandwidth Requirement:

? Mbps (10% penetration)

No Of User (10% Penetration) × 64 kbps = ? Mbps (10% Penetration)

No Of User (50% Penetration) × 64 kbps = ? Mbps (50% Penetration)

Total cost of bandwidth

Total cost of bandwidth = {?} Mbps/1000 (50% penetration) × Bandwidth (price) in KP/sec

4.2.3.5.9 Constrains:

All the text boxes must be filled valid values integer or double no special characters.

4.2.3.6 Display Total Cost WNDTR_UC_06

Figure 4.2.7: Display Total Cost
4.2.3.6.1 Brief Description:
This use case displays total cost on the interface for the telecenter owner

A ctors: the system, telecenter owner.

4.2.3.6.2 Characteristic of activation:
Even driven by the telecenter owner

4.2.3.6.3 Precondition:
Variable sets A, C is calculated successfully entered.

4.2.3.6.4 Basic Flow:
This use case becomes active when the telecenter Finish calculate the Variable A, C and Click on Total cost in the main interface and the system will process the variables and display the total cost on the interface

4.2.3.6.5 Alternative flow:
Not applicable

4.2.3.6.6 Exceptional Flow:
Not applicable

4.2.3.6.7 Post Condition:
The interface displays the compute total cost in RM on the interface.
4.2.3.6.8 Rules:

Total cost = Total cost of bandwidth + Total cost of equipment.

4.2.3.6.9 Constrains:

All the text boxes must be filled valid values integer or double no special characters.
4.2.4 Sequence Diagrams:

4.2.4.1 Diagram Use Case Input Variables Set A  WNDTR_UC_01

Figure 4.2.8: Sequence Diagram.
4.2.4.2 Sequence Diagram Use Case Input Variables Set A WNDTR_UC_01
(ALT)

Figure 4.2.9: Input Variables set A Sequence Diagram
4.2.4.3 Sequence Diagram for Use Case Display Equipment Cost

WNDTR_UC_02

Figure 4.2.10: Case Display Equipment Cost Sequence Diagram

4.2.4.4 Sequence Diagram for Use Case Calculate Fresnel Zone

WNDTR_UC_03)

Figure 4.2.11: Calculate Fresnel zone Sequence Diagram.

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4.2.4.5 Sequence Diagram of Use Case Input Variables Set C WNDTR_UC_04:

![Sequence Diagram]

Figure 4.2.12: Input Variables set C Sequence diagram

4.2.4.6 Sequence Diagram of Use Case Input Variables Set C WNDTR_UC_04 (Alt)

![Sequence Diagram]

Figure 4.2.13: Input Variables set C (Alt) Sequence diagram
4.2.4.7 Sequence Diagram Display Total Cost Of Bandwidth WNDTR_UC_05

Figure 4.2.14: total cost of Bandwidth Sequence Diagram

4.2.4.8 Sequence Diagram for Display Total Cost WNDTR_UC_06

Figure 4.2.15: Display total cost Sequence diagram
4.2.5 Class Diagrams:

4.2.5.1 Class Diagram for Sequence Input Variables Set A

Figure 4.2.16: Input Variables set A Class Diagram
4.2.5.2 Class Diagram for Sequence Input Variables Set a (Alternative)

Figure 4.2.17: Input Variables set A (Alternative) Class Diagram

4.2.5.3 Class Diagram for Use Case Display Equipment Cost WNDTR_U C_02

Figure 4.2.18: Display Equipment Cost Class Diagram
4.2.5.4 Class Diagram Use Case Calculate Fresnel Zone  (WNDTR_UC_03)

Figure 4.2.19: Calculate Fresnel zone Class Diagram

4.2.5.5 Class Diagram of Use Case Input Variables Set C WNDTR_UC_04:

Figure 4.2.20: Input Variables set C Class diagram
4.2.5.6 Class Diagram of Use Case Input Variables Set C WNDTR_UC_04 (Alt)

Figure 4.2.21: Input Variables set C (Alt) Class diagram

4.2.5.7 Class Diagram Display Total Cost Of Bandwidth WNDTR_UC_05

Figure 4.2.22: Display total cost of Bandwidth Class Diagram.
4.2.5.8 Class Diagram for Display Total Cost WNDTR_UC_06

<<Boundary>>
: Required Equipment Interface

- click calculate total cost()
- Display total cost()

<<Control>>
: System Controller

- send request to calculate()
- retrieve values()
- compute()

Figure 4.2.23: Display total cost Class diagram
4.2.6 Explain the Specifications of the Program Pages

4.2.6.1 Identification Page

![Image of Identification Page]

**Wireless Network Design for Telecenter in Rural Areas (W.N.D.T.R) System**

*Satea Hikmat Aboud*

*MR.800168*

Figure 4.2.24 Login Page

Above is the Identification page user, from this interface user can login to program. The user should be capable from any location.
4.2.6.2 Main Page for User

Figure 4.2.25 Main Page for User

Above is the main page for user, here created many buttons for user to easy use the system.

Explain the specifications of the Main page

- Part 1: Select your equipment requirement:

Should the user select the equipment type from the (press buttons select equipment) appear to him equipment page, the user can select equipment from this window; see Figure 4.2.27.
Figure 4.2.26: Main Page Select Your Equipment Requirement (Part 1).

Figure 4.2.27: Equipment Page (Part 1)
Part 2: this part uses it if the user need to deployment has network for another area, and should be determine the distance between the telecenter and target.

The user select the Range and Price of device (P-P/P-MP) from the page of equipment, appear to user when a press the (button (P-P AND P-MP) see Figure 4.2.28.
Figure 4.2.29: The Range and Price of Device (P-P/P-MP) (Part 2).

Figure 4.2.30: Equipment cost.
After the user select the equipment the system appear to him the information about equipments select.

Note: the button of calculate bandwidth active its now.

• Part 3: Here are some important factors in the deployment, whether the coverage area inter-barrier (Hills, trees) this option assist the user to calculate the height of the antenna, for the purpose of overcoming the barrier.

Figure 4.2.31: Fresnel Zone.
4.2.6.3 Bandwidth Page

Explain the specifications of the bandwidth page

Part 1: the owner can estimate the No of user:

Should the user enter the user numbers in network and enter the bandwidth ISP price in Malaysia. And when press the button calculates cost, appear to user these results.

Figure 4.2.32: Calculate Bandwidth Cost If The Owner Inter The No Of User In Network.

-The number of network users by 10%/50%.
-Average system bandwidth require in 10%/50%.
-Peak system bandwidth requirement in 10%/50%.
-Total price of the required bandwidth in network.
Part 2: In the event the owner cannot estimate the number of users.

The owner should be select the area that telecenter establishment from baton area selected from select area the system enter population density from this area.

![Diagram showing network bandwidth requirements](image)

Figure 4.2.33: Calculate Bandwidth Cost If the Owner Select the Region of Telecenter Network
4.2.7 Overall Flow Diagram W.N.D.T.R System

This figure paper to as the information should be entering to system and result from the system (Input...process...output).

![Flow Diagram](image)

Figure 4.2.34: W.N.D.T.R System Overall Flow Diagram
CHAPTER 5
SIMULATION AND RESULTS

5.1 Introduction

This chapter presents the results of this study through the discussion of statistical analysis. The report focuses on the analysis of test samples. A total of 30 samples were obtained from questionnaires distributed, the experts and those interested in designing networks. This chapter discusses access to the results of the study, which is based on the objectives of the study and evaluation of this system by 30 of the samples. Evaluation is based on review: a test for the possibility of using the computer program, to assist the owner or the implementing of the project to select the best design for a wireless network and evaluation of the estimated cost of the telecenter project.

5.2 System Evaluation

5.2.1 Usability Test for the Computer Program on Network Design Telecaster Progress Prototype

Usability Test for the program computer (VB6) on progress Prototype The objective of this evaluation is to examine the possibility of the use of the software to assist the owner to selection the necessary requirements for the project.

Test usability, one of the most important Approaches in the assessment of usability. The questionnaire was asked to use the model for the purpose of testing system, especially for practitioners interested in the design and implementation of networks.

5.2.2 Data Analysis

The summary of the descriptive statistic of the variables is given in Table 5.1 all variables were measured using 5- points Likert scale which being strongly agree. From the study, it was found that the means are between numbers 3.566 to 4.266.
For Question 3 ((W.N.D.T.R) System would facilitate my work to choose requirement, and to establishing wireless network.) Has the highest mean 4.266 with a standard deviation 0.785.

For Question 14(I found it easy to determine my choice to get my best requirement) for Question has the second highest mean 4.233 with a standard deviation 0.774.

For Question 2 ((W.N.D.T.R) System is useful for my job.) Have the Third Highest means 4.033 with standard deviation 0.8087.

For the lowest mean is 3.566 from the Question 11 (I feel comfortable by using (W.N.D.T.R) System.) with standard deviation 1.278.

And the second lowest mean is Question 8 ((W.N.D.T.R) System is easy to use.) 3.633 With standard deviation 1.033.

Table 5.1 Descriptive Statistics

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(W.N.D.T.R) system will enable the owner of telecenter to choose the best requirement quickly.</td>
<td>3.866</td>
<td>0.629</td>
</tr>
<tr>
<td>2</td>
<td>(W.N.D.T.R) System is useful for my job.</td>
<td>4.033</td>
<td>0.8087</td>
</tr>
<tr>
<td>3</td>
<td>(W.N.D.T.R) System would facilitate my work to choose the best requirement, and to establishing wireless network.</td>
<td>4.266</td>
<td>0.785</td>
</tr>
<tr>
<td>4</td>
<td>(W.N.D.T.R) System will save my money and time.</td>
<td>4</td>
<td>0.871</td>
</tr>
<tr>
<td>5</td>
<td>Learning to operate (W.N.D.T.R) System is easy.</td>
<td>3.9</td>
<td>0.885</td>
</tr>
<tr>
<td></td>
<td>Interaction with (W.N.D.T.R) System is clear understandable.</td>
<td>3.933</td>
<td>1.015</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>7</td>
<td>It is easy to become skilful at using (W.N.D.T.R) System</td>
<td>3.966</td>
<td>0.999</td>
</tr>
<tr>
<td>8</td>
<td>(W.N.D.T.R) System is easy to use.</td>
<td>3.633</td>
<td>1.033</td>
</tr>
<tr>
<td>9</td>
<td>I completely satisfied in using the (W.N.D.T.R) System.</td>
<td>3.866</td>
<td>0.937</td>
</tr>
<tr>
<td>10</td>
<td>I feel very confident in using the (W.N.D.T.R) system.</td>
<td>3.666</td>
<td>0.959</td>
</tr>
<tr>
<td>11</td>
<td>I feel comfortable by using (W.N.D.T.R) System.</td>
<td>3.566</td>
<td>1.278</td>
</tr>
<tr>
<td>12</td>
<td>It easy to interact with (W.N.D.T.R) System by using PCs.</td>
<td>3.966</td>
<td>0.89</td>
</tr>
<tr>
<td>13</td>
<td>The procedure through (W.N.D.T.R) System by compi system is clear.</td>
<td>3.77</td>
<td>1.006</td>
</tr>
<tr>
<td>14</td>
<td>I found it easy to determined my choice to get my requirement</td>
<td>4.233</td>
<td>0.774</td>
</tr>
</tbody>
</table>

The most questions that have gotten high agreement such as (Q3, Q14 and Q2) will be shown in the next charts.
Question 3:-(W.N.D.T.R) System would facilitate my work to choose requirement, and to establishing wireless network).

Figure 5.1 Q3's frequency

Figure 5.2 Q3's Statistics
Question 14:-(I Found It Easy to Determine My Choice to Get My Best requirement).

Figure 5.3 Q14's frequency

Figure 5.4 Q14's Statistics
Question 2: (W.N.D.T.R) System Is Useful For My Job.

Figure 5.5 Q2's frequency

Figure 5.6 Q2's Statistics
For the lowest mean is 3.566 and 3.633 from the Questions 11, 8.

First lowest mean are 3.566 from the Question 11.

Question 11 : (I feel comfortable by using (W.N.D.T.R) System.) with standard deviation 1.278.

Second lowest mean is Question 8 ((W.N.D.T.R) System is easy to use.) 3.633 With standard deviation 1.033.

Figure 5.7 Q11's frequency

Figure 5.8 Q11's Statistics
Figure 5.9 Q8's frequency

Figure 5.10 Q8's Statistics
5.3 Conclusion

This study was conducted for the purpose to facilitate the work of the owner (telecenter) or performance of the telecenter through a system of computer program applications.

IT accounts the estimated costs of the network system to assist the owner to select the best equipment required and it calculation of the cost of the project easily in less time and negligible effort.
CHAPTER 6

Conclusion and Recommendations

6.1 Introduction

This chapter reviews the features of development also includes problems and constraints that accompanied the researcher during the development of this project. Finally, this chapter ends with the possible improvements and recommendations for future action.

The following are review of project objectives:

- To design a practical and effective network design in rural area.
- To determining estimate cost needed for the telecaster and network project.
- To evaluate the design through expert review.

Design requirements in wireless networks and (WNDRT) system, the cost estimate submitted to the requirements of design, has been described in Chapter IV. And it identifies the requirements of the system used to solve the problem for the implementation of the proposed system.

This study also includes analysis and design of the system which was used later to develop the desired protototype of the system.

After the system has been developed, it was evaluated by the 30 students and staff experts on usability testing, and the functionality evaluation. The system has gained satisfaction and dissatisfaction for students and experts. There are some comments in order to strengthen the system that been introduced in the proposed system based on interviews conducted with the guidance of expert’s specialists, The system has
gained the students and staff satisfaction and they have suggested some comments in order to enhance the system.

The researcher conducted a series of interviews with experts and practitioners in the field of networking; the idea was presented by the researcher and takes some advice and important information that supports research, see the appendix for questionnaires and the responses.

6.2 Contributions of the Study

The owner or the implementing of the telecenter project will be able to access and obtain the necessary requirements and estimated costs of the project at any time in any place and at low cost through the use of the computer without complications.

6.3 Recommendations and Future Work

This model should be further developed in order to be more reliable through the integration of the system with relevant departments of the telecenter systems such as MCMC in order to ensure consistency of data and increase the reliability of the network.

Another important future in development of the system it was possibility that owner of project is fully funded (government regulations) this feature will be processing of user requirements necessary to service Mesh network, in this case the system could be developed to assess and calculate the total cost of the project (the main requirements of the network with the requirements of users).
6.4 Conclusion

The objectives of this study is to facilitate owner’s, to use the technology that fit in telecenter, and estimate cost of the basic requirements of the project in rural areas and make it more easily, quick, reduce the time and effort.

- The results of this study will help telecenter (TC) owners to reduce cost in the deployment of a new TC from current existing TC already set up in a village.
- The current cost of building a telecenter starts from at least RM 30,000

The application developed will help implementers to evaluate and compare costs.

6.4.1 Important Concepts in This Study

Through this study is focusing on the quality of the technology used in rural areas and basic needs, it is important to shed light on the question:

Why focus on this kind of basic technical requirements of the network without focusing on the remainder of the roles of telecenter?

Observe some shifting in procedure work of "telecenter"; it was noted at the current time and through many countries that is taking a new protocol it’s become the status of broadcast communications in these areas in addition to the roles of the former is well known.

For these reasons, the researcher focus from the type of technology used and the mechanism used to link the network.
References


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Appendix A

Questionnaire

Wireless network design telecenter in rural area

MSc (ICT)

College of Arts and Sciences

NAME    : Satea Hikmat Aboud
E-MAIL  : sateaahn@yahoo.com
SUPERVISORS: A.P.DR WAN ROZAINI BT SHEIK OSMAN

*NOTE: wireless network design telecenter in rural area system. Being used this short (W.N.D.T.R).

Introduction:

(W.N.D.T.R) system, a system which allows the right holder for the project (telecenter) to identify the best conditions for the building wireless communications network and bandwidth services, and to determine the total cost, this method used in the communication facilities, and rural areas.

(W.N.D.T.R) system applies the use of computer an application has been proposed to solve the problem of determining the cost of Telecenter owner, and to identify the necessary requirements, which provides time and effort.
Part 1: General Information

1. Gender:
   [ ] Male  [ ] Female

2. Age: ________ Years

3. Place of Living [ ] e.g. (Jitra, Alor Setar, Penang, Changlun… etc)

4. Are you a …
   [ ] Staff and Networks experts
   [ ] Student interested in the field of networking

Part 2: Overall Satisfaction.

This part is intended to rate your satisfaction with the overall usability of the computer-based application wireless network design telecenter in rural area. Please mark [v] your answers.

1 = Strongly Disagree.
2 = Disagree.
3 = Natural.
4 = Agree.
5 = Strongly Agree.
<table>
<thead>
<tr>
<th>Description</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived of Usefulness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1  (W.N.D.T.R) System will enable the owner of telecenter to get the best requirement quickly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  (W.N.D.T.R) System is useful for my job.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3  (W.N.D.T.R) System would facilitate my work to choose requirement, and to establishing wireless network.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4  (W.N.D.T.R) System will save my money and time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Perceived of Use</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1  Learning to operate (W.N.D.T.R) System is easy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  Interaction with (W.N.D.T.R) System is clear and understandable.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3  It is easy to become skilful at using (W.N.D.T.R) System.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4  (W.N.D.T.R) System is easy to use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>User Satisfaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1  I completely satisfied in using the (W.N.D.T.R) System.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  I feel very confident in using the (W.N.D.T.R) system.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3  I feel comfortable by using (W.N.D.T.R) System.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attribute of Usability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1  It easy to interact with (W.N.D.T.R) System by using PCs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  The procedure through (W.N.D.T.R) System by computer system is clear.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3  I found it easy to determined my choice to get my best requirement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix A

Questionnaires

Appendix A: Q4's

Figure appendix A: Q4’s frequency

Figure appendix A.4: Q4’s Statistics
Appendix A: Q5’s

Figure appendix A: Q5’s frequency

Figure appendix A: Q5’s Statistics
Appendix A: Q6's

Figure appendix A: Q6's frequency

Figure appendix A: Q6's Statistics
Appendix A: Q7's

Figure appendix A: Q7's frequency

Figure appendix A: Q7's Statistics

110
Appendix A: Q8’s

Figure appendix A: Q8’s frequency

Figure appendix A: Q8’s Statistics
Appendix A: Q9's

Figure appendix A: Q9's frequency

Figure appendix A: Q9's Statistics
Appendix A: Q 10's

Figure appendix A: Q10's frequency

Figure appendix A: Q10's Statistics
Appendix A: Q 12’s

Figure appendix A: Q12’s frequency

Figure appendix A: Q12’s Statistics
Appendix A: Q 13's

Figure appendix A: Q13's frequency

Figure appendix A: Q13's Statistics
Appendix B

TABLES

**POPULATION DENSITY OF SELECTED STATES (BASED ON 2004 PROJECTIONS) IN MALAYSIA[63].**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Pop. density/ per km²</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Area (Very High Density)</td>
<td>5818</td>
<td>Federal Territory of Kuala Lumpur</td>
</tr>
<tr>
<td>Urban Area (High Density)</td>
<td>539</td>
<td>Selangor</td>
</tr>
<tr>
<td>Average density</td>
<td>180</td>
<td>Kedah</td>
</tr>
<tr>
<td>Low density</td>
<td>90</td>
<td>Kelantan</td>
</tr>
<tr>
<td>Sparsely Populated</td>
<td>17</td>
<td>Sarawak</td>
</tr>
</tbody>
</table>
Appendix C

Experts Interview

Wireless network design telecenter in rural area

College of Arts and Sciences

MSc (ICT)

NAME : Satea Hikmat Aboud

E-MAIL : sateaahn@yahoo.com

CONTACT: 0174081516

Supervisors: A.P.Dr Wan Rozaini BT Sheik Osman

Experts Interview

Abstract

This study is focus how to obtain the best design for wireless networks with the best major requirements in the construction and implementation, the beneficiary will receive the value of the estimated cost of the enterprise project and this would save time and effort, with no loss of funds.
Introduction

Telecenter is an important point in the delivery of information and communication technology in rural areas and, as a watershed in the telecommunications service delivery in these areas.

Telecenter is up to the point at which the telecommunications service first, then the publication and distribution of telecommunications service.

Problem Statement

"Stakeholders of the Telecenter", which is facing problems and challenges for the identification of needs and the design of network connectivity, especially in rural areas. We need more time and effort in some cases loss money through the use of the traditional way at the same time, the inability to provide appropriate solutions and the needs, is leading the Telecenter significant challenges. This proposal is to assist the "Stakeholders of the Telecenter" or the administrator to provide the appropriate design and to determine project estimated cost. This will reduce the time and effort, to provide rural areas in efficient and affordable Technologies available [7], by using computer program system, which includes smart questions to provide fit solutions.

The Research Questions Of This Study Are:

- How to Use the technology that fit for telecenter, and how determined the cost of project in rural areas.
- What are the basic requirements for infrastructure network design and deployment in this area

Project’s Objective

This study attempts to achieve the following objectives:

1. To design a practical and effective network design in rural area.
2. To determine the cost needed for the telecenter network.

3. To evaluate the design through expert review.

This study is how to obtain the best design for wireless networks with the best major requirements in the construction and implementation, and we must follow the instructions in the case for the subject of this research, the beneficiary will receive the value of the estimated cost of the project and this would save time and effort, with no loss of funds.
Experts Interview-A

Your Answer is important for the researcher, and these questions and information to help him, to get project requirements for MSc (ICT).

The use of multi-hop (from point to point) Figure 1, access to a wide range using this method up to 20 kilometers, which makes access to the distance with the lower cost of deployment, especially in the last mile. Have been deployed a number of places in all parts of the world, such as [1].

![Diagram showing data rates and distances for Wi-Fi 802.11 networks.]

Figure 1: Extended Wi-Fi 802.11.

1- Do you think can we use 802.11 WI-FI, to obtain the largest distance coverage link by using point to point (antenna)?

YES [ ]  NO [ ]

120
2- Do you think that use Wi-Fi 802.11 techniques to deployment in last mile, better than another's techniques when at compare from the costs?

YES  v  NO

3- To give values close to the truth, assuming the real capacity coverage is ~ 75% from total coverage area.

YES  v  NO

4- If you need to estimate the Average network bandwidth required, need to estimate
The:
1- Numbers of user in network.
2- Service penetration in network. (Can we estimate this range 10%- 50%)?
3- Average/peak bandwidth per user. (Can we estimate this range 15 Kbps - 64 Kbps)?

Peak system bandwidth requirement =

\[ \text{N0.of users} \times \text{Peak bandwidth per user} \times \text{Service penetration in network} \]

YES  v  NO

*if no, and if you have any command about the range, please answer the next question
a- Service penetration in your network, can estimate this range ( % - %)
b- Average/peak bandwidth per user, can estimate this range ( Kbps - Kbps)
5- Communication between mesh nodes are based on WI-FI (IEEE 802.11 a/b/g).

Lower cost of infrastructure to mesh nodes, could be built in a rural area, especially when we have a small number of participants in the network

Assessment:

This part is intended to rate your satisfaction with the overall usability of the computer-based application wireless network design tools in rural areas. Please mark [x] your answers.

1 = Strongly Disagree.
2 = Disagree.
3 = Neutral.
4 = Agree.
5 = Strongly Agree.

What do you think if you have some program application system that gives you these results?

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Average number of users in the network area you need to cover.</td>
<td></td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Average/peak network bandwidth required.</td>
<td></td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Determining to you the number of devices (sensors or antennas) needs to cover all distance.</td>
<td></td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Estimate and calculate to you the cost of wireless network equipment requirements.</td>
<td></td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Estimate and calculate to you the total cost of wireless network.</td>
<td></td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
</tbody>
</table>

Thanks for your help

Personal Information for Expert

1. Name Neil Kabbany
2. Work place [Redacted]
3. Specialization scientific MSEE, CCMR, CCNP
4. Are you a ... [Redacted]

| [ ] Staff or a Networks experts |

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Experts Interview-B

Your Answer is important for the researcher, and these questions and information to help him, to get project requirements for MSc (ICT).

The use of multi-hop (from point to point) Figure 1; access to a wide range using this method up to 20 kilometers, which makes access to the distance with the lower cost of deployment, especially in the last mile. Have been deployed a number of places in all parts of the world, such as [1].

![Diagram](image)

**Figure 1:** Extend Distance Wi-Fi 802.11, Reliance To (Kurose, J., & Ross, K., 2008).

1- Do you think can we use 802.11 WI-FI, to obtain the largest distance coverage link by using point to point (antenna)?

- [ ] YES
- [ ] NO
2- Do you think that use Wi-Fi 802.11 techniques to deployment in last mile, better than another's techniques when at compare from the costs?

YES [ ] NO [ ]

3- To give values close to the truth, assuming the real capacity coverage is ~ 75% from total coverage area.

YES [ ] NO [ ]

4- If you need to estimate the Average network bandwidth required, need to estimate the:

- Numbers of user in network.
- Service penetration in network. (Can we estimate this range 10%- 50%)?
- Average/peak bandwidth per user. (Can we estimate this range 15 Kbps- 64 Kbps)?

Peak system bandwidth requirement =

\[ \text{No.of users} \times \text{Peak bandwidth per user} \times \text{Service penetration in network} \]

YES [ ] NO [ ]

*if no, and if you have any command about the range, please answer the next question

1) Service penetration in your network, can estimate this Range ( % - %)

2) Average/peak bandwidth per user, can estimate this Range ( Kbps - Kbps)
5- Communication between mesh nodes are based on WI-FI (IEEE 802.11 a/b/g).

Lower cost of infrastructure to mesh nodes, could be built in a rural area, especially when we have a small number of participants in the network.

YES [ ] NO [ ]

References

Assessment:

This part is intended to rate your satisfaction with the overall usability of the computer-based application wireless network design telecenter in rural area. Please mark (✓) your answers:

1 = Strongly Disagree.
2 = Disagree.
3 = Neutral.
4 = Agree.
5 = Strongly Agree.

What do you think if you have some program application system that gives you these results?

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Average number of users in the network area you need to coverage.</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Average/peak network bandwidth required.</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Determining to you the number of devices (sector or antenna) needs to coverage all distance.</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Estimate and calculate to you the cost of wireless network equipment requirements.</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Estimate and calculate to you the total cost of wireless network.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Thanks for your help

Personal Information for Expert

1- Name  **Omar Almomani**

2- Work place  **UCM**

3- Specialization scientific

4. Are you a ...

   [ ] Staff or a Networks experts
   [X] PhD Student (Network

   [Signature]
Experts Interview-C

Your Answer is important for the researcher, and these questions and information to help him, to get project requirements for MSc (ICT).

Based application wireless network design telecenter in rural area. Please mark [ ] your answers.

1 = Strongly Disagree.
2 = Disagree.
3 = Natural.
4 = Agree.
5 = Strongly Agree.

What do you think if you have some program application systems that gives you some results?

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Average number of users in the network area you need to coverage</td>
</tr>
<tr>
<td>2</td>
<td>Average peak network bandwidth required</td>
</tr>
<tr>
<td>3</td>
<td>Determining to you the number of devices (sector or antenna) needs to coverage all distance</td>
</tr>
<tr>
<td>4</td>
<td>Estimate and calculate to you the cost of wireless network equipment requirements</td>
</tr>
<tr>
<td>5</td>
<td>Estimate and calculate to you the total cost of wireless network</td>
</tr>
</tbody>
</table>

Thanks for your help

Personal Information for Expert

1. Name ________________________________
2. Work place _____________________________
3. Specialization scientific ________________________________
4. Are you a ... of community center

[ ] Staff and Networks experts

(under previous yes in survey)

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Appendix E

Telecenter owner Interview

UNIKL Ujong Rhu
Kedah Darul Aman

Untuk pihak yang berkenaan,

Pihak kami mengesahkan pada 8 April 2005, Encik Saitee Hikmat Aboud telah mengadakan seti temubual
dan kaji selidik di Perpustakaan Benta ini berkenaan dengan penggunaan internet dan kemudahan ICT
yang tersedia di sini.

Encik Saitee juga ingin mendedahkan bberapa masalah berkenaan dengan pusat komuniti ini untuk
memenuhi kriteria sedia pengajian belia dalam sanjana (ICT).

Sebaik untuk maklumat.
Terima kasih.

Yang benar,

[Signature]

[Seal]

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Appendix E: Pictures for Telecenter Location & Network Equipments

Picture (1)

Picture (2)

Picture (3)

Picture (4)

Picture (5)