Development of a Networked Interactive Information Environment within a National Park

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Development of a Networked Interactive Information Environment within a National Park

A project report presented for the MSc. in Computing in Education of the National Council for Educational Awards

by

John Clifton, GradDip. in Computing in Education

Supervisor: Mr. John Brosnan

Submitted to the National Council for Educational Awards, September 2001
MSc. in Computing in Education Project Report  
2000/2001

Development of a Networked Interactive Information Environment within a National Park

by

John Clifton  
John Brosnan (Supervisor)

ABSTRACT

For the most part, the Killarney National Park (KNP) currently disseminates information to visitors in paper format and by word of mouth in a non-coherent fashion. Society as a whole is moving towards an Information Age delivered through an electronic medium. This project aims to facilitate the KNP in delivering a new electronically presented information experience to its global visitors.

Electronic media facilitate the delivery of in-depth multimedia as well as multilingual information. This information will be made available on demand to visitors and delivered through a variety of media including information points and handheld devices to facilitate the various needs of the Park visitor. These delivery media will also enable information to be distributed at multiple locations throughout the Park as opposed to the present situation where information for the total Park visitor population is centrally delivered for the most part from Muckross House.

This report discusses in detail the infrastructure required to deliver this new mode of information delivery at KNP. This will include both the hardware and software infrastructure. The hardware infrastructure focuses on integrating traditional Ethernet LAN topologies with new Spread Spectrum Wireless technologies. The software aspects of the project focus on combining commercial off the shelf operational software with custom developed software that will eventually deliver the multimedia-based information to the visitor.
I wish sincerely, to thank my project supervisor Mr. John Brosnan for his time, invaluable guidance and leadership skills offered to me throughout the project.

May I extend my gratitude to my wife Marie and my family for their steadfast support and encouragement.

I would also like to thank my colleagues at St. Oliver’s N.S., Killarney, for their continued support.

May I extend a special word of appreciation to:

- Mr. Daniel Kelleher, South-West Regional Manager of Dúchas.
- Dr. Jim Larner, Assistant Park Superintendent of the Killarney National Park.
- Mr. Pat Dawson, Manager of Muckross House, Killarney.
- Mr. Peter Bellew, Wapprofit, Killarney.
- Mr. Pat Lawlor, Tralee Teacher Centre.
- The Board of KATE Killarney Ltd.
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This chapter presents a concise background on the intended location for the project’s eventual implementation, the Killarney National Park (KNP) and reviews the means by which information is currently delivered to visitors of the Park. It then goes on to consider the overall objective of this project report – the creation of networked visitor information points at KNP. The types of information that are to be provided by such information points are then examined and finally the remainder of the project report is outlined.
1.1 A Brief History of Killarney National Park

The nucleus of the Killarney National Park is the former 4,300 hectare Muckross Estate. This estate was presented to the nation in 1932. The State is required to "maintain and manage the Park as a National Park for the general purpose of the recreation and enjoyment of the public". "I want especially, the young people to come to Muckross, to trail those mountains and enjoy nature in all its aspects. I hope that Muckross will be made a real garden of friendship", said its donor Author Vincent. (1887 – 1956)

Over the years the KNP has been expanded to encompass 25,000 acres of mountains, lowlands and lakes. Killarney House and gardens, (accessible via the Golden Gates) are the latest additions to this magnificent National Park.

1.2 Existing Visitor Information Dissemination Methods

Muckross House is conceivably the only visitor information outlet serving the entire 25,000-acre Park. The excellent information service given here is delivered to the visitor by means of top class guided tours of Muckross House and a superb audio-visual presentation of the House and Park.

Over the years, Dúchas - The Heritage Service of the Department of Arts, Heritage, Gaeltacht and the Islands, has published an impressive range of visitor information pamphlets on the KNP. The Park and Muckross House also publish two separate excellent websites on the Internet for information purposes.

The KNP's educational services offered to schools by the staff at Knockreer House are indeed to be complemented.

1.3 New Visitor Information Dissemination Methods

At the core of this project report is the establishment of an infrastructure, which will lead to a novel approach to the distribution of data at KNP. Firstly, however, two important questions should be addressed. These pertain to the reasons as to why a new approach to the dissemination of information should be considered at KNP and what types of information are to be distributed by this new mode.
1.3.1 Networked Visitor Information Points – Why Bother?

As the KNP attracts over a million visitors annually, the current provision of visitor information services briefly outlined in the preceding paragraph could be augmented and enhanced through the establishment of networked “visitor interactive information points” at specific locations throughout the KNP. This additional visitor information service would be another feather in the KNP’s hat in its endeavour to:

- Further penetrate its visitor population market with information as to how he/she might “enjoy nature in all its aspects”.
- Lead to the delivery of a higher quality of visitor information.
- Make the availability of KNP information more accessible and more convenient for the Park visitor.
- Facilitate the delivery of information in the native tongue of the visitor.
- Micro-segment the vast amount of KNP information to make it more relevant to the specific part of the Park in which the visitor finds himself/herself currently visiting.
- By providing the visitor with the option of viewing information on other zones within the KNP (in addition to information on the specific Zone in which the guest finds himself/herself currently visiting) would clearly demonstrate the diversity of attractions which the Park has to offer and enhance the holiday experience of the visitor. It may also encourage the visitor to stay longer in the area or to return at a future date.
- Since the information points are interactive, visitors to the Park can submit visitor survey information through the kiosks that will enable the Park authority to enhance the services provided to future visitors.
- The envisaged interactive information points would be specifically amenable to disabled people e.g. The kiosks would provide a comprehensive audio presentation for the visually impaired.

1.3.2 Types of Information Disseminated at Information Points

The type of information disseminated at each specific networked interactive information point will be of three types:

- General information on the Park itself.
Chapter 1 Introduction

- Specific information on the immediate surrounding/topography of each specific information point (zone).

- Non-technical information about the specific zone as outlined in the previous point, to be adapted to the level of comprehension and understanding of junior visitors to the Park. The information on display could be used by geography, history and biology teachers to provide:

(i) Field trip exercises on Geography and Biology to students.

The Park’s Ecosystems in their natural state are highly valued and offer considerable educational opportunities to students engaged in Geography and Biology studies.

(ii) Nature Study information to students

Special Areas of Conservation (SAC) are habitats of special importance in which certain species of birds, flora and fauna require special protection. The EU has listed the species of birds, plants, animals and habitats, which require special protection in the Killarney Region e.g. the Killarney Fern, Pinemarten, Otter, Fresh Water Pearl Mussel, Kerry Slug, Peregrine Falcon, Merlin, Blanket Bogs and the Killarney Oak Woods at Tomies.

(iii) Local History information to students.

The documented evolution of the Killarney National Park into its present position as Ireland’s premier National Park provides a valuable repository of Local History information for students.

1.4 Structure of the Project Report

Chapter Two – Sourcing Information for Use in the KNP System

This chapter explores in detail how the important information seen at the front-end of the KNP system has been researched and gathered. The means by which the chosen multimedia information has been adapted, edited and converted into digital format is examined. In addition, the manner in which the disseminated multilingual information is presented to the visitor at each specific information zone is discussed.
Chapter Three – Networked Interactive Information Points

This chapter begins by examining the selection criteria used in choosing the diverse locations of the information points. The various types of kiosks available on the market together with the “kiosk of tomorrow” are outlined. Kiosk storage mechanisms are explored. Various tiered software architecture approaches are discussed and a solution for the optimal software deployment is chosen. The interactive kiosk solution, which best suits, the needs of the KNP is detailed. Networking topologies are explained. The issue of Private Addresses for use in KNP Local Area Network is dealt with. Home user options to add value to the benefit of accessing the KNP Website are detailed.

Chapter Four – Communications Media

This chapter deals specifically with communications media. These include such carrier mediums as leased lines, dial up connections, satellite and wireless solutions. The Direct Sequence and Frequency Hopping options for the Spread Spectrum wireless carrier are explored. The preference for the wireless Frequency Hopping Spread Spectrum solution as the chosen carrier medium for this project is explained. A range of solutions for the deployment of multiple kiosks and iPAQ handheld devices at each information point are explored. The preference for the solution which avails of a combination of kiosks and iPAQs per information zone is argued.

Chapter Five – Information Storage Mechanisms

In this chapter, the means by which the information gathered for the KNP system might be stored is examined in some depth. After a thorough review of traditional file system storage and Relational (RDBMS) solutions, some of the lesser known database technologies including Object-Relational DBMS and Object-Oriented DBMS are discussed. Based on the review of the numerous options available, and despite the fact that the chosen storage solution may not be the most optimal in terms of its performance and efficiency, the recommendation for utilising an RDBMS in the KNP implementation is analysed and defended.

Chapter Six – Project Implementation

This chapter deals in detail with the project implementation. This project delivers an academic implementation of the KNP IT Infrastructure, which is the fruit of the learning process involved in this project. The author offers advice by detailing the envisaged requirements the KNP authorities will have to implement in order to guarantee its successful deployment in the commercial environment. The fourteen phased development and deployment steps that need to be performed for its Commercial Implementation are
detailed and described in depth. The chapter also deals with the requirements for outsourcing, developing and maintaining the KNP IT infrastructure along with the skills required by the Park staff to maintain the system.

Chapter Seven – Conclusions and Recommendations

This chapter looks back on the contents of this report, both from a research and implementation viewpoint and draws several conclusions and recommendations from it.
This chapter begins by examining various sources of the textual and multimedia information on the KNP being used in the system. The collection of this data is vital to the overall project implementation as it will reflect the eventual view to the end-user of the system. In addition, the details of some visitors' surveys are analysed so that it may be determined what languages the system's data might eventually be translated into. Finally, the details of the specific information to be distributed at each of the interactive information points in the system are investigated.
Chapter 2 – Sourcing Information for Use in the KNP System

2.1 Sourcing Information on the KNP

Although it may not seem like such an important task, the gathering of information on the Killarney National Park itself is of paramount importance in the overall KNP system implementation. This is because the data gathered at this early stage is the very same data that the end-user of the system, the Park visitor, will see later on. Therefore the information being collected must be accurate, entertaining and concise. The task of collecting this information is a difficult one as many of the information sources are not readily available in digital format. The following subsections outline the sources of the data gathered by this author.

2.1.1 Books

Down through the centuries an extensive collection of books has been written on Killarney and its environs. The Library at Muckross House houses an excellent ‘book-source’ of invaluable information relating to the Park. However a major constraint in the context of this project is the fact that little or none of this invaluable repository documentation, relating to the Park, is in “electronic paper” format. Appendix A1 and A2 which detail 338 Killarney National Park References and 72 Killarney National Park Historical References are courtesy of Dr. Jim Larner Assistant Park Superintendent of the KNP.

2.1.2 Dúchas’ Pamphlets and Publications

The impressive range of visitor information pamphlets and publications on the KNP produced over the years by Dúchas is an obvious source of reference material. Again however the fact that none of these publications are available in “electronic paper” format is a major constraint.

2.1.3 Magazine Sources

Past publications of the ‘Where Killarney’ and ‘Kerry Gems’ magazines provide excellent hard copy source material on the KNP. Also over the years, MAC - the Killarney based Publishing House has produced excellent visitor information material on the KNP. The owners of these publications may have prepared some of their published material in electronic format prior to ‘going to press’ and could be approached to make this digital material available for the purpose of this project.
2.1.4 Multimedia Material on the KNP

Multimedia means that multiple forms of information can be used in an integrated manner. These types of information include speech, music, text, graphic, still, animation and video. According to M.J. Hoogeveen's findings multimedia provides the ability to add an entertainment value to the information that is presented. This is particularly useful in the KNP context, where information kiosks are the preferred medium for the delivery of entertainment material to the visitor at chosen interactive information points throughout the Park.

Thus, multimedia material in the form of video clips, sound clips, MM animations etc. is a prerequisite information delivery format for this project. However, the availability of multimedia material on the KNP is very scarce even in analogue and VHF format. Relatively no multimedia material on the KNP is available in digital format.

Sources of non-digital multimedia material on the KNP, which would have to be converted to digital format, include:

- Muckross House Audio- Visual Presentation (Analogue format)
- Blue Pool Nature Trail for the Blind AudioTape (Analogue format)
- RTE archive material on KNP: e.g. Eamon de Buitléar’s film based on the work of Mr. Paddy O Sullivan, South West Deputy Regional Manager of Dúchas, when he was employed as a Park Ranger. (VHF format)
- History of Killarney House: Sr. Pauline Mac Shane’s video on the history of Killarney House (Golden Gates entrance to the KNP) and its occupancy by the Mac Shane Family. (VHF format)

2.1.5 Musical Material

The following are examples of music material (available on analogue format only) on Killarney and nature themes relevant to this project.

- How Can You Buy Killarney
- By Killarney’s Lakes and Fells
- Cill Cais – This song laments the destruction and exploitation of our forests in the 19th Century for the provision of ship building in England.
- Fáinne Geal an Lae.
2.1.6 Expertise of the KNP Staff

In the course of their careers, the staff of the KNP have acquired considerable expertise on caring for various aspects of the flora, fauna and water-dwellers of the Park. The acknowledged expertise of Dr. Jim Lamer; Mr. Paddy O Sullivan, South-West Deputy Regional Manager of Dúchas; Mr. Cormac Foley, Park Superintendent and the Park Rangers could be utilised to further add to the repository of information on the Park.

2.1.7 Digital Maps

Ordnance Survey Maps of the KNP may be purchased in digital format from the Ordnance Survey Office, Phoenix Park, Dublin.

2.1.8 Free Digital Images

Cork Kerry Tourism provides 100 free images from the Cork Kerry Region scenic location. These are available from their Website at www.ireland.travel.ie
E-mail: user@cktourism.ie (Tel. 021-273251)

2.1.9 Web Sources

The following are some Websites, which contain valuable information on KNP for use in this project:

- Dúchas Site – www.heritageireland.ie
- Where Killarney Magazine - www.wherekillarney.com
- Live Ireland Site – www.liveireland.ie
- Scoilnet Site – www.scoilnet.ie
- Heritage Office, Kerry County Council- www.kerrycoco.ie
- National Centre for Technology in Education (Schools’ Integration Project) – www.sip.ie
2.1.10 Technical Documentation

The following is the address of the European Body for National Parks, which is an excellent source of Technical Documentation on the KNP.
Europarc Federation, Krollstrasse, 5, Postfach 1153, D-94475, Grafenau, Germany.
E-mail: office@europarc.org
http://www.europarc.org

2.2 Database of Visitors’ Needs – Visitor Surveys

Visitor Surveys are a prime source of information for the establishment of a database on KNP visitors and their needs. Such surveys help to quantify among other things:

- How many visitors come to the Park each year?
- What are the main languages spoken by the KNP visitors- so that translation requirements can be catered for. e.g. The 1996 KNP Visitor Survey established the fact that after English the main languages spoken by visitors, in the following order of greater frequency were French, German and Italian.
- The category of visitors who come.
- The needs of the visitor.
- What visitors like to see when they visit the Park.

Details on the 1998 RPS Cairns - Killarney Visitor Survey are available at the Killarney Library, Rock Road, Killarney. The following findings in Figure 2.1 below are extracts from the invaluable data which is contained in this report.

![Country of Origin](chart.png)

Figure 2.1 Visitor Country of Origin Statistics (RPS Cairns Report 1998) [1]
Chapter 2 – Sourcing Information for Use in the KNP System

In addition Bord Fáilte operates a special telephone enquiry line @ tel.01- 6024193 which, provides visitor research and statistical data to the caller.

Details on the 1996 KNP Visitor Survey; the June 2000 Ecotourism Survey conducted by Dutch students, and the various surveys conducted on KNP by the students from the College of Marketing, Cahal Brugha St., Dublin are available from: Dúchas Heritage Service, Ely Court, 7 Ely Place, Dublin 2.

The June 2000 Ecotourism Survey gives the following details on KNP Attractions with Capacity Problems.

- Muckross House is close to its maximum carrying capacity, especially in the high season.
- The traditional Farms are also close to their maximum capacity in the high season.
- Ross Castle is over the maximum capacity in the high season. This is affecting the visitor quality experience, but luckily not the historical resource itself. [2]

2.3 Gathering Information on the Kerry SAC

The European Community Directive 1992 details the SAC of County Kerry. In total there are 77,000 hectares of SAC in Kerry of which the KNP includes 10,500 hectares.

SAC’s are habitats of special importance in which certain species of birds, flora and fauna require special protection. The EU has listed the species of birds, plants, animals and habitats, which require special protection in the Killarney region e.g. The Killarney Fern, Pinemarten, Otter, Fresh Water Pearl Mussel, Kerry Slug, Peregrine Falcon, Merlin, Blanket Bogs and the Killarney Oak Woods. [3]

The collecting of information relating to the Kerry SAC will certainly add great value to the KNP system and would be a most useful resource to anyone interested in learning about this very important feature of the KNP environment. It would also teach schoolchildren the importance of ecosystems and how they must be protected in order to keep certain rare species alive.

2.4 Assembling Specific Information to be Disseminated at each Interactive Information Point

It is envisaged that kiosks located at the different Information points will:
Chapter 2 – Sourcing Information for Use in the KNP System

- Open with a splash screen displaying general information on the KNP.
- Display detailed KNP information on its specific Zone location.
- Provide detailed information on the other Zones within KNP, which the visitor may also wish to visit

2.4.1 Assembling the Multimedia Content

The multimedia data (text, graphics, video and sound) that is to be disseminated at each interactive information point – to be henceforth referred to as zone information for brevity - must be decided upon and put into some related, orderly structure. This is important later when it comes to actually designing and implementing the software component of the KNP system. The information sources described in the previous three sections are to be utilised for this purpose.

2.4.2 Converting the Multimedia Content to Electronic Format

As mentioned earlier, vast quantities of information currently available on the Park are only available in paper or analogue format and this is fine if information does not need to be distributed via electronic means. However, given the digital nature of the proposed KNP system, it will be necessary to translate the required documentation and analogue sound and video excerpts into electronic format i.e. some digital multimedia format. With respect to this there are some questions that need to be addressed as follows:

- If material is sourced from publishers in the form of books and pamphlets do the publishers hold the master copies of these works in electronic format? If so, will they allow it to be used at the interactive information points?
- Paper-only versions of diagrams, drawings and photos will need to be scanned. Therefore what resolution is required and what level of quality is acceptable?
- If textual material is of sufficiently poor quality will it have to be retyped?
- How can existing audio-visual material in analogue format be transferred into a digital equivalent?

2.5 Conclusions

This chapter has considered the sourcing of the information to be used in the KNP system. The sources themselves are vast and varied but are certainly available. The process of
gathering the relevant information is a time-consuming one in its own right but what makes the task so much more difficult in the case of the KNP is that the large majority of textual information available is only in paper format and, in the case of multimedia information, only available in analogue format. Therefore the information must be converted into digital format by some means if the system is to be properly realised.

This is an arduous task but certainly possible provided the right equipment and a sufficient number of people are available. The process of translating the information being used in the Park system into other European languages is an important one if the system is to be truly multilingual. Again, this process will not be an easy one given that most information sources are only available in English and, worse still, the fact that multimedia information such as audio and video data will have to be translated using proper sound equipment into foreign language equivalents.
This chapter focuses in on interactive information points, also known as kiosks. These points are central to the KNP system as they are what the visitor will interact with in order to obtain information on the Park. To begin with, the whole area of kiosk technology is examined in some detail and the many kiosk types that are available are reviewed. Decisions are then made on the type of information point to be used in the KNP system. Then the means by which the kiosk data is to be stored is analysed. Based on the topography of the KNP and the existing visitor “hot-spots”, the actual locations of the kiosks are then decided upon. As the KNP system is to contain a collection of networked kiosks to form a LAN, some of the available network topologies are looked at next. Finally, the integration of the system with the Internet and WWW is explored.
3.1 Introduction to Kiosks

The next few subsections examine kiosks in some detail and look at their evolution.

3.1.1 What is a Kiosk?

Kiosks are freestanding cabinets with a display, an interactive user-interface, and possibly a network connection. They are designed to provide information, sell products, and entertain. Kiosks are typically located in high-traffic areas such as museums and shopping centres. Kiosks are designed for use by the average user who has little or no experience with computers or information systems. Existing kiosk applications include information centres at theme parks like Disney's Epcot Centre, music CD preview stations, airplane/cinema/concert ticket dispensers, and custom greeting card machines. Current kiosks are limited in their interaction with people to responding to touchscreen or keyboard input.

Fig 3.1 below illustrates a couple of typical modern-day kiosks.

![Figure 3.1 Today’s Kiosks](image)

3.1.2 History of Kiosks

The following table includes some of the major milestones in the development of kiosk technology:
### Date | Event
--- | ---
1939 | “Pay per click” was born
1966 | Marshall McLuhan writes, "*Xerography is bringing a reign of terror into the world of publishing...*" Copyrights are now a concern
1981 | Minitel (Teletel) is deployed across France by France Telecom
1984 | Domain Name System (DNS) introduced.
1990 | The first remotely operated machine to be hooked up to the Internet, the Internet Toaster by John Romkey, (controlled via SNMP) makes its debut at Interop.
1997 | Annual interactive kiosk sales are forecast to rise from $678 million this year to $3.33 billion by 2001. Probe Research.
2001-April | April: Members of Kiosk.org meet for the first time in Orlando.

### 3.1.3 Why use Kiosks?

Kiosks are quickly becoming user-friendly solutions to everyday dilemmas. They are convenient for end users and vendors alike. They provide the end user with ease in accessing useful information and benefit the vendor by providing the ability to increase customer service and decrease labour costs. According to Frost & Sullivan's strategic research, (http://www.frost.com), U.S. Interactive Kiosk Components Market, kiosks have advanced from being boxy information machines to elegant and attractive self-service stations. Kiosks generated revenues totalling $213 million in the USA in 1998, which constituted a 32 percent increase over 1997. The fact that interactive kiosks are capable of operating anytime, anywhere and inherently reduce labour costs means that they have become highly marketable devices. Since a modern kiosk can take an organisation's complete Internet investment and make it available to the general public in strategic locations, it is only a matter of time before their popularity explodes. The current success of stalwarts such as ATM machines and self-service petrol stations are a testament to kiosk technology and the future looks very bright indeed. Some analysts believe that the
growth of the kiosk market has not yet taken off properly as consumers still lack awareness about their benefits but also, perhaps more importantly, the technology is still relatively expensive and poor designs have lead to some project cancellations. [5]

As kiosks continue to gain popularity, their components contain a growing market of their own. The components market can be broken down into printers, enclosures, software, hardware, touchscreens and other peripheral devices. By next year, printers are expected to be installed in approximately 90% of interactive kiosks. Printer manufacturers are realising the demand for printed information in kiosks and have manufactured kiosk-specific printers. As a result, printers are projected to experience strong growth. A majority of kiosks now use touchscreens as well, forcing touchscreen manufacturers to improve clarity, reliability and durability. Kiosk application software allows clients to obtain information or perform transactions with the use of a touchscreen interface. Several software market participants of various sizes customise software for kiosks, allowing variability between units.

### 3.1.4 Kiosk Design Considerations

Kiosk design can refer to both the computer system application and the structure that houses it, therefore there are two separate fields of design involved in kiosks manufacturing; the physical kiosk and the application that resides on it.

**Physical Design Issues**

Kiosks should be attractive structures and fit snugly into their surroundings. Selecting a suitable site at the location is important. The enclosure must:

- Be secure
- Be well-ventilated
- Be free from electromagnetic interference
- Be accessible to all types of people with different sizes, physical abilities and language skills
- Have a single switch restart in the event of power failure
- Provide privacy for the user
- Be hard wearing and weatherproof.

-18-
Application Design Issues

Kiosk applications must

- Meet the performance requirements of the user
- Have navigational consistency throughout
- Have easily readable text and visual information
- Have a sound system which is clear enough to understand but not loud enough to offend
- Enable content to be accessed as directly as possible [6]

In addition to above kiosk application requirements, a kiosk software vendor (Montegenot) has developed the so-called Automated Kiosk Attendant (AKA) Software which has the ability to continually detect Exe failures and automatically reboot the kiosk upon such occurrences. At reboot, a message is given to the user that the kiosk has to reboot because of a program failure.

If AKA detects failure of an EXE to launch, then to prevent the AKA going into a continuous re-boot loop it will halt the kiosk and display a configurable message to the kiosk user that the system has failed and a message: "maintenance phone number or contact details" can be displayed on the screen. [7]

3.1.5 User Interaction

Human interaction can be achieved via

- Keyboard and monitor
- Keyboard, monitor and mouse
- Touchscreen enabled
- Voice-activated to facilitate interaction with the visually impaired

One of the challenges facing interface designers is the support required for the visually impaired. One solution is to provide voice-driven menus and input, based on touches in the corners, edges or middle of the screen. The application would call a voice-reader component to read back the text displayed on the screen and issue instructions to the
visitor on how to navigate through the system. Headphone capabilities on the Kiosk would
enhance the quality of the experience for the visitor, as possible nearby noise distractions
would be minimised.

The keyboard-based kiosk is the cheapest type. However the more 'multi-sensed' and
multimedia enabled the kiosk is, the better is its human interaction capability. This type of
kiosk is also the most expensive.

The touchscreen multimedia kiosk is the preferred kiosk choice for the KNP networked
environment. It would be desirable that these kiosks would have voice-activation
capabilities.

### 3.1.6 Multimedia Kiosks

As mentioned earlier in this report, multimedia has the capability of bringing information
to life and hence will be an integral part of the KNP system. Indeed, given the fact that a
primary role of the KNP system will be in the educational arena, the presence of
multimedia content will be of particular importance.

The success of a multimedia system is highly dependent on a number of important factors
which include:

- A high level of man-machine interactivity
- Adequate use of mental reference models
- Good quality of information representation
- Using all the information types congruently

### 3.1.7 Networking Kiosks

Kiosks, if required, can be hooked up via standard 10base-T for local area network
connections and can accept wide area network options for:

- Wireless Radio
- Frame Relay
- Advanced Digital Subscriber Line (ADSL)
• Asynchronous Transfer Mode (ATM)

Today kiosk system manufacturers offer Web-enabled interactive solutions that incorporate servers, PC's, thin clients, touchmonitors, wireless communications, third-party applications and software, with the latest technologies in standard and customised cabinets. Kiosk solutions, if desired, can consist of integration, installation, and program management services for quick and efficient deployment. Maintenance services are also available to minimise downtime.

3.1.8 Kiosk Displays

One of the most important features of any kiosk is its display. It obviously needs to accommodate the vast array of different people that will need to interact with it. In relation to the KNP the focus will be on kiosks of a tangible nature where the visitor can obtain the information they desire by simply touching the screen of the kiosk display. The following subsections deal initially with the concept of a touchscreen and then move on to the actual technologies behind such devices.

3.1.8.1 Touchscreens

Touch technology simplifies the complex tasks of process and machine control by replacing keyboards, mice, multiple buttons, knobs, gauges, meters, and other interfaces with a single touch display capable of complex monitoring and control. A key benefit of touch technology is its inherent flexibility that allows users to perform multiple functions from one machine. Today, that flexibility is extended even further because software drivers e.g. ELO's MonitorMice™, allow users to operate multiple touchscreens from a single PC, increasing the number of touchscreens monitoring/testing an operation without increasing computer costs.

Manufacturers of touchscreen kiosks employ different touch display solutions to suit the environment where the kiosk is to be located. Kiosk touchmonitors are available with a host of touch technologies. Surface wave is the most widely used touch technology for kiosk applications. Typical intuitive touchmonitors include Cathode Ray Tube (CRT) and Liquid Crystal Display (LCD) displays in a range of sizes and enclosures for countertop/desktop or kiosk enclosure use.

The picture below in Fig. 3.2 illustrates a typical touchscreen display.
A particular touchscreen, the Elo Entuitive rear mount touchmonitor, is tailor-made for kiosk applications. It integrates easily into any kiosk design and eliminates the need for purchasing brackets and supports. Also the fact that it maintains fixed external dimensions of the rear-mount touchmonitor much longer than usual plastic-case monitors reduces the chance that a kiosk will have to be redesigned due to a monitor component change. [9]

3.1.8.2 Cathode Ray Tube (CRT) Displays

For most unmanned kiosk solutions, touchscreen kiosks employ CRT touch displays with IntelliTouch™ touchscreens that can withstand the high use in open public spaces. For CRT based applications, iTouch touch-on-tube technology provides an impressive set of features, including superior optical and image quality along with resistance to scratches, breakage and vandalism.

3.1.8.3 Liquid Crystal Display (LCD)

Often, in the case of corporate, hotel and retail public spaces, where space is at a premium, touchscreen kiosks may be designed around flat panel displays using LCD technology. For LCD products, IntelliTouch overlay touchscreens are widely used. SecureTouch technology provides an additional measure of resistance to breakage and vandalism because of its tempered glass construction.
3.1.8.4 Outdoor Kiosk Displays

Infrared technology products from such companies as CarrollTouch™ might be considered for outdoor kiosks that may be exposed to harsh weather conditions and may require the combination of watertight sealing, optical performance, and vandal resistance.

3.1.9 A Closer Look at Some Kiosk Models

Literally thousands of companies worldwide are engaged in kiosk production. However, kiosks delivered services are primarily of two types: *Informational* and *Transactional*. The following is a brief outline of the kiosk models manufactured by TouchMedia Corporation.

<table>
<thead>
<tr>
<th>Cat-s Slimline LCD Display Kiosk</th>
<th>Cat-I Informational Kiosk</th>
<th>Cat-t Transactional Kiosk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14” Flat LCD Touch, XGA Resolution</td>
<td>Large 17”-20” CRT Touch</td>
<td>14” CRT Touch</td>
</tr>
<tr>
<td>Processor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>166MHz Pentium MMX, 32MB RAM</td>
<td>166MHz Pentium MMX, 32MB RAM</td>
<td>166MHz Pentium, 32MB RAM</td>
</tr>
<tr>
<td>Multimedia Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sound Card + speakers, MPEG1 Card</td>
<td>Sound Card + speakers, MPEG1 Card</td>
<td>Sound Card + speakers</td>
</tr>
<tr>
<td>Transactional Extras</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal printer, IC &amp; Magnetic Card Reader</td>
<td>Receipt Printer, IC &amp; Magnetic Card Reader</td>
<td>Receipt Printer, IC &amp; Magnetic Card Reader</td>
</tr>
<tr>
<td>Networking Options</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Yes – Call centre telephony option</td>
</tr>
<tr>
<td>Hard Disk Space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2GB</td>
<td>2.4GB</td>
<td>2.4GB</td>
</tr>
<tr>
<td>Media Options</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floppy, CD-ROM</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Security/Sensor Options</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Alarm, Human Sensor</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal, customisable side panels; base plate transaction and printer housings finished in metallic colours</td>
<td>Heavy Duty Metal, finished in white/blue or white/red</td>
<td>Heavy Duty Metal, finished in sky blue red or green</td>
</tr>
</tbody>
</table>
Figs. 3.3–3.5 below, illustrate the various kiosk options available from TouchMedia discussed in the table above.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>137cm X 48cm X 60cm</th>
<th>127cm X 55cm</th>
<th>135cm X 68cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications</td>
<td>Good for confined spaces, interactive work, simple information access, self-service transactions</td>
<td>Good for MM and Data presentation in shopping centres, retail stores, hotels, bus stops etc.</td>
<td>Good for non-cash transactions, dispensing tickets, stamps, phonecards etc.</td>
</tr>
</tbody>
</table>
Chapter 3 – Networked Interactive Information Points

Figure 3.4 TouchMedia CAT-i Informational Kiosk

Figure 3.5 TouchMedia CAT-t Transactional Kiosk
3.1.10 Touchscreen Kiosk Applications

Touchscreen interactive Kiosks provide a variety of services to the public at a finger’s touch. The following are some of these services:

- Retail Market Services
- Tourist Hospitality Services
- Medical/Healthcare Services
- Frequent Player Services
- Ticketing Transportation Services
- Government Services
- Financial Transaction Services

3.1.10.1 Retail Market Kiosks

Today, shops and retail outlets are using kiosks to give customers better buying options, more merchandise, faster home deliveries, and ultimately a better shopping experience. Major retailers are placing Intranet-based kiosks, with touchscreens, on the shop floor.

Figure 3.6 below illustrates some kiosks used for retailing purposes.

Figure 3.6 Retail Market Kiosks
Customers can use the kiosks to purchase otherwise undisplayed merchandise from the stockroom or warehouse, and have it delivered directly to their home. The retailer expands its product selection without having to expand in-store inventory, makes more sales without increasing staff, and hopefully leading to a higher level of customer satisfaction.

Some typical retail kiosk applications are:

- **Transaction-enabled self-service terminals** that offer faster, do-it-yourself-services.
- **Multimedia information booths** that provide free inquiry-based convenience information and advertising to shoppers, travellers and visitors.
- **Point-of-sale (POS) and merchandising kiosks** that provide in-store product information and promotional displays and, in some cases even dispense products.

Retail kiosks also provide the opportunity to use graphics and design to incorporate and customise product/company branding. Brand marketers use point-of-information kiosks to educate potential customers about their products in the shops, getting the message across without relying on sales people. Because interactive kiosks must be intriguing and fast-moving enough to attract and sustain the user's interest, the screen action must be fast, colourful, and entertaining. The graphical user interfaces (GUIs) used with touch systems promote creative screen design and are easily combined with music to achieve captivating results.

In the retail industry where employee turnover can be high, simplifying point-of-sale (POS) operation has resolved a major issue. A touchscreen kiosk's natural and direct interface helps reduce training time and operator error. A touch-enabled, graphical user interface enhances time-sensitive operations from store checkout to the returns counter. Touch-based systems do much more than speed up customer processing: more and more retail outlets are using their touch-based systems to capture and analyse detailed transaction data, while building a comprehensive customer database to help them better manage their businesses. Today, one system can provide POS functions, timekeeping, labour scheduling, inventory control, management reporting, accounting, promotions, and marketing. The results: a speedier, more organised service and greater level of customer satisfaction.

### 3.1.10.2 Tourist Hospitality Kiosks

Hospitality kiosks are being used to provide information and interaction in hotel and museum settings along with customer self-service in the restaurant environment. In the hospitality kiosk environment, one's choice of kiosk can be a freestanding enclosure or a countertop/desktop interactive display.
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Figure 3.7 below illustrates some kiosks used for tourist hospitality purposes.

![Image of hospitality kiosks](image.png)

*Figure 3.7 Hospitality Kiosks*

Unattended public-access systems rely on providing easy-to-access information in a safe and secure environment. Here, the kiosk is key. From customer self-service food order entry to tourist information in a hotel lobby, public-access hospitality systems have to provide accurate information—fast. This is no place for clumsy keyboards or messing around with mice. In a kiosk, the interface has to be direct, efficient, effective, and, most of all, so intuitive that it makes every user an instant expert. So it's no wonder that touch-enhanced applications are found in hotel lobbies, restaurants, cinemas, and a host of other public access locations around the world.

### 3.1.10.3 Medical/HealthCare Kiosks

Medical kiosks are being used to provide information and interaction in hospitals and in doctors' and dentists' offices. Kiosk manufacturers and multimedia touch software application developers are finding expanding receptive markets in this niche area for their products.

Figure 3.8 below illustrates a kiosk used for medical purposes.
3.1.10.4 Frequent Player Kiosks

Today, casinos are using kiosks to give frequent players improved service and better rewards. Casinos are placing intranet-based kiosks, with touchscreens on the casino floor. Customers can use the kiosks to redeem frequent player points for drinks, meals, and merchandise. Kiosk manufacturers provide Casino owners with all facets of a kiosk launch, from kiosk design and manufacturing to installation and support for freestanding enclosures or countertop/desktop interactive displays.

Figure 3.9 below illustrates a kiosk used for gaming purposes.
3.1.10.5 Ticketing Transportation Kiosks

The most successful applications of touch technology within the transportation industry are public-access-ticketing kiosks in airport, bus, and train terminals. Touch-based systems are an integral part of the rapid growth of ticketing kiosk applications because the touch interface is universal and can be used by anyone. Ticketing systems usually employ a touchmonitor using IntelliTouch surface wave technology. Automating the process reduces personnel, expedites check-in, and streamlines baggage handling.

Figure 3.10 below illustrates a kiosk used for ticketing purposes in a transportation environment.

![Ticketing Transportation Kiosk](image)

3.1.10.6 Government Kiosks

Today's government organisations are using kiosks to give citizens better service and support, and ultimately, a lower-cost to government. In a networked environment, public-access services can easily be delivered via a touch-enhanced kiosk/workstation in libraries, the post office, other government offices, or even high-traffic areas such as shopping centres. City Corporation and County Council officials can easily conduct surveys and solicit local opinions safely and securely from a public access kiosk—unattended, if required—with touchscreens that are resistant to public abuse, such as scratches, dirt, or spilled liquids. In fact, no matter how busy or demanding the location the touchscreen kiosk never tires, and delivers consistent service to users.
3.1.10.7 Financial Kiosks

As the complexity services provided by ATMs increases, the need for touch versus button interface becomes stronger. Companies deploying ATMs realise they need technology that will not require adjustments once deployed. The market is demanding greater touchscreen technology advancements in the areas of calibration stability and durability to ensure that scratches do not affect or disable the performance of interactive touchscreen products.

Figure 3.11 below illustrates a kiosk used for financial interactions.

![Figure 3.11 Financial Kiosks](image)

Touch-based systems are an integral part of the rapid growth of kiosk applications because the touch interface is universal and can be used by anyone regardless of language, education, socio-economic or cultural background. [11]

3.1.11 Speciality Devices to Facilitate the Disabled

Interactive Touchscreen Inc (www.itouchinc.com), providers of the Navigo® system and the Wayfinding System, customise a variety of optional featured speciality devices to aid disable person interaction with its touchscreen way-finding and informational kiosk systems.

(i) Voice Prompt Activation Motion Sensors

Motion sensors automatically detects when a person has approached the kiosk. To aid those with reading difficulties or the visually impaired a voice prompt is activated
instructing users on the operation of the Navigo® system. Voice prompts can be used throughout the entire navigation of the system to ensure the ease of use for all visitors.

(ii) **Braille Keyboards**

Navigo ® Systems integrate with a Braille Keyboard interface (optional feature) to assist the visually impaired.

### 3.1.12 Internet Kiosks

Presently we are witnessing a proliferation in the availability of Internet kiosks from companies such as Eircom and Esat, in public access areas such as public bars, restaurants, hotel foyers, shopping centres and airports in the form of wall mounted or free standing units. These units provide a convenient new way for the mobile public to keep in touch instantly with access to email and the entire World Wide Web.

Figure 3.12 below illustrates a kiosk used for browsing the WWW.

![Figure 3.12 Internet kiosks](image)

Esat supplies analogue- Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN) public Internet kiosks, to Irish businesses. Its turnkey free installation and maintenance leasing arrangements range from:

- A fixed weekly rent paid through a bank-standing debit plus a percentage split of the cash receipts with the business proprietor.
A negotiated percentage split of the cash receipts with the business proprietor.

3.2 Tomorrow’s Kiosks

Human-computer interaction is on the brink of radical change. We anticipate a new generation of kiosks with speech and visual perception capabilities. The catalyst for this change will be the computer's ability to sense and recognise its users, to see and reconstruct its environment, and to respond visually and audibly to these stimuli.

These kiosks of tomorrow have been termed "Smart Kiosks" by Compaq Cambridge Research Laboratory (CRL). Such "Smart Kiosks" are aware of their environment, can identify potential customers and initiate contact. These kiosks communicate in a natural way using animated personable characters.

In the early 1990’s the Smart Kiosk Project was initiated at Compaq CRL research laboratory to explore how advances in computer technology could be applied to improve public kiosks through researching vision-based human-computer interaction. The goal of this ongoing project is to build real systems for real users, by developing a Smart Kiosk that interacts with people in a natural, intuitive fashion. The ideal Smart Kiosk will recognise people and track people in its vicinity, communicate with them visually and audibly, and interact in a friendly, natural intelligent manner in real-time via a talking synthetic face.

Figure 3.13 below illustrates a smart kiosk.
The following are examples of some of the diverse fields of expertise required by the Smart Kiosk Project:

- Computer Vision-based Human Hand Tracking
- 3D Model Building
- Facial Animation

The following subsections analyse the Smart Kiosk research in a little more detail, looking initially at features such as facial animation and synthesis. In addition the ability of such a kiosk to simulate human speech is examined and the current results of Compaq’s work in this area are reviewed.

3.2.1 Smart Kiosk Technology – Giving the Kiosk a “Face”

One of the elements of the Smart Kiosk is the animated talking face. There are two aspects to this feature; actually modelling the face to make it look a human’s - *synthesis* -
and making it move in the same way a human's does to express emotions and speak — animation.

(i) Facial Animation

Humans are experts at interpreting and understanding subtle motions and expressions displayed on the face. Cells in the brain activate when presented with images of faces and respond directly to facial orientation and pose. Understanding human response to faces has been the subject of much investigation by the scientific community over many years. Tapping into human responses to faces promises to re-shape the human computer experience. The ability to present talking faces provides a unique opportunity for multimedia providers to create animated characters to deliver messages, guides to provide information about a site, or bring e-mail and Chat avatars to life.

(ii) Facial Synthesis - A Challenge

When presented with a synthetic face of an individual, the illusion of reality is soon lost as we can quickly determine that it is a fake due to our expertise at interpreting and understanding subtle facial motions and expressions. However as the fidelity of facial synthesis improves, it becomes increasingly hard to deceive the observer.

It is clear that at some point in the future we will be able to synthesise characters that can masquerade as real people. However, the possibility of taking a single snapshot of an individual, recording some voice samples and then re-animating the individual in a new sequence to be indistinguishable from the real person, remains a imposing challenge for computer synthesis.

3.2.2 Smart Kiosk Technology — Speech and Audio Research

Over the last five years a tremendous surge has focused on researching continuous speech recognition and audio processing. Current commercial solutions for speech recognition lack the flexibility needed for building new and interesting applications; human factor issues for consumer product applications are still poorly understood.

(i) Speaker Recognition

Speaker recognition is the area of speech technology which attempts to answer the question "Who is speaking?" This area can be broken down into two key problems. In the first problem there exists a claimed, or expected, identity of a speaker, which is then confirmed or refuted. This is the problem of speaker verification. The second problem is where a speaker is identified from among a pool of candidates. This is the problem of speaker identification. Speaker identification is made more difficult if there is no guarantee that the speaker is in the pool. This means that the correct answer might be "unknown speaker."
Additional factors directly impact the complexity of these tasks. Among these factors are the prevailing acoustic conditions, the sampling rate of the signal, and whether the spoken input has known word content or not. In all instances, it is necessary to collect data ahead of the time for each speaker to be "enrolled" in the system.

At Compaq's CRL, the problem of speaker recognition is a key focus in its effort lead to build superior real-world systems and applications in the areas of security and fraud detection. Compaq CRL is looking at ways to improve speech recognition performance in several key areas and its integration with the user interface. It is also exploring the area of music classification, clustering\(^1\) and eventually understanding. Its benchmark applications are the indexing of Web-served multi-media and voice control of new appliances.

Compaq CRL focus on three main areas:

- Audio and video indexing for the Web
- Spoken interface for information retrieval
- Content-Based analysis of music

(ii) **Audio/Video Indexing for the Web**

Compaq CRL believe that the amount and type of multimedia content on the Web is ready to explode and that new modalities to interact with this content will be needed. Speech recognition provides an interesting way to access, classify and index spoken content. Since November 1999 they have been working on the SpeechBot multimedia search engine.

SpeechBot indexes streaming media files based on their content, much as conventional search sites index ordinary Web pages by their text content. Like conventional search sites, SpeechBot does not store or serve the multimedia files themselves, but rather provides users with links. The index is continually updated using SpeechBot’s highly scalable architecture. It currently indexes more than 8,500 hours of content and it is possibly the largest such index on the Web. [12]

(iii) **Spoken Interface for Data Retrieval**

The integration of computer capabilities into home appliances such as a digital VCR or MP3 jukebox increases the complexity of the user interface. Compaq CRL believes that speech recognition can play a role in reducing this complexity. Its research focuses, however, on using speech to improve the information retrieval aspects of the user interface rather than to provide command and control functionality. It is investigating the use of

\(^1\) Clustering is concerned with storing related information close to each other on disk for more efficient retrieval
speech recognition to augment the user interfaces of such systems to provide simple, efficient, and reliable information retrieval.

(iv) Music Similarity, Clustering and Understanding

Compaq CRL’s interest in music is based on the prevalence of the MP3 format on the Web and its migration to people's homes, offices and cars. The ability to access hundreds of millions of hours of music from a single place raises new questions of how to access, classify and cluster songs, learn musical tastes and detect copyright violations? Compaq are actively exploring this area further, building on knowledge learned from speech processing. To date, it has developed promising technology called BoogieBot, which can choose similar music based solely on audio properties. Compaq has also investigated ways of automatically summarising songs. [13]

3.2.3 Smart Kiosk Technology – Compaq CRL Smart Kiosk Face

The Smart Kiosk Face, an implementation of the DECface software created by Keith Waters and Tom Levergood, can speak with either a synthesized voice or by lip-synching to a pre-recorded audio track. Based on plain ASCII text input, a synthetic speech segment is generated and synchronized in real-time to a graphical display of an articulating mouth and face. The key component of DECface is the run-time facility that adaptively synchronizes the graphical display of the face to the audio. The face is a texture-mapped three dimensional model that is drawn in real time (approximately 10-15 frames per second). By changing the facial geometry and texture map, any face can be animated. To express emotions, the animated face uses a set of facial muscles corresponding to a subset of the muscles in the human face. By combining muscle deformations, eye position, and eyelid movement, the face is capable of dynamically expressing a wide variety of human emotions.

Figure 3.14 below illustrates a synthesised face with key facial muscles highlighted.
3.2.4 Smart Kiosk Technology – Compaq CRL Kiosk Prototypes

To test kiosk technologies and explore user requirements, Compaq have been building a series of kiosk prototypes. Each prototype addresses a real-world problem and provides an experimental test vehicle for exploring core kiosk technologies. The first prototype placed outside the CRL laboratory was installed in the Cybersmith Cafe in Harvard Square, Cambridge, Massachusetts in September 1997. The early months of activity were scheduled as a "shakedown" where bugs were fixed and content was tailored to the store customers. Later efforts concentrated on running experiments and testing the usability and utility of the kiosk.

Figure 3.15 below illustrates Compaq CRL’s Smart Kiosk in action

![Screen Capture of the Cybersmith Version of the Smart Kiosk](image)

The display on the kiosk screen is divided into four logical areas, as shown in the above illustration. The upper-left hand corner contains the animated talking face. Shown in this illustration is "Nethead Red", the character created by the Cybersmith staff. Nethead Red watches the people in the immediate vicinity of the kiosk, tracking their motion and talking to them. Beneath the face is an image of what the camera sees; in this case, two people standing in the hallway of the Compaq CRL research lab.

The navigation bar at the bottom of the screen allows the user to quickly travel to areas of interest in the kiosk. The right-hand side of the screen contains standard HTML pages.
3.2.5 Remote Access Communication Kiosk – Next Generation

Soon you will notice kiosks replacing both payphones and ATMs across the world. Our society is demanding access to the Internet and to meet this need access to public kiosks will be essential and available everywhere. Many of us depend on the Internet for business; communication and information even when we are away from home or work. The phone booth of the future will provide such multiple remote access communications services such as Internet access, telephone and videoconferencing, as well as credit card and bill acceptance options. Enclosures will range from a comfortable sit down unit with privacy concerns to counter top units.

Figure 3.16 below illustrates an integrated kiosk used for remote access communications.

![Figure 3.16 WebStop- Next Generation Remote Access Communications Kiosk](image)

3.2.6 Collaboration on the Kiosks of the Future

Net-BlueBox.com recently created EuroKiosks.org to serve as the meeting place for everyone involved in the kiosk industry throughout Europe. With the launch of the Euro Kiosks Network by Charles and Robert Porter, EuroKiosks.org are providing a platform open to software suppliers (Degasoft), hardware suppliers (Elo TouchSystems & Neo Products), network operators (APC Interactive), telecommunication firms (Deutsche Telekom), as well as other kiosk applications. Its goal is to provide an interactive gathering place open to all suppliers within the kiosk industry and will be presented in several European languages to ensure user-friendliness.
3.3 Kiosk Storage Mechanisms

There has been some debate by experts in the area about the best method of storage for kiosks. Should information be located locally on the kiosk or should the kiosk be a smart or dumb terminal. Among other things, information currency and updating requirements need to be considered in the context of storage. In the KNP context, some information will seldom if ever need to be updated e.g. history of different areas of the Park: Muckross Estate, Knockreer Demesne and Tomies Wood. Other information may need to be updated on a daily basis, depending on the events calendar and specific circumstances. Topical information might need updating seasonally.

3.3.1 CD-ROM/DVD Kiosk (Juke-box)

Information may be stored locally on the kiosk using CD-ROM or DVD technology. In this case the information point is a stand-alone non-networked unit. In circumstances where current information is required on a daily or semi-daily basis, updates would change too fast for CD-ROM or DVD distribution. This kiosk type is not an option for the KNP, as information updates are required at least on a daily or semi-daily basis.

3.3.2 Client/Server Model Kiosks

Computer networking aims to deliver (i) the sharing of resources, (ii) reliability (backup), (iii) ease of communication and (iv) cost savings. Machines on a network are of two types, either client or server. On such a system, part of the work is executed on the client and part on the server. Any server-based model can be classified as client-server. In a true client/server system the client depends on the server to provide much of its required resources. These resources are termed “networked” resources, as the information must travel along the communications network from server to client if the client is to be of any practical use to the end-user. Typical resources range from database management systems to text processing applications to Internet access software.

The server can be any type of adequate high specification machine running any type of appropriate operating system. One or multiple servers may serve on a network. In the KNP context, much of the information stored on the servers, for dissemination to the kiosks will be multimedia content. Clients on a network are of two types, either thin or smart.
3.3.3 Thin Client Kiosks

3.3.3.1 Introduction to Thin Clients

Thin clients are essentially monitors or touch screen appliances with little or no hard drive space, floppy drives, CD-ROM drives, or other moving components. The idea behind thin-client application server computing is simple: computing power, storage, applications and data are centralised on the server. Thin clients depend on the server and cannot operate without the network. Thin clients require minimal maintenance, as they do not possess many active components [16].

Figure 3.17 below illustrates a network infrastructure, which utilises a thin client model.

![Figure 3.17 A Network Infrastructure with a Thin Client Model](image)

Recent advances in thin-client computing technology are driving the Post-PC Era. Thin clients are termed *Networked Computers* and are referred to as NCs in the literature. The NC appears as a black box. Its dimensions are similar to an A4 sheet of paper bearing a thickness of 2.5cm. The network card is an integral part of the NC. Typically, a mouse, keyboard, and monitor are connected individually to the NC. A thin client network protocol is used to transport keystrokes, mouse clicks and screen updates over standard protocols from the server to the client and vice versa. On the client, users see and work only with the application's interface.
Manufacturers such as WYSE provide customised units, which integrate the monitor and the NC.

Other NC manufacturers include Acorn, Sun Systems, Pace and Funia.

### 3.3.3.2 Thin Clients in the KNP

The thin client kiosk remotely calls the information, from a central terminal server, down a permanent connection (cable, wireless or satellite), each time a user requests it. The central information /transaction repository can in turn be routed to independent databases.

In the KNP context, a touch screen monitor would be wired to an encased NC, housed in the plinth of the Kiosk. Both the NC and the touch screen are wired to a timer-enabled power supply. When the power is switched on, the NC announces that it is active on the network and automatically loads the browser. A simple browser interface is adapted to allow the user to navigate the touch screen with ease and confidence.

Alternatively the Kiosk may comprise of a housed integrated Touch Screen / NC unit which is wired to a timer-enabled power supply.

Windows 2000 Terminal Server operating system is used in combination with Citrix MetaFrame 1.8, which is thin client application server software.

Alternatively one can install Citrix MetaFrame 1.8 software on top of the Terminal Server package of NT4 server software.

Figure 3.18 below illustrates a potential server machine set up at Muckross House using client software.
Chapter 3 – Networked Interactive Information Points

Figure 3.18 A Potential Server Machine Located at Muckross House Utilising Thin Client Software.

Figure 3.19 below illustrates a typical 3-tiered architecture that could be used with a thin client.
### 3.3.3.3 Thin Client Server Software

**Citrix Metaframe 1.8**

Citrix MetaFrame 1.8 allows all NCs, produced by the different Manufacturers, to be Windows 2000 enabled on the network. This is referred to as *Independent Computing Architecture* (ICA).

Citrix *Independent Computing Architecture* (ICA) is an industry standard for server-based computing. Citrix ICA technology includes a server software component, a network protocol component, and a client software component. On the server, ICA separates application logic from the user interface and executes 100% of the application on the server.

#### Figure 3.19 Three Tiered Architecture with Terminal Server

<table>
<thead>
<tr>
<th>(i) Presentation Layer:</th>
<th>Thin Client</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ii) Business Layer:</td>
<td>Terminal Server</td>
</tr>
<tr>
<td>ASP, VBScript, JavaScript</td>
<td>Traditional Programming Languages</td>
</tr>
<tr>
<td>(iii) Data Layer:</td>
<td>MS Access, Flat Files</td>
</tr>
<tr>
<td>MS Access, Flat Files</td>
<td>MS Access, Flat Files</td>
</tr>
</tbody>
</table>

[Diagram of Three Tiered Architecture with Terminal Server]
Figure 3.20 below illustrates how a thin client model operates.

![Thin Client Model Illustration]

*Figure 3.20 With the thin client model only the keyboard strokes, mouse clicks and the screen updates travel across the network. 100% of the application logic is executed on the server.*

Citrix application server software and services offer "Digital Independence™" - the ability to run any application on any device over any connection, wired, wireless and Web.

**Bandwidth**

Citrix MetaFrame thin client application server software is frugal on bandwidth. It uses 60 kilobits-per-second of network bandwidth. It is sound and mini-video enabled. Typically less than 5 kilobits-per-second of this bandwidth are consumed when transporting keystrokes, mouse clicks and screen updates over standard protocols from the server to the client and vice versa.

In the literature Citrix WinFrame refers to the precursor of Citrix MetaFrame which did not possess sound and mini-video capabilities.

The minimum base unit license for Citrix MetaFrame covers 15 users at a cost of €6,580. Additional user licences in excess of this minimum requirement may be purchased at a reduced rate.

**Note:** Citrix MetaFrame and Legacy PC’s Investment Leverage: Citrix MetaFrame software can be installed on any make of PC and on older, legacy low specifications PCs.
As a result these PCs will be both networked and Windows 2000 enabled to function as NCs. So, if the KNP were to consider this option this author would recommend that they should purchase more licences, in excess of the 10 kiosk NC licences as its existing PCs could be configured to access the network regardless of their architecture or specification.

Citrix VideoFrame™

Citrix VideoFrame 1.0 enables organizations to efficiently integrate, manage, publish and maintain streamed audio and video content to clients throughout the enterprise.

Video files are required to be in either Motion Picture Expert Group (MPEG) or AVI format. Better compression is achieved with MPEG files however.

As VideoFrame dynamically scales video streams according to available bandwidth; modem users and LAN-based users working over low bandwidth connections can access the same content and enjoy a high-quality multimedia experience. VideoFrame enables an organisation to deploy multimedia content with the same speed, simplicity and reliability as all other server-based published applications. Administrators can centrally manage multiple VideoFrame servers, media streams and published content across the enterprise - all from a single point.

Figure 3.21 below illustrates streamed video with Citrix VideoFrame

![Figure 3.21 Streamed Video using Citrix VideoFrame](image)
Launching Videos Through Citrix VideoFrame

VideoFrame improves the video capabilities of organisations using Citrix MetaFrame™. Typically, videos that are embedded into applications do not run correctly or with the level of quality that users expect. Now, in a server-based computing environment using MetaFrame, one can link a video to an application and launch it with the resolution and performance that users demand.

A Citrix VideoFrame™ licence for up to 200 concurrent streamed video delivery costs 5,300 €. Data Solutions Ltd., (Tel 01- 4604888) are Citrix’s Irish Agents. [18]

3.3.4 Smart Client Kiosks

3.3.4.1 The Typical Smart Client Kiosk

The kiosk terminal can be a smart client, with its own operating system and software, networked via a central information /transaction centre, which in turn is routed to independent databases. The kiosk could be remotely updated via Public Switched Telephone Network, ISDN, DSL or leased line. Alternatively the kiosk may have a radio receiver, a satellite receiver or a connection to a local cable TV system. In the KNP context, the Master Relational DBMS, Master IIS Server (WWW Server) and the Flat File System would be centrally located at Muckross House. The information could be called from the kiosk each time a person requests it. This would be similar to the way the Web works.

Alternatively all the information could be called from the kiosk by night and stored on the client.

A further option, combining the above two strategies might be employed, where the Flat File System data, which is the bulk of the information, would be brought down to the booths at night with a small portion of information being available live over a permanent connection from the Primary server. In this approach the text based DBMS information, which is small in size would be available live to each Booth. Current emergency information could also be displayed on tickertape across the screen of the booth.
3.3.4.2 The Replica Server Smart Client Kiosk

The Replica Server Smart Client Kiosk: It is possible to have a local Relational DBMS, Local IIS Server (WWW Server) and the Flat File System on replica servers located on each booth. Information would be transferred to these replica booth servers on a nightly basis, from the primary Web and database server, which is centrally located at Muckross House.

SQL Server 7 fully supports replication of databases with many built in features to perform these tasks. Features supported include the ability to replicate at specific time intervals (scheduled). This is achieved by SQL taking a snapshot of the data.

Features also support *replication by transaction*: When a change is made on the master database the replication software automatically updates all the local databases.

Taking a snapshot of the data uses less resources as it can be done at non-peak intervals such as at night. There are several methods available as to how the snapshot is replicated onto the subscribing machine. The simplest method is to take a snapshot of the whole database and overwrite the local copy of the data on replication.

Figure 3.22 below illustrates how subscribing machines may be immediately updated following changes to a master database.
Using replication by transaction will provide all servers with the most up to date data. However this tends to place a huge load on the primary server. One way to alleviate this is to put a separate replication server in place to handle all replication transactions. The trade off between which method to choose depends on how up to date the information needs to be against the cost of implementing expensive replication options.

Data can be passed between SQL servers in one of two formats, *Push and Pull* respectively. Push is where the publishing SQL server pushes information out to the subscribing servers. Pull is where a subscribing server subscribes to a publishing server to pull information from it [19]

The main benefit of replication is reliability in the form of the kiosk’s up-time being maintained even if the primary server and/or a network connection becomes unavailable. Another benefit would be speed of access with the kiosk’s client software calling information from a server located on the same machine.

However, these kiosks would be far too expensive, in a KNP context, due to their hardware specifications and software licensing costs. Each kiosk would require a version of SQL server and IIS server running on it. This scenario would place a high level of demand on hardware resources, requiring each kiosk to house a high specification hardware environment.

### 3.3.5 Choosing a Kiosk Client for KNP

The solution the author has chosen is based on using a smart client architecture environment without the use of replication. This solution was chosen for the following reasons:

- Smart clients offer greater functionality over thin clients.
- Smart clients use less bandwidth in the exchange of information.
- If the server “goes down” smart clients can use cached material to remain functioning where as the effects of a down server on a thin client are instantaneous.
- Kiosks running smart clients function using open standard protocols, whereas thin client kiosks use proprietary standard protocols.

The Specifications and Costings for the KNP Kiosk, which is recommended by the author are to be discussed in the following subsections.
3.3.5.1 Background

It is envisaged that within the Killarney National Park (KNP) there will be 10 diversely located Visitor Information Delivery Points (Information Zones) with 4 Information Kiosks at each of these zones. The physical and application requirements of these kiosks are reviewed in the following sections.

3.3.5.2 Physical Kiosk Requirements

From a purely physical viewpoint this author recommends that the KNP kiosk be

- *Indoor in semi-open shelters* - due to the heavy annual rainfall which Killarney receives
- *Accessible to all visitors*, including the physically handicapped such as those wheel-chair bound.
- *Network-enabled* to ensure interconnection of all kiosks is possible and a facility to send e-cards is available
- *Attractive* looking within the Park setting
- *Robust*, have a *heavy-duty construction* and be *vandal resistant*
- Equipped with *Built-in Speakers* for information dissemination

**Note:** As the KNP will require multiple kiosks, a bulk order will reduce the price per kiosk unit.

3.3.5.3 Kiosk Application Requirements

The overall requirements from a kiosk application viewpoint are that they should be

- *multimedia-enabled* to entice and excite the visitor
- *touchscreen-enabled* to facilitate user interaction
equipped with a *Voice-activated capability for the visually impaired visitor*. A set of Earphones will be connected into to the Earphone socket jack on the sound card.

The kiosk should have a high hardware specification as outlined in the following table in order to support the above requirements:

<table>
<thead>
<tr>
<th>Kiosk Requirement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor Speed</td>
<td>800MHz Effective delivery of MM content</td>
</tr>
<tr>
<td>RAM</td>
<td>256MB Effective delivery of MM content</td>
</tr>
<tr>
<td>Hard Disk Space</td>
<td>10GB Database Storage requirements</td>
</tr>
<tr>
<td>Network Card</td>
<td>PCI, 10/100Mbps For potential networking requirements</td>
</tr>
<tr>
<td>Touch Screen</td>
<td>ELO LCD 15” Ease of user-interaction</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Built in UPS</td>
<td>Ensure reliability</td>
</tr>
<tr>
<td>MPEG Video Card</td>
<td>PCI, 8MB Facilitate video content delivery</td>
</tr>
<tr>
<td>Sound Card</td>
<td>PCI Facilitate audio content delivery</td>
</tr>
<tr>
<td>Single Switch Restart</td>
<td>Necessary if a power failure occurs</td>
</tr>
<tr>
<td>Auto-alert Feature</td>
<td>To alert technical support that the monitor is down</td>
</tr>
<tr>
<td>AKA</td>
<td>To reboot the kiosk on failure</td>
</tr>
</tbody>
</table>

Figure 3.23 below illustrates the kiosk recommended by this author. It is quoted at around $4000 from Meridian Kiosks. [http://www.meridiankiosks.com](http://www.meridiankiosks.com) (Date 09 July 2001)
3.4 Network Infrastructure

Network topology describes the physical layout of the network. This includes the actual devices and the manner in which they are connected to each other. The connection can be via wire, a microwave link or a communication satellite. Three topologies are dominant: bus, ring, and star.

3.4.1 The Bus Network

This is the simplest type, comprising a single main communications pathway with each device attached to the main cable through a device called a transceiver. From each transceiver on the bus, another cable runs to the device’s network adapter.

Figure 3.24 below illustrates a bus networking topology.

![Bus Networking Topology](image)

Figure 3.24 Bus Networking Topology

Until recently, machine-to-machine networks were limited to a throughput of about 10 Mbps, although current developments in Fast Ethernet and Fibre Distributed Data Interchange allow for speeds of 100 Mbps and Gigabit Ethernet (1Gbps) respectively.

Advantages

- Simplicity - Adding new machines to the network means installing a network card and connecting the new machine into a logical place on the backbone. Some rewiring
will be necessary, however.

- Cost - Probably the cheapest LAN topology available.

Disadvantage:

- If there is a problem anywhere along the bus, the entire network is down.

3.4.2 The Ring Network

Token ring is a ring topology network. There is no physical ring architecture in a ring network. Rather, the ring refers to the design of the central unit that handles the network’s message passing. In a token ring network, the central control unit, called a Media Access Unit, or MAU has a ring circuit inside it. The ring inside the MAU serves as the bus for devices to obtain messages.

Figure 3.25 below illustrates a ring networking topology.

![Figure 3.25 Ring Networking Topology](image)

Advantages

- It delivers point to point connections.
- Wiring centres allow for detection of cable breaks.
Disadvantage

- IEEE 802.5 Token Ring speed is very slow at 4mbps across a LAN. This speed would be proportionately slower across a WAN.

3.4.3 The Star Topology

The Star network, known as a hub network uses a main cable much like the bus network, which is called the backplane. From the backplane, a set of cables leads to a hub, which is a box containing several ports into which devices are plugged. Hub networks can be very large, using a high-speed fibre optic backplane and slightly slower Ethernet drops to switching hubs from which a workgroup can be supported.

Figure 3.26 below illustrates a star networking topology.

Advantage

- If one cable is faulty it does not affect the entire network.

Disadvantage

- It can be expensive as switching hubs and more cables are required.
3.4.4 Killarney National Park Network Topology Options

3.4.4.1 The Star Topology Option

Figure 3.27 below illustrates a possible star networking topology option for the KNP system.

![Diagram of Star Topology]

**Advantages:**

- As all lines of communication are controlled from a single point the system is easily maintained.

**Disadvantages:**

- As there are long distances between some kiosks and the base station, the option of deploying Sub Station(s) should be considered.
- The choice of communication mediums (wired, wireless) will have to be seriously considered also in light of these distances

3.4.4.2 The Bus Topology Option
Figure 3.28 below illustrates a possible bus networking topology option for the KNP system.

Advantages:

- Shorter distances between kiosks can be achieved.

Disadvantages:

- Maintenance of kiosks would be more difficult.
- Extra hard disk space would be required at each kiosk to ensure better reliability.

3.4.4.3 Combination of Star and Bus Topology Option

A solution involving a combination of the star and bus topologies could be considered. This decision would be based on:

- The proximity of the information points to the base station.
- The distances between the information point zones relative to each other.
- Security considerations- A kiosk situated in a remote location may be difficult to maintain. Line of communication (communication medium) to a Kiosk may need to be checked regularly.
Figure 3.29 below illustrates a possible bus/star networking combination option for the KNP system.

In this example, some of the kiosks are connected directly back to the Muckross House Base Station (Star Topology). More of them are indirectly connected to the base station, through other kiosks (Bus Topology). The Knockreer Zone is chosen in this scenario as the end node in the Bus because Park staff employed in its vicinity could maintain its dependent kiosks. Furthermore if leased line connections were chosen as the preferred overall communication medium, some costs could be reduced as leased lines less than 1.5 km from the Exchange are cheaper.
3.4.5 KNP and the World Wide Web

3.4.5.1 Connecting KNP to the Net

Figure 3.30 below illustrates how the Internet may be connected to the KNP system.

The firewall contains two network cards. One has an address consistent with the private address range of the LAN. The other card contains an external IP address, which is obtained when the leased line is purchased. This IP address will be used to communicate with the Internet regardless of which node on the internal network is requesting information to/from the Internet. The firewall and Proxy server software perform the internal private to external public IP address translation.

3.4.5.2 Private IP Addresses

Each computer or device on a network requires a so-called IP address that is globally unique. As the Internet grew, organisations connecting to it required a public address for each node on their intranets. This requirement placed a huge demand on the pool of available public addresses.

When analyzing the addressing needs of organisations, the designers of the Internet noted that for many organizations, most of the hosts on the organization's intranet did not

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2 IP stands for Internet Protocol and is the standard by which all Internet communications take place.
require direct connectivity to Internet hosts. Those hosts that did require a specific set of Internet services, such as the World Wide Web access and e-mail, typically access the Internet services through Application layer gateways such as proxy servers and e-mail servers. The result is that most organizations only required a small amount of public addresses for those nodes (such as proxies, routers, firewalls, and translators) that were directly connected to the Internet.

For the hosts within the organisation that do not require direct access to the Internet, IP addresses that do not duplicate already-assigned public addresses are required. To solve this addressing problem, the Internet designers reserved a portion of the IP address space and named this space the *private address space*. An IP address in the private address space is never assigned as a public address. IP addresses within the private address space are known as *private addresses*. Because the public and private address spaces do not overlap, private addresses never duplicate public addresses.

The private address space specified in RFC 1918 is defined by the following three address blocks:

- **10.0.0.0**
  
  The 10.0.0.0 private network is a class A network ID that allows the following range of valid IP addresses: 10.0.0.1 to 10.255.255.254. The 10.0.0.0 private network has 24 host bits that can be used for any subnetting scheme within the private organization.

- **172.16.0.0**
  
  The 172.16.0.0 private network can be interpreted either as a block of 16 class B network IDs or as a 20-bit assignable address space (20 host bits) that can be used for any subnetting scheme within the private organisation. The 172.16.0.0 private network allows the following range of valid IP addresses: 172.16.0.1 to 172.31.255.254.

- **192.168.0.0**
  
  The 192.168.0.0 private network can be interpreted either as a block of 256 class C network IDs or as a 16-bit assignable address space (16 host bits) that can be used for any subnetting scheme within the private organization. The 192.168.0.0 private network allows the following range of valid IP addresses: 192.168.0.1 to 192.168.255.254.

The result of many organisations using private addresses is that the private address space is re-used, helping to prevent the depletion of public addresses. Because the IP addresses in the private address space will never be assigned by the InterNIC as public addresses, there will never exist routes in the Internet routers for private addresses. Private addresses
are not reachable on the Internet. Therefore, Internet traffic from a host that has a private address must either send its requests to an Application layer gateway (such as a proxy server), which has a valid public address, or have its private address translated into a valid public address by a network address translator (NAT) before it is sent on the Internet. [20]

3.4.5.3 Hosting the KNP Website

According as the Web pages change one can post them to the Internet Service Provider’s web server for viewing on the WWW. These pages are usually posted using an FTP client\(^3\). However some service providers may support the use of front page server extensions (or other proprietary server extensions). This would allow for the use of an application such as Microsoft FrontPage 2000, to both author and post the pages.

The amount of space available to host web pages on an ISP server ranges from the standard 50 MB which is provided free of charge for non-commercial purposes, up to as much space as is required by commercial companies who have the means to pay for it.

An alternative option would be for the KNP to host its own Website/s on site. The site/s would be hosted on a server that is located on a separate network from the KNP internal network called a DMZ (Demilitarised zone) network. The benefits of using this system include the KNP’s ability to dictate the hardware and software requirements on the external server (i.e. Windows 2000 Server with IIS). This would make the transfer of data between the internal and external server run seamlessly as both servers would be running on the same environment. The disadvantages of this method would include the KNP having to employ staff with the necessary skills to implement and maintain this environment.

The complete specifications and costings for both the hardware and software components of the KNP IT infrastructure are to be found in Appendix B at the end of this report.

3.4.5.4 The WWW Home User Options

The KNP Website is an important feature of the system from both an internal and external viewpoint. Externally, there is a need to advertise the goods on offer at KNP to would-be clients and those interested enough to visit the KNP site. Hence, depending on the visitors connection mode the following options should be considered.

- For people with DSL links offer them full access to text and multimedia content. Possibly, offer them the choice to download the MM content first and then browse, as

\(^3\) FTP stands for File Transfer Protocol and is part of the TCP/IP suite of protocols. It is used for transferring files from one computer to another.
the database is always live. The same technology that was used in downloading information to the Kiosks is enabled here also.

- For people with slow connections offer a text only version and some graphics without the heavy MM content. Upon paying a small mail order subscription, a CD ROM of Park’s MM content, can be acquired and used in conjunction with the KNP site on offer to them.

3.5 Kiosk Location and Selection Criteria

Fig. 3.31 below indicates the ten locations that were chosen as information zones for the KNP system. These were chosen in particular as they represent the areas of highest visitor traffic generation. In this way it is hoped to maximise the level of information dissemination to our visitors.

Each of the chosen ten zones is located at an existing entrance/exit point to the KNP. The electricity and telephone infrastructure already exists at each of them. Minimal interference, in the form of excavation work and cable laying will need to be undertaken. Of primary concern of course is how the desired IT infrastructure would be put in place, in the highly sensitive natural environment which a National Park is, by its very nature. Muckross House was chosen as the **Base Station** as it is the focal point of the KNP. The Knockreer Zone, as evident from the drawing of the KNP illustrated in Fig 3.31 below was chosen as a **Sub-Station** option due to its proximity to the Golden Gates, Ross Castle and Tomies Wood.
The table below gives the approximate distances of each of the chosen zones from the KNP Base Station at Muckross House “as the crow flies”

<table>
<thead>
<tr>
<th>Zone Number</th>
<th>Zone Description</th>
<th>Distance from Base Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tomies Wood</td>
<td>7.5km</td>
</tr>
<tr>
<td>2</td>
<td>Knockreer (King’s Bridge)</td>
<td>4.75km</td>
</tr>
<tr>
<td>3</td>
<td>The Golden Gates</td>
<td>4.25km</td>
</tr>
<tr>
<td>4</td>
<td>Ross Castle</td>
<td>3.25km</td>
</tr>
<tr>
<td>5</td>
<td>The First Entrance</td>
<td>1.875km</td>
</tr>
<tr>
<td>6</td>
<td>Dinish Cottage</td>
<td>3.25km</td>
</tr>
<tr>
<td>7</td>
<td>Torc Waterfall</td>
<td>1.5km</td>
</tr>
<tr>
<td>8</td>
<td>Muckross Gardens</td>
<td>Local</td>
</tr>
<tr>
<td>9</td>
<td>Ladies View</td>
<td>8.0km</td>
</tr>
<tr>
<td>10</td>
<td>Lord Brandon’s Cottage</td>
<td>9.25km</td>
</tr>
</tbody>
</table>

The diagram in Fig 3.32 below illustrates visually how the KNP zones are separated from each other and the Muckross Base Station.

Figure 3.32 Direct Distances from the Muckross Base Station
The diagram in Fig. 3.33 below represents the direct distances between selected zones and the Knockreer Substation.

![Diagram showing distances between zones and Knockreer Substation](image)

**Figure 3.33 Direct Distances from the Knockreer Substation**

### 3.6 Conclusions

This chapter has examined in some detail the device that is central to the operation of the KNP system – the kiosk. This mode of information conveyance is well suited to the Park environment because it is reliable, robust and efficient and an examination of several kiosk models has revealed that they have all the qualities of a typical workstation computer with the possibility of many extras – it just depends on the user requirements. Indeed, from the several research papers reviewed it appears that the whole area of kiosk technology is about to explode and that more and more features are being added to the devices.

In the case of the KNP the recommended kiosk is a design which can accommodate the visitor under the "soft" conditions that furnish the Park throughout the year – therefore an "indoor" unit of some heavy duty construction is the recommended option. From a purely functional viewpoint, the KNP kiosk is rather simplified in that it does not require anything that the transactional-type points investigated have such as smart card readers, receipt printers and telephony devices for direct Internet access. Instead it is more like an informational-type point and just needs a touchscreen for ease of user interaction.

The various types of touchscreen technologies have been discussed also – each having their own applications - with the flat panel 20” LCD display a must for anyone who can
afford the luxury of them. In the KNP system the kiosk display is an important consideration and in this respect a display that is durable and vandalism resistant is the primary concern as the kiosk display is to be touchscreen. For security, it may also be worthwhile installing an alarm device in the kiosk itself (it might be triggered if sufficient force is applied to the kiosk display for instance).

As the kiosk is to deliver rich multimedia content to the visitor via Web pages, a model having a suitable, “multimedia extensions” high-speed processor is a must as well as sufficient (at least 128MB) RAM. In addition to this a design coming with built-in speakers is an obvious need as are sound and MPEG cards.

The KNP kiosk is also to have a voice-activation facility for the visually impaired. This will be a most useful appendage and will help make the kiosk truly accessible to all. Indeed, examination of kiosk research indicates that the kiosk of the future will actually be able to speak just like a human, convey human emotions accurately, and interact with people at a level never before thought possible. The years ahead certainly look very exciting for kiosk technology.

The storage of the information to be delivered to the kiosk is another important feature of the system and from this perspective a number of traditional storage options such as CD-ROM and DVD were explored initially but the fact that much of the system information will change on a daily basis and also since the desire is to create a network of information points (due to the many advantages such a set-up promises e.g. maintainability, shareability, consistency etc.) all that is really required is sufficient hard disk space to hold a copy of the Master Server information held at Muckross House Base Station. This will mean that if the server at Muckross “dies” the kiosks will continue to operate as normal.

The possibility of using a so-called “thin-client” kiosk model was also examined and the Citrix software provided by Legacy PC certainly makes this a very plausible option. The major drawback to such a solution, however, is that a thin client means little or no hard-disk space and this is a major issue if the server at Muckross fails for some reason. The recommended solution comes in the guise of a “smart client” architecture, mainly because it overcomes the hard-disk space problem and it supports open standards and protocols for greater interoperability.

As mentioned, the ideal scenario for the KNP infrastructure is to have a network of kiosks all being fed from some common location (Muckross House for the KNP system). The various network topology options that might be used to implement such a set-up have been discussed and each approach offers its own pros and cons. One interesting option proposed involved combining a bus and star topology into an overall KNP network layout. This approach would probably be the optimal one as it would reduce the average distances information must travel on the network and hence improve performance and costs.

Finally, the integration of the KNP infrastructure with the Internet and WWW was reviewed and in essence, the problem is akin to a typical organisation’s intranet. The
desire is to keep organisational traffic within the confines of an internal network as much as possible yet, if the requirement is there to “escape from” the bounds of this network, provide a facility to do so. In the KNP context the problem is similar – the desire is to allow the Park visitor interact and obtain information from the kiosk but, if they wish to send an e-mail to a friend from the Park then let them do so. The technical means by which such a scenario could be realised has been discussed fully in relation to private IP addresses and proxy servers. In order to satisfy the needs of the home user who wishes to explore the KNP Website the recommendation is to allow the possibility of dropping the heavy multimedia content for those with slower Internet connections.
At this stage much of the KNP set-up has been decided upon – the information points, the server room requirements, the network topology and the data storage model. This chapter presents a review of the various media by which the information in the KNP system can be propagated from one point to another. It begins by examining traditional cabled media and then moves on to exploring the wireless radio options in some detail. Satellite transfer links are also briefly analysed and, finally, handheld device technologies are discussed.
Chapter 4 – Communications Media

4.1 Wired Medium – Circuit Switching Technologies

4.1.1 Leased Line

A leased line is a telephone line that has been leased for private use. In some contexts, it's called a dedicated line. A leased line is usually contrasted with a switched line or dial-up line. Typically, large companies rent leased lines from the telephone message carriers to interconnect different geographic locations in their company.

The following table illustrates the leased line signal formats available in this country along with their associated number of channels and data rates.

<table>
<thead>
<tr>
<th>Signal Format</th>
<th>Channels Carried⁴</th>
<th>Associated Data Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>32 channels</td>
<td>2.048Mbps</td>
</tr>
<tr>
<td>E2</td>
<td>4 multiplexed E1 signals</td>
<td>8.448Mbps</td>
</tr>
<tr>
<td>E3</td>
<td>16 multiplexed E1 signals</td>
<td>34.368Mbps</td>
</tr>
<tr>
<td>E4</td>
<td>4 multiplexed E3 signals</td>
<td>139.264Mbps</td>
</tr>
<tr>
<td>E5</td>
<td>4 multiplexed E4 signals</td>
<td>565.148Mbps</td>
</tr>
</tbody>
</table>

The following table illustrates Eircom’s pricing structure for its various leased line services as at 10/5/01. It should be noted here that, for all digital leased lines beyond 512kbps, an extra annual rental charge of £60 + VAT is charged for each additional 100m step in excess of 1.5km from the exchange.

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Data Rate</th>
<th>Connection Fee</th>
<th>Annual Rental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analogue Leased</td>
<td>56kbps - 4 wire</td>
<td>£164.46 + VAT</td>
<td>£29 + VAT</td>
</tr>
<tr>
<td>Analogue Leased</td>
<td>56kbps - 2 wire</td>
<td>£164.46 + VAT</td>
<td>£29 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>64kbps</td>
<td>£1500 + VAT</td>
<td>£1216 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>128kbps</td>
<td>£1500 + VAT</td>
<td>£1216 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>256kbps</td>
<td>£1500 + VAT</td>
<td>£2324 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>384kbps</td>
<td>£1500 + VAT</td>
<td>£2324 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>512kbps</td>
<td>£1700 + VAT</td>
<td>£2324 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>1Mbps</td>
<td>£1700 + VAT</td>
<td>£2324 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>2Mbps</td>
<td>£3000 + VAT</td>
<td>£3600 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>3Mbps</td>
<td>£4700 + VAT</td>
<td>£5924 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>4Mbps</td>
<td>£6000 + VAT</td>
<td>£7200 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>11Mbps</td>
<td>£16700 + VAT</td>
<td>£20324 + VAT</td>
</tr>
<tr>
<td>Digital Leased</td>
<td>34.368Mbps</td>
<td>£5540 + VAT</td>
<td>£29200 + VAT</td>
</tr>
</tbody>
</table>

⁴ A channel has a bandwidth of 64kbps so the greater the number of channels carried the greater the amount of information that can be transmitted per second
Chapter 4 – Communications Media

4.1.2 Integrated Services Digital Network (ISDN) – Switched Dial-Up

Telephone companies with the intention of creating a totally digital network developed ISDN. There are two ISDN services—Basic Rate Interface (BRI) and Primary Rate Interface (PRI).

(i) ISDN BRI operates over most of the copper twisted-pair telephone wiring in place today. It delivers a total bandwidth of a 144 kbps line into three separate channels. Two of the channels, called B (bearer) channels, operate at 64 kbps and are used to carry voice or data traffic. The third channel, the D (data) channel, is a 16 kbps signalling channel used to carry instructions that tell the telephone network how to handle each of the B channels. ISDN BRI is often referred to as “2B+D.”

(ii) ISDN PRI in Europe, Australia, and other parts of the world provides 30 B plus one 64-kbps D channel and a total interface rate of 2.048 Mbps.

The PRI physical-layer specification is ITU-T I.431.

The following table illustrates Eircom’s ISDN charges as at 10/5/01

<table>
<thead>
<tr>
<th>ISDN Service</th>
<th>Connection Fee</th>
<th>Monthly Rental</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRI (2 channel)</td>
<td>£164.46 + VAT</td>
<td>£29 + VAT</td>
</tr>
<tr>
<td>Fractional PRI (16 channel)</td>
<td>£3480 + VAT</td>
<td>£152 + VAT</td>
</tr>
<tr>
<td>PRI (30 channel)</td>
<td>£3480 + VAT</td>
<td>£208 + VAT</td>
</tr>
</tbody>
</table>

4.1.3 Digital Subscriber Line (DSL)

DSL technology is used for bringing high-bandwidth information to homes and small businesses over ordinary copper telephone lines. Data, at rates up to 6.144 Mbps, enables the continuous transmission of motion video, audio, and even 3-D effects. More typically, individual connections will provide from 1.544 Mbps to 512 Kbps downstream and about 128 Kbps upstream (maximum 640Kbps) A DSL line can carry both data and voice signals and the data part of the line is continuously connected.

If one chooses, the signal can be separated so that some of the bandwidth is used to transmit both the telephone and computer data on the same line and at the same time.
Eircom is testing DSL in this country for the past while. Its bandwidth allows for capabilities up to 10 times that of ISDN. It would have no dial-up time-lag as there is a permanent connection obtained.

DSL would, most likely, not be an option in the KNP context as it only delivers services for distances of between 3km to 5km from the nearest exchange.

4.2 Radio Medium – Wireless Networking Technologies

4.2.1 The concept of Wireless Networking Technology

IEEE 802.11 is a standards working group on wireless local area networks. The working group is a part of IEEE LM (LAN, MAN) Standards Committee formerly called IEEE Project 802. IEEE LMSC reports to the Standards Activity Board (SAB) of the IEEE computer society. [21]

In 1997 IEEE defined the 802.11 Wireless LAN (WLAN) standard, intended to allow wireless connection of workstations to their base LAN. WLANs may be implemented using radio or optical technologies for the transmission of the signals through the air.

Nowadays this technology is also deployed to provide large scale Broadband Wireless Access (BWA) to public networks. In this scenario the base LAN is owned by a service provider while the workstation is owned by a subscriber.

Wireless LANs use electromagnetic airwaves (radio and infrared) to communicate information from one point to another without relying on any physical connection. Radio waves are often referred to as radio carriers because they simply perform the function of delivering energy to a remote receiver. The data being transmitted is superimposed on the radio carrier so that it can be accurately extracted at the receiving end. This is generally referred to as modulation of the carrier by the information being transmitted.

Once data is superimposed (modulated) onto the radio carrier, the radio signal occupies more than a single frequency, since the frequency or bit rate of the modulating information adds to the carrier. Multiple radio carriers can exist in the same space at the same time without interfering with each other if the radio waves are transmitted on different radio frequencies.

To extract data, a radio receiver tunes in (or selects) one radio frequency while rejecting all other radio signals on different frequencies.
4.2.2 An 802.11 WAN Overview

An 802.11 WLAN is based on a cellular architecture where the system is subdivided into cells. Each cell, called a Basic Service Set (BSS), is controlled by a Base Station called Access Point (AP).

Although a wireless LAN may be formed by a single cell, with a single Access Point, most installations will be formed by several cells, where the Access Points are connected through some kind of backbone called a Distribution System (DS). This backbone is typically Ethernet and, in some cases, is wireless itself.

The whole interconnected Wireless LAN, including the different cells, their respective Access Points and the Distribution System, is seen as a single 802 network to the upper layers of the OSI model and is known in the Standard as an Extended Service Set (ESS).

![Figure 4.1 A typical WLAN](image)

In a typical WLAN configuration, a transmitter/receiver (transceiver) device, called an Access Point, connects to the wired network from a fixed location using standard Ethernet cable. At a minimum, the access point receives, buffers and transmits data between the WLAN and the wired network infrastructure. Data can be transmitted to internal end users through wireless LAN adapters (PC cards, ISA/PCI adapters). Internally a single Access Point can support a small group of users and can give coverage of 100ft radius.

Figure 4.2 below illustrates some accessories that are found in a typical WLAN.
High Speed Seamless Roaming can be achieved in Wireless LANs. The collocation of APs generate overlapping coverage. Overlapping coverage areas increases aggregate throughput.

Figure 4.3 below illustrates some accessories that are found in a typical WLAN.
4.2.3 Building to Building Links

For a building to building link, the AP is connected to external directional antennae. Data can be transmitted to a remote LAN using a Wireless Bridge unit at the remote end and external directional antennae. Buildings to building links require Line of Sight between the antennae. Distances of up to 15km are easily achieved for such links. The access point or the antenna attached to the access point is usually mounted high but may be mounted essentially anywhere that is practical as long as the desired radio coverage is obtained.

Antennae include the following types: Directional Antenna and Omni-directional with 10 to 20m coaxial cable. For any type of antenna, 80% of its Fresnel Zone has to be cleared to achieve maximum efficiency from a link.

**Directional Antennae** are of two types:

- 18dBi (decibel above isotropic) antenna delivers distances up to 500 metres.
- 24dBi antenna delivers distances from 500 to 15,000 metres.

Figure 4.4 below illustrates a standard directional antenna and its associated Fresnel Zone

![Figure 4.4 Directional Antenna with Fresnel Zone](image)

A Directional Antenna has a beam-deviation of 10% to 15%. This beam-deviation is referred to as its Fresnel Zone. The Fresnel requires 80% clearance to enable a link to operate at optimal throughput.
**Omni-directional** Antennae are of two types also:

- Omni 6dBi antenna transmits and receives up to 150 to 200 metres.
- Omni 7dBi antenna transmits and receives up to 1,000 metres.

Figure 4.5 below illustrates an omni-directional antenna and its associated Fresnel Zone

![Figure 4.5 Omni-directional Antenna Beam Deviation](image)

An omni-directional antenna, which deploys a cellular topology, has a 360% beam deviation. This is referred to as its Fresnel Zone. Thus an omni-directional antenna is able to flood a general area. The Fresnel requires 80% clearance to enable a link to operate at optimal throughput.

Wireless LANs frequently augment rather than replace wired LAN networks – often providing the final few hundred meters of connectivity between a backbone network and the remote users.

Figure 4.6 below illustrates wireless bridges connecting to external omni-directional antennae
End users access the WLAN through wireless LAN adapters, which are implemented as PC cards in notebook computers, or use ISA or PCI adapters in desktop computers, or fully integrated devices within hand-held computers. WLAN adapters provide an interface between the client network operating system (NOS) and the airwaves (via an antenna). The nature of the wireless connection is transparent to the NOS.

Manufacturers of Wireless LANs and providers of Broadband Wireless Access have a range of Technologies to choose from when designing wireless solutions. Each technology comes with its own set of advantages and limitations.

Figure 4.7 below illustrates that wireless networking technology is highly scalable.
4.2.4 Technology Options – Spread Spectrum

Most wireless LAN systems use spread-spectrum technology, a wideband\textsuperscript{5} radio frequency technique developed by the military for use in reliable, secure, mission-critical communications systems. Spread-spectrum is designed to trade off bandwidth efficiency for reliability, integrity and security. In other words, more bandwidth is consumed than in the case of narrowband transmission, but the trade off produces a signal that is, in effect, louder and thus easier to detect, provided that the receiver knows the parameters of the spread spectrum signal being broadcast. If a receiver is not tuned to the right frequency, a spread spectrum signal looks like background noise.

Spread Spectrum systems can coexist with other radio systems, without being disturbed by their presence and without disturbing their activity. The immediate effect of this elegant behaviour is that Spread Spectrum systems may be operated without the need for license. Thus Spread Spectrum modulation can be the chosen technology for license-free WLAN and BWA operations.

WLAN and BWA applications in the unlicensed spectrum use the frequency band known as "2.4 GHz". This band ranges from 2.4 GHz to 2.4835 GHz (83.5 MHz) and is the same as the Industrial, Scientific and Medical (ISM) band. Licensed spectrum operation includes frequencies such as 2.5 GHz, 2.6 GHz, 3.5 GHz, 3.6 GHz, 3.8 GHz, etc.

\textsuperscript{5}\textit{wideband} (or \textit{broadband}) means that a large range of frequencies are used by the associated wireless technology whereas its counterpart, narrowband, refers to technologies which use a very well defined, specific frequency (ies) and reject signals being propagated at other frequencies.
By transmitting the message energy over a bandwidth much wider than the minimum required, Spread Spectrum modulation techniques present two major advantages: *low power density* and *redundancy*.

*Low Power Density* relates to the fact that the transmitted energy is spread over a wide band, and therefore, the amount of energy per specific frequency is very low. The effect of the low power density of the transmitted signal is that such a signal will not disturb or interfere with the activity of other systems' receivers in the same area and that such a signal cannot be detected by intruders, providing a high level of intrinsic security.

*Redundancy* relates to the fact that the message is or may be present on different frequencies from where it may be recovered in case of errors. The effect of redundancy is that Spread Spectrum systems present high resistance to noise and interference, being able to recover their messages even if noise is present on the medium.

Spread Spectrum modulation techniques are composed of two consecutive modulation processes executed on the carrier signal:

(i) Process 1 is termed the *spreading process* and is executed by the spreading code. It is this spreading process that generates the wide bandwidth of the transmitted signal.

(ii) Process 2 is executed by the message to be transmitted.

There are two types of spread spectrum radio:

- *Frequency Hopping*

- *Direct Sequence.*

### 4.2.4.1 Frequency Hopping Spread Spectrum Technology

Frequency Hopping Spread Spectrum (FHSS) uses a *narrowband carrier* that changes frequency in a pattern known to both transmitter and receiver. Properly synchronised, the net effect is to maintain a single logical channel. To an unintended receiver, FHSS appears to be short duration impulse noise.

The FHSS technique works as follows:

(i) Process 1 - *Spreading Code Modulation*
The frequency of the carrier is periodically modified (hopped) following a specific sequence of frequencies. In FHSS systems, the spreading code is this list of frequencies to be used for the carrier signal. This is also known as the hopping sequence. The amount of time spent on each hop is known as dwell time.

(ii) Process 2 - Message Modulation

The message modulates the hopping carrier, thus generating a narrow band signal for the duration of each dwell, but generating a wide band signal if the process is regarded over periods of time in the range of seconds. Redundancy is achieved by the possibility to execute re-transmissions on different carrier frequencies (hops).

4.2.4.2 Direct Sequence Spread Spectrum Technology

Direct Sequence Spread Spectrum (DSSS) generates a redundant bit pattern for each bit to be transmitted. This bit pattern is called a chip (or chipping code). The longer the chip, the greater the probability that the original data can be recovered (and, of course, the more bandwidth required). Even if one or more bits in the chip are damaged during transmission, statistical techniques embedded in the radio can recover the original data without the need for retransmission. To an unintended receiver, DSSS appears as low power wideband noise and is rejected (ignored) by most narrowband receivers.

The DSSS technique works as follows:

(i) Process 1 - Spreading Code Modulation

For the duration of every message bit, the carrier is modulated following a specific sequence of bits known as chips. The process is known as chipping and results in the substitution of every message bit by the same sequence of chips. In DSSS systems, the spreading code is the chip sequence used to represent message bits.

(ii) Process 2 - Message Modulation

For message bits "0", the sequence of chips used to represent the bit remains as dictated by process1 above. For message bits "1", the sequence of chips dictated by process1 above, is inverted. In this way message bits "0" and "1" are represented by different chip sequences, one being the inverted version of the other one.

Redundancy is achieved by the presence of the message bit on each chip of the spreading code. Even if some of the chips of the spreading code are affected by noise, the receiver may recognise the sequence and take a correct decision regarding the received message bit.
Fig. 4.8 below illustrates the signals used to modulate the carrier in FHSS and DSSS.

<table>
<thead>
<tr>
<th>Data to be Transmitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulating signal in FHSS</td>
</tr>
<tr>
<td>Modulating signal in DSSS (for 5 chip sequence)</td>
</tr>
<tr>
<td>Dwell time</td>
</tr>
</tbody>
</table>

Figure 4.8 Signals Used to Modulate the Carrier in FHSS and DSSS

4.2.4.3 Comparing FHSS and DSSS Technologies

Spreading Codes

Dwell time in FHSS is represented as 3 x data bit duration. Spreading sequence in DSSS is represented as being 5 chip long. In FHSS the frequency of the carrier has a different value for each dwell time. In DSSS the frequency of the carrier has a constant, fixed value for each system.

Transmission Rates

DSSS systems transmit at rates of up to 11 Mbps using a contiguous sub-band of 22 MHz. On the other hand FHSS systems use a channel of 1 MHz. to transmit at rates of up to 3 Mbps. However as a result of last summer’s decision by the Standards Activity Board (SAB) of the IEEE to allow FHSS to operate in the 2.4 GHz band with 5MHz channels, FHSS systems operating at circa 15 Mbps are expected on the market shortly.

The above figures represent the theoretical rates of the systems. The throughput is circa 7 Mbps for 11 Mbps DSSS, and circa 2.2 Mbps for 3 Mbps FHSS.
Chapter 4 – Communications Media

Systems Collocation

In an environment where wireless technology is to be deployed the determination of the number of independent systems which may operate simultaneously without interference is often a critical issue when choosing the adoption of either DSSS or FHSS.

DSSS systems use 11 bit long spreading sequences and system collocation is based on the fixed allocation of bandwidth to each system. This is same as in narrow band systems. For transmission DSSS needs a contiguous band of 22 MHz, and a minimum distance of 30 MHz between the carrier frequencies of collocated systems. As the total available bandwidth in the ISM band is 83.5 MHz (2.4GHz - 2.4835GHz) and as the distance between carriers has to be 30 MHz, only 3 DSSS systems may be collocated.

For FHSS systems, IEEE 802.11 defines 79 different hops for the carrier frequency. Using these 79 frequencies, IEEE 802.11 defines 78 hopping sequences (each with 79 hops) grouped in three sets of 26 sequences each. Theoretically, 26 FHSS systems may be collocated, but collisions will still occur in significant amounts. To lower the amount of collisions to acceptable levels, the actual number of FHSS collocated systems should be circa 15.

Thus for installations requiring wide coverage and multiple collocated cells, it would be much easier to use FHSS. DSSS could be used too, but then, mechanically collocated cells, which require antennae to be installed on the same pole, should be made non overlapping cells at the radio level, through the use of directional antennae. But directional antennae means limited coverage, requiring more systems to be installed, which are difficult to design because of the collocation issue.

Noise and Interference Immunity

The capability of the system to operate without errors when other radio signals are present in the same band is also a primary installation issue. DSSS systems can operate with lower signal levels and therefore, for same level of transmitted energy, DSSS systems can operate over longer distances.

The spectrum used in FHSS is 83.5 MHz while for DSSS it is only 22 MHz bands. The effects of having interference covering a range of 22 MHz are obviously greater than the effects of having the same interference covering 83.5 MHz. A 22 MHz wide interference may totally block a DSSS system, while it will block only 33% of the hops in a FHSS system. A FHSS system will work in these conditions at 66% of its capacity, but a DSSS system would not work at all.

Near/Far Problem

The problems generated to a DSSS receiver by other active transmitters located in its proximity, are known as Near/Far problems.
The interfering signals described above may be generated for example by another radio transmitter located close to the receiver of a DSSS system. The signals generated by such a transmitter, being received by the DSSS receiver at higher power levels, could blind it, making it unable to hear its partner. On the other hand, if the receiver is FHSS, the worst case will be that the other transmitter will block some hops, forcing the FHSS system to work in less than optimum conditions, but still allow it to work.

Coverage

11 Mbps DSSS and 3 Mbps FHSS, cover more or less the same distances i.e. 15km in theory.

4.2.5 Choosing a Wireless Solution for the KNP

DSSS has the advantage of providing higher capacities than FHSS, but it is a very sensitive technology, influenced by many environment factors (noises, interference, etc.). The best way to minimise such influences is to use the technology in point to point applications. DSSS point to point systems can take advantage of the high capacity, without paying the high price of environment influences. As so, typical DSSS applications include building to building links, as well as Point of Presence (POP) to Base Station links, in cellular deployment systems. Small wireless LAN can also take advantage of the high capacity provided by the DSSS technology.

On the other hand, FHSS is a very robust technology, with little influence from noises, reflections, other radio stations or other environment factors. In addition, the number of simultaneously active systems in the same geographic area (collocated systems) is significantly higher than the equivalent number for DSSS systems. All these features make the FHSS technology the one to be selected for installations designed to cover big areas where a large number of collocated systems are required and where the use of directional antennae in order to minimise environment factors influence is impossible.

FHSS is the chosen wireless technology for the KNP, due to its reliability, robustness, security and functionality. Its collocation features allow for the required 10 systems to be collocated at the Muckross House Base Station. The use of this technology allows for a number of implementation options to optimise delivery of Park information to the visitor. One could, where feasible, seek to deliver blanket wireless coverage of the whole KNP by providing a network of broadcast footprints throughout the entire area. Park information could then be accessed via the WLAN anywhere with any device carrying a WLAN card. This could be a Kiosk, PC, Laptop, Personal Organiser (PALM), Pocket PC etc. However, at present, this could prove to be a very costly solution.
The following is an example of a potential 'down-scalable' implementation option for the KNP system: provide wireless service to a number of kiosks at each of the 10 information Zones. The architecture and costing for this solution is now discussed.

Fig. 4.9 below illustrates the KNP wireless LAN solution using FHSS technology.

![WLAN Star Topology using Frequency Hopping Spread Spectrum Technology](image)

Figure 4.9 Four Kiosks per Zone FHSS Solution

A 10 Zone FHSS solution servicing 4 kiosks per zone would require 10 separate radio links from the Muckross House base-station. Each 3Mbps link with its enabling hardware costs £4,800 + VAT. Ten AP10d's, nine * 24dBi Directional antennae and one * 7dBi Omni-directional antenna would be located at Muckross House.

One SA40d (a Station Adapter to cater for 4 MAC addresses) and an antenna would be located at each of the ten zones.

Thus to accommodate one kiosk per Zone one would use an SA10d. To accommodate 4 kiosks per Zone one would use an SA40d. And to accommodate a large number of kiosks per Zone one would use a WB40d.

The associated individual pricing for the hardware described in the above solution is presented in the table below.
Wireless Hardware Item | MAC Addresses Accomodated | Price
--- | --- | ---
AP10d | 1024 | $1786 + VAT
SA10d | 1 | $1018 + VAT
SA40d | 4 | $1530 + VAT
WB10 | 1024 | $2298 + VAT

The total cost including Site Surveys and Installation has been quoted as £48,000 + VAT. by Wireless.ie (www.wireless.ie dated 20-05-01).

Maintenance would be free of charge for the first 6 months. For the second 6 months a maintenance contract costs 6% of the capital outlay. 12% (negotiable) of the capital outlay would be the annual maintenance contract costs for subsequent years.

The solution discussed here, although feasible, is not the author’s preferred optimal solution from a wireless context as there is an inherent lack of mobility associated with the set-up i.e. although wireless, the visitor must remain stationed at a kiosk for receipt of Park information. An alternative solution will be discussed shortly.

Note: In Wireless nomenclature the use of an AP combined with a SA is known as a Wireless Bridge.

4.2.6 An Emerging Wireless Technology Option- Optical Wireless Laser Infrared

Optical Wireless Laser Infrared (line-of-sight wireless laser) is a relatively new concept. It offers high-performance and cost-effective alternatives to existing radio, microwave, leased-line and fibre-optic options. Bandwidth upgrades from E1/T1 to Gigabit Ethernet and beyond can be achieved.

Optical wireless technology converts data into light just as in the case of fibreoptic networks, however, instead of shining the light into transparent fibre, it is emitted through
thin air as an infrared laser beam. A line-of-sight link can be set up to bring broadband
data links the "last mile" from the telephone exchange.

The smallest system is the size of a shoebox, the largest has dimensions similar to a
portable television. Each contains a laser that generates a beam of light of only one
wavelength. Data sent to the system is converted into pulses in the laser beam. These
travel almost instantaneously to a similar system across the rooftops, where they are
decoded and sent to the recipient network. The beams can carry the equivalent of circa
15,000 phone calls at a time. The beam, being optical, is safe even if one looks directly
into it. It is radiation free unlike microwave links.

The major drawbacks of such a system are weather interference and distance limitations
Laser beams find it more difficult than radio waves to penetrate fog and rain. In the
context of the KNP climatic conditions, two systems could be located no more than 2km
apart. [23]

Fig. 4.10 below illustrates an optical wireless solution to resolve the so-called “last mile”
networking issue

![Figure 4.10 Optical Wireless Resolving ‘Last-Mile’ Network Problems]

4.3 Satellite Medium
Satellite microwave communication is currently ramping up and is now examined in relation to its potential as a solution for the KNP infrastructure.

4.3.1 Full Internet Access Solution at Each Kiosk

It is perfectly feasible to use traditional satellite access from Eutelsat to provide a high volume fast downlink and a 32kbps uplink from any location that has electricity and line of sight to the Eutelsat's satellite. The world leader in this field is an Irish Company called Armstrong Electronics. [24]

The charge is approx. $3000 for installation per Kiosk - and a monthly charge of $200. This system guarantees a broadband connection. A satellite dish would be required at each kiosk. The charges incurred here could be absorbed by the visitor paying for the service. Figure 4.11 below illustrates a potential satellite connection to a KNP interactive information point.

![Figure 4.11 Satellite Service Option for KNP Kiosk](image-url)

Figure 4.11 Satellite Service Option for KNP Kiosk
4.3.2 Traditional Sky Digital Service

Another satellite option entails a less reliable downward link using a traditional Sky Digital setup with a PC terminating into a Digital Video Broadcast (DVB) card which also has access to a phone line ISP connection. Europeonline is one such service provider. This system is not as independent as in the previous case as the data is downloaded via Satellite and uploaded by phone. The charges incurred here could be absorbed by the visitor paying for the service. Europeonline charges £120 per annum for internet access. The Sky Digital subscription is £9 per month [25]

4.3.3 Satellite in the KNP

As a sizeable portion of the KNP is comprised of mountain terrain satellite receivers could prove impossible to position due to direct line of sight requirements. For a clear reception dishes would need to be elevated above tree level, which may be impractical in many circumstances. In the KNP context, satellite dishes may prove environmentally undesirable or impossible in the KNP setting, due to their unsightly intrusive appearance.

Internet access facilities would conflict with the purpose of having kiosks. Their intention is to act as Park information points and not to provide Internet Café type facilities. Although some limited Internet access will be provided to the Park visitor so that e.g. e-mail could be sent to a friend.

4.4 Hand Held Devices

The KNP could leverage the use of its 802.11b technology capabilities by providing visitors with handheld devices where they could tour the park and have their personalised guide through accessing the KNP Wireless LAN. (Also, handheld devices could conceivably be used by KNP management for other activities such as networking sales terminals, tills, flora and fauna monitoring etc. if it so wished. In this event SQL 7’s ability to replicate data between a database server and a handheld device could be utilised. [26]

Any device carrying a WLAN card such as a Laptop, Personal Organiser (e.g.PALM) or a Pocket PC could provide this capability. However in the KNP context the use of Pocket PCs would seem to ideally suit the purpose. Wireless-ready Pocket PCs are available from Hewlett-Packard (HP Jornada), Compaq (Compaq iPAQ), Casio (Casio E-125) and other
manufacturers.

The following Figure 4.12 shows some examples of wireless handheld devices

![Figure 4.12 Wireless-ready Pocket PCs](image)

4.4.1 An Investigation of a Pocket PC for the KNP

There are a large number of pocket PC manufacturers and just as many models for each vendor. Therefore this section just looks at a pocket PC model which is fairly representative of what is currently available and how it could be supported within the KNP.

4.4.1.1 The iPAQ Pocket PC

The iPAQ, from Compaq, is a Personal Digital Assistant (PDA) that can be used to manage a person’s work and personal life, anytime anywhere, by providing access to network resources and the Internet. Presently it is available on the market in seven flavours: H3670, H3650, H3635, H3150, H3135, and BLACKBERRY.
Figure 4.13 below illustrates the Compaq iPAQ H3670 Pocket PC

Figure 4.13 Compaq iPAQ H3670 Pocket PC

iPAQ H3670 specifications include

- Operating System: Windows® Powered Pocket PC
- Processor: 206 MHz Intel StrongARM 32 bit RISC Processor
- Touch Screen Capabilities
- Viewable Image Size 2.26 x 3.02 inches
- RAM 64 MB
- ROM 16 MB

Price: Compaq iPAQ H3670 Pocket PC - £599 (VAT included)
Compaq iPAQ H3630 Pocket PC special offer (PC World- Quotation dated 10-05-01) -£499 (VAT included)
4.4.1.2 Connecting the Pocket PC to the KNP

An iPAQ with an installed Wireless PC Card (e.g. Compaq WL110) can provide the same high-performance connectivity as wired systems, with the added freedom to roam the KNP. Figure 4.14 below illustrates an example of such a card.

![Figure 4.14 Compaq WL110- Wireless PC Card](image)

The W110 Specifications include

- **Frequency Band**: 2.4- 2.4835GHz (2400-2483.5 MHz)
- **Modulation Technique**: Direct Sequence Spread Spectrum.
- **Standards**: IEEE 802.11b

The table of values below illustrate the speed and range options for the Compaq W110.

<table>
<thead>
<tr>
<th>Speed Options</th>
<th>11 Mbps</th>
<th>5.5 Mbps</th>
<th>2 Mbps</th>
<th>1 Mbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range in Open Space</td>
<td>160 m</td>
<td>270 m</td>
<td>400 m</td>
<td>550 m</td>
</tr>
<tr>
<td>Semi Open Space</td>
<td>50 m</td>
<td>70 m</td>
<td>90 m</td>
<td>115 m</td>
</tr>
<tr>
<td>Closed Space</td>
<td>25 m</td>
<td>35 m</td>
<td>40 m</td>
<td>50 m</td>
</tr>
</tbody>
</table>

Price: W110 Compaq Wireless PC Card costs £150 (VAT included)

4.4.1.3 Supporting the KNP Pocket PC

In the KNP setting the network infrastructure to support the use of iPAQ devices may be implemented in the following three ways.
• The data may be pre-downloaded and cached on the iPAQs utilising AVANTGO technology.

• The data may be called to each iPAQ dynamically utilising 802.11 wireless technology from the Muckross House Server. This would require a permanent live connection as facilitated by wireless technology.

• Employees could utilise the SQL 7 ability to replicate data between a database server and the iPAQ devices.

(i) Avantgo Technology

To utilise AvantGO Technology (www.avantgo.com) the KNP will have to introduce an AvantGO Server to the KNP network. A special machine will be purchased which will have the capabilities of supporting many simultaneous connections from handheld devices i.e. iPAQs. This machine would have the AVANTGO client Software loaded on it. The machine would request information from the AVANTGO Server, which would query the KNP Webserver for data. In turn the data would be returned to the AVANTGO Server where AvantGO technology would prepare the data so that it could be displayed on the iPAQs. This would include removing Java and other unsupported technologies as well as shrinking images so that they could be displayed on the iPAQ screen as well as compressing the data to be displayed. The formatted data is then passed to the client machine, which would synchronise it onto the iPAQ.

Fig. 4.15 below shows how an AvantGO server can be used to integrate with a Pocket PC.
(ii) *Dynamically Calling Live Data from the KNP Webserver to the iPAQ utilising 802.11 Wireless Technology*

The data may be called to each iPAQ dynamically utilising 802.11 wireless technology from the Muckross House Server. A permanent live footprint connection as facilitated by wireless technology would be required as a minimum at each zone. A visitor to the Park would be informed that in this scenario the iPAQs would only function correctly in certain areas of the Park, usually in close proximity to an information kiosk. Proprietary software designed to work on the iPAQs will keep the visitor informed of their arrival at the information point. This will be achieved by means of the software alerting the visitor when it picks up a signal from an omni-directional antenna located near an information point. (The iPAQs will only function within a radius of 500m from the Zone antenna and will require line of sight to it.)

(iii) *Utilising SQL 7’s Pocket PC Replication Technology*

Employees could utilise SQL 7’s ability to replicate data between a database server and iPAQ devices. Employees engaged in the remote collection of data in the KNP can store the data on an iPAQ and replicate it to a SQL7 database when they return to signal range of the KNP LAN. Scenarios where this technology could be utilised include:

- Peregrine Falcon Surveys
- Animal Counts
- Results of Daily Water Pollution Analysis
- Collection of information on rare flora sightings

**Case Study**

Since 25th April 2001, Denver Zoo gives its members Handheld Pocket PCs to take them on an interactive journey of the Park. The system being implemented in the zoo utilises *Bluetooth Technology* with transmitters being placed 30 feet apart throughout the zoo. The pocket PC picks up a different signal as it roams to a different transmitter. The information displayed on the device’s screen is updated accordingly. [29]
4.4.2 An Optimal Wireless Solution for the KNP

The KNP visitor, while roaming, could access information via 4 Kiosks and iPAQs (to dynamically call live data from the KNP Webserver as detailed earlier) which would be ‘located’ at each of the 10 information Zones. The KNP could rent iPAQs to visitors. These would be configured to receive transmissions on the same frequencies as emitted by the transmitters in the Park. Once a connection is established between the Park’s LAN and the iPAQ the visitor can then use the built in version of Internet Explorer on the iPAQ to view information on the Park. (In this particular option, as mentioned above, the iPAQs will only function within a radius of 500m from the Zone antenna and will require line of sight to it.) While browsing, visitors will be restricted to viewing information available on the KNP LAN only. They will not be allowed unlimited Internet browsing access but may be allowed to view certain predetermined sites relevant to information on the Park and controlled by the KNP LAN firewall.

A FHSS 3 Mbps link (channel access) affords great scalability as it offers the option of installing multiple information point (kiosks/iPAQs) at each zone. (A channel access of 3Mbps shared by 25 devices offers each device a 120 Kbps radio link). Fig. 4.16 below shows an example of a FHSS wireless card from Breezecom.

![Figure 4.16 Breezecom FHSS Radio Network Card (SAC-PR)](image)

**Price:** Breezecom FHSS radio network cards (SAC-PR) cost 350$ + VAT each ([www.wireless.ie](http://www.wireless.ie)) -Quotation dated 20-05-01)
A 10 Zone FHSS solution servicing 4 kiosks and multiple iPAQs per zone would require 10 separate radio links from the Muckross House Base-station. Each 3Mbps link with its enabling hardware costs £5,500 + Vat.

Ten * Wireless Bridges (WB10d), nine * 24dBi Directional antennae and one * 7dBi Omni-directional antenna would be located at Muckross House.

One Access Points (AP10d) - one 24dBi Directional Antenna and one * 7dBi Omni-directional Antenna would be located at each of the ten Zones.

Note: In this scenario the replacement of Wireless Bridges (WB10d), at each Zone by a Access Points (AP40d) is to accommodate the use of four Kiosks (or more) and multiple iPAQs.

The total cost including Site Surveys and Installation would be £55,000 + Vat. (www.wireless.ie -Quotation dated 20-05-01)

Maintenance would be free of charge for the first 6 months. For the second 6 months a maintenance contract costs 6% of the capital outlay. 12% (negotiable) of the capital outlay would be the annual maintenance contract costs for subsequent years.

4.5 Conclusions

This chapter began by looking at some of the various “wired” means by which the information in the KNP system might be transferred. ISDN and DSL leased technologies, in particular, were reviewed and are not the preferred solution due to their high costs, especially given the large distances required between the KNP base station and each of the Park zones, and the fact that the laying down of a wire-oriented networking infrastructure could interfere with the Park’s sensitive ecological environment. In addition, it would not allow the Park visitor the flexibility to “roam” the surrounding area while obtaining data on the KNP.

In addition, satellite communication was also explored and although feasible, this option is also unsuitable as it would leave the visitor open to direct Internet access which is not the intended purpose of the Park system.

Optical infrared was also examined as a potential medium for the Park infrastructure but this is a relatively newcomer to the communications field and does have severe distance limitations from a KNP perspective, especially considering the often rainy climatic conditions that the KNP is subjected to. It is, perhaps, possible to make use of this
technology to connect locations which are less than 2km apart which is the case for a number of zones in the KNP.

Wireless radio was also investigated as to its suitability for the KNP setting. After outlining the concepts and components behind wireless communications and the cellular topology it utilises, the two main areas of wireless spread spectrum applications were explored in depth i.e. FHSS and DSSS. Both approaches have their respective merits and limitations but FHSS emerges as this author’s preferred option due to the fact that it can support several systems in close proximity which would be ideal for the KNP and its 10 networked interactive information points.

With respect to the various networking options available this author believes that wireless would be the obvious choice for the KNP system as it overcomes many of the obstacles other approaches are subjected to. It provides the possibility for connecting “difficult links” in the Park and delivers high bandwidth at no cost over a permanent link. In addition, by comparison to other options explored, it is certainly the cheapest solution in the long term as there are no annual leasing charges involved. Further to this, the wireless system can be set up and relocated without much difficulty and, more importantly, without any excavation of the Park required.

Handheld devices were also reviewed as a possible means by which value could be added to the Park system. Through the use of these devices, the park visitor would be able to roam the Park area within certain “coverage zones” and remain connected to the network via specialised servers. This would enhance the visitor’s enjoyment of the Park experience and would not incur a huge additional outlay on the KNP authority. While the use of the handheld device complements the kiosk, it would also provide the visitor with a more private approach to obtaining information than the booth.

Finally the overall KNP networking infrastructure recommended by this author was examined. This involves using a combination of FHSS wireless components connected to the individual information points integrated with handheld devices for maximum visitor experience.
This chapter explores the various data storage environments available today including both academic and commercial solutions. To begin with the author offers a definition for a database. This is followed by examining the file storage mechanism which was the precursor to databases. Database management systems are then defined and the various categories of databases are discussed in detail including Relational, Object Orientated and Object-Relational database types. The author explains the various rules and methodologies used by these database types. The author concludes the chapter by recommending a database solution that best suits the KNP’s present requirements.
5.1 Definition of a Database

A database is an organised collection of information representing some aspects of the real world. It consists of a self-describing collection of related and integrated data that is shared by various application programs of specific purposes. “Self-describing collection of data” refers to the fact that a database contains, in addition to the user’s data, a description of the database structure. “Related data” refer to a logically coherent collection of data with some inherent meaning. “Integrated data” refer to a unification of several otherwise distinct data files, with any redundancy among those files either wholly or partly eliminated. “Shared” refers to the fact that a database provides a central information repository, which is accessed by multiple application programs/users.

5.2 Why have a Database?

Specific visitor information on KNP will, in theory, need to be updated on a daily basis. Pages that change regularly can easily be updated on a database and called from it.

The Park staff at present are not familiar with Web page updating methodologies. By providing them with tailored screens to input the information and store it in the database, it will ensure that the information displayed on the screen of the kiosk is consistent and legible. The program to input the information used by staff will be intelligent enough to know how to display the information the staff are inputting by calling Style sheets to display the information. The database will take care of the structure of the information. All the staff will have to do is input the information on simple input screens and will not have to worry about learning HTML and other Web Publishing skills.

A database provides a structured means of holding the data. The database will provide extra security and will help maintain the integrity of the data.

Since the information is held in a structured database it can easily be replicated if this is desirable. The structured information can also be called by other applications that the Park may require. Semi structured information (i.e. storing the HTML files as static pages in directories) is hard to replicate from one server to another as it requires a lot of discipline keeping the structure of the information intact in this environment.

A database may be of any of the following types:

(a) Traditional Relational Database which makes use of a relational model and is the most widely used and well known database technology in existence today.
(b) *Object Orientated Database* is not widely adopted for use in the commercial environment and is relatively expensive at the moment.

(c) *Object Relational Database* will most likely be the next generation of Database. This type is not widely commercially available at present.)

**5.3 Database Management Systems (DBMS)**

Society has gone from the agricultural age to the present era - the Information age. Commercial companies realise that information brings power and profit. They need a well-structured method of storing this information. Information comes from a wide variety of sources from text documents to multimedia objects. Highly specialised software is needed to store all this information in a collective and meaningful way. This software is called database technology, and is the cornerstone of most modern organisations. These databases are charged with handling huge volumes of data as well as ensuring the critical features of integrity, redundancy, security (incorporating authentication) and concurrency. These features are the key to any database system. The better databases can handle these features when scaling up to huge amounts of data.

Recently, companies have begun the practice of storing multimedia and image objects in databases. These objects are referred to as two-dimensional objects whereas text is referred to as single dimensional. This is because the text can be queried using traditional SQL where images and video cannot. This practice has led to databases having to become more complex to support this new multidimensional environment.

DBMS applications are classified into four types:

- simple data without query
- simple data with query
- complex data without query
- complex data with query

These four types describe

- File Systems,
- Relational DBMS,
- Object-Oriented DBMS,
- Object- Relational DBMS, respectively.
## DBMS Categories

<table>
<thead>
<tr>
<th>Category Type</th>
<th>Description</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Simple data without queries</td>
<td>File Systems</td>
<td>Operating systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Windows from Microsoft,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Unix from Sun</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mac OS from Apple</td>
</tr>
<tr>
<td>2. Simple data with queries</td>
<td>Relational DBMS (RDBMS)</td>
<td>• Microsoft Access from Microsoft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• SQL Server 7 from Microsoft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Oracle 7, from Oracle Corporation</td>
</tr>
<tr>
<td>3. Complex data without queries</td>
<td>Object Orientated DBMS (OODBMS)</td>
<td>• Ardent (Formerly termed 02) from Ardent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ObjectStore from Object Design Inc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Jasmine from Computer Associates</td>
</tr>
<tr>
<td>4. Complex data with queries</td>
<td>Object Relational DBMS (ORDBMS)</td>
<td>• Universal Server, from Informix,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Oracle 8i, from Oracle Corporation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Universal DB (UDB) from IBM</td>
</tr>
</tbody>
</table>

### 5.3.1 File Systems

This was the first system used to store data. It is a simple and effective method of storing information if no database is available. Its data model uses a sequence of characters of arbitrary length. File Systems have the ability to access files through standard programming languages such as C and Pascal, utilising file organisation structures such as sequential, indexed or direct. Nowadays they are often used for storing multimedia content on web servers and word documents on operating systems. Their advantages include simplicity, high performance and maintainability. Their disadvantages include; the use of a directory structure, data is inaccessible through a query language such as SQL and lack of data independence.
5.3.2 Relational DBMS

Relational databases are based on the idea that the data in a database is related. The data is represented in tables, which contain rows and columns, which contain related tuples. The rows are called records. The columns, which are fields in the rows, are called attributes. All the columns in databases have associated data types. These data types can vary from int or float to string and date. Some databases will allow the user to create his/her own data types. When creating a database the user is not permitted to declare tables or columns with the duplicate name values. There are various other rules (including Normalisation Rules, which are explained below) that the user must conform to when creating the database. These are called the database constraints. They are referred to as domain constraints, key constraints, entity integrity constraints, and referential integrity constraints.

Figure 5.1 below illustrates an example of Attributes and Records using the KNP database as an example.

![Figure 5.1 Relational DBMS- Attributes and Records](image)

Normalisation Rules

As mentioned above, when designing databases you are faced with a series of choices. How many tables will there be and what will they represent? Which columns will go in which tables? What will the relationships between the tables be? The answer to each of these questions lies in something called formalisation. Normalisation is the process of simplifying the design of a database so that it achieves an efficient structure.

Normalisation theory gives us the concept of normal forms to assist in achieving the optimum structure. The normal forms are applied in order, with first normal form having to be completed on a table before it can be transformed into second normal form. The
same rule applies for third normal form. This means that each higher normal form achieves a better, more efficient design.

The normal forms are:

- First Normal Form
- Second Normal Form
- Third Normal Form

**First Normal Form**

*First Normal Form (INF) says that all column values must be unique.* 1NF dictates that, for every row-by-column position in a given table, there exists only one value, not an array or list of values and each of these values can only appear in the column once. The benefits from this rule should be fairly obvious. If lists of values are stored in a single column, there is no simple way to manipulate those values if the first normal form is not applied to the table. Retrieval of data becomes much more laborious and difficult to generalise.

**Second Normal Form**

*A table is said to be in Second Normal Form (2NF), if it is in 1NF and every non-key column is fully dependent on the primary key.* Put another way, tables should only store data relating to one "thing" (or entity) and that entity should be described by its primary key.

**Third Normal Form**

*A table is said to be in Third Normal Form (3NF), if it is in 2NF and if all non-key columns are mutually independent.* An obvious example of a dependency is a calculated column. For example, in a teacher table it may contain a salary amount and an expense amount. One may be tempted to put in a third column called totalPay. This would be an accumulation of the salary and expenses columns. To do this would be wasteful on resources since the data can be calculated in a report form the information already available in the table. It would also mean that the table would not be in third normal form.

Figure 5.2 below shows an example of a Relationship Diagram taken from a relationship model taken from the KNP database generated using SQL 7.
Relational Databases use the standard *Structured Query Language* (SQL). SQL allows the user to create statements for data definitions, modifications, querying and constraints. The queries that can be executed using SQL range in complexity from simple one-table queries to multi-table queries involving joins, nesting and other methods. SQL allows for users to access a wide variety of databases using the same syntax. SQL allows the data in the database to be accessed quickly and efficiently. An exception is large objects such as multimedia which is defined in a RDBMS as a blob.

**Binary Large Objects**

Binary Large Objects (BLOBS) are supported as a database storage attribute in Relational database management systems including MS Access. When Access stores a BLOB it stores it as attribute type OLE object (Object Linking and Embedding object). While this method allows multimedia data types including images, sound and video clips to be stored in a database, there are several shortcomings associated with using this approach. Firstly, these objects cannot be queried using the standard SQL2 query language. Secondly, these objects cannot be retrieved and stored easily in a database. The only BLOB that MS Access has included support for storage and retrieval methods is a bitmap. If one wishes to store a BLOB from a different medium one would have to write their own encapsulation code around the object in order to store and retrieve the object. Thirdly, in a Web environment (which this project's implementation focuses on) it is extremely difficult to retrieve a number of images from a database and display them using the one recordset query. This is because when retrieving binary data (which is how BLOBS are retrieved) the recordset can only retrieve one binary stream per connection. In order to facilitate this in a web application the programmer has to temporarily store the...
images in another temporary page and then write a function to call the images for displaying purposes.

The disadvantages of RDBMS include their inability to access complex data types such as images and other multimedia content. When storing large amounts or complex data RDBMS databases do not scale well. Performance tends to be degraded the more complex the data becomes. There is no support for reusing custom defined rules, queries etc. (i.e. Inheritance is not supported in RDBMS databases)

5.3.3 Object Orientated DBMS (OODBMS)

The increasing use of multimedia in databases, the size of databases, and the complexity of today's databases, requires a solution that RDBMS cannot handle.

The original idea behind the development of Object Orientated programming languages was that they would have the ability to handle complex objects. The concept of Abstract Data Types (ADTs), where the internal data structure is hidden from the outside and the external operations can be applied on the objects that are specified by the program, led to the concept of encapsulation. Programming languages such as C++ and Java were designed to be object-oriented.

The main features associated with OO programming languages are encapsulation, inheritance and polymorphism.

Encapsulation can be thought of as a protective area of the program that prevents the code and the data from being accessed by other code defined outside of the program.

The process in which one object inherits the properties of a previously defined object is called inheritance. Inheritance allows for the reuse of code by allowing programs to inherit the functionality of previously written programs.

Polymorphism allows an operator or symbol to have different meanings depending on the circumstances of where it is used in the program.

Object Orientated databases can be thought of as the merging of object oriented programming and database management systems. [32]

OODBMS aim to solve many of the shortcomings of RDBMS. OODBMS have the ability to represent data and relations, as well as versioning. The simplifying of the process of data access is also one of its main features.

The benefits of using an OODBMS approach increase in proportion to the complexity of the data being stored. That is to say, for simple text-based databases the programmer will find little advantage using OODBMS technology over traditional RDBMS. However if the database is going to represent more complex objects such as multimedia content then the
benefits that OO technology bring can be utilised. These benefits include better modelling capabilities through the extensibility of OO. Also the versioning and reusability capabilities of the OO environment can be utilised.

However, OODBMS require a new set of skills and an entirely different thinking methodology than the RDBMS developer would be used to. This would require the OODBMS developer to be trained in a new set of skills, which can be costly and may prove difficult to achieve.

There is also no standard specification defined for OODBMS to enable users to query a database. Unlike RDBMS, which have the SQL syntax as standard, the industry has yet to agree on a standard for OODBMS technology.

To begin integrating OODBMS databases technologies into a business environment a number of obstacles have to be overcome. The first of these is to define a query syntax standard to query the OODBMS Databases. This query syntax should, as closely as possible, mirror the industry standard SQL query syntax. Standards also need to be agreed as to how the structure of the databases themselves are laid out as well as the syntax that is to be used in these databases. Other areas that need implementing include OODBMS integration with XML\(^6\) and other web technologies including their ability to integrate with Web Servers so as that information from these databases can be manipulated from a web page.

With the increasing amount of data that has to be managed today, the traditional RDBMS system is becoming outdated and does not have the capabilities to manipulate and query data stored in their systems. Developers are becoming frustrated with the lack of capabilities and limited functionality of the SQL syntax. In turn users are frustrated that they cannot find the information they are looking for through using the supplied querying tools. There is no where that this is more evident than on the Internet, where users input a query and often get results back that are in no way related to what they were looking for. With this in mind it is obvious that a database environment such as that offered by OO technology will replace the traditional RDBMS technology in the near future. For OODBMS to become an industry acceptable standard the technology has to be standardised in the manner outlined above. Then it can become a widely accepted and used technology.

5.3.4 Object-Relational DBMS (ORDBMS)

ORDBMS are a result of combining the traditional methodologies of RDBMS with the enhanced features of OODBMS. They provide the benefits of scalability and simplicity.

ORDBMSs attempt to marry the simplicity of RDBMS with the advanced scalability and functionality of OODBMS. The data model used by ORDBMS combines the features of

\(^6\) XML stand for eXtensible Markup Language which a method for describing metadata on a WebPage.
OODBMS technology into an RDBMS environment. The data is still stored in tables but the tables provide support for Abstract Data Types (ADT). ORDBMS are attempting to extend the functionality of SQL2 into an extended SQL3. These extensions will provide the programmer with the ability to query the newly defined ADTs. The ORDBMS maintains the RDBMS model through the use of tables and SQL query syntax, which uses the same methodology as RDBMS. But the relational model has been modified to support the features offered by OODBMS. The new features of ORDBMS over RDBMS are outlined below:

- **Base Type Extensions** which allow developers to define their own data types instead of using the standard types provided in the database.

- **Support is provided for complex objects**, examples of which include images and other multimedia datatypes.

- **Support for Inheritance**, which allows one to use functions, defined in one class in another class.

- **Rule Systems** that provide a standard set of rules defined in the system which all data will have to adhere to.

ORDBMSs allow users to define their own data types, functions and operators. This results in an increase in performance and functionality.

An example of this functionality is:

**STUDENT (fname, Sname, ID, gender, subjects, address, Year, course, picture)**

The attribute picture is defined by the user. It refers to an image of the student. Traditional databases would not support this type of attribute.

Stonebraker’s prediction is that ORDBMS will be the next database structure to take over from RDBMS. This is because it encompasses the features of OODBMS without programmers having to learn the complex issues associated with OODBMS. [33]
### 5.3.5 A Comparison of the Storage Options Available

<table>
<thead>
<tr>
<th>Criteria</th>
<th>RDBMS</th>
<th>OODBMS</th>
<th>ORDBMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining standard</td>
<td>SQL2</td>
<td>ODMG-2.0</td>
<td>SQL3 (in process)</td>
</tr>
<tr>
<td>Support for object-oriented features</td>
<td>Does not support; It is difficult to map program object to the database</td>
<td>Supports extensively</td>
<td>Limited support; mostly to new data types</td>
</tr>
<tr>
<td>Usage</td>
<td>Easy to use</td>
<td>OK for programmers; some SQL access for end users</td>
<td>Easy to use except for some extensions</td>
</tr>
<tr>
<td>Support for complex relationships</td>
<td>Does not support abstract datatypes</td>
<td>Supports a wide variety of datatypes and data with complex inter-relationships</td>
<td>Supports Abstract datatypes and complex relationships</td>
</tr>
<tr>
<td>Performance</td>
<td>Very good performance</td>
<td>Relatively less performance</td>
<td>Expected to perform very well</td>
</tr>
<tr>
<td>Product maturity</td>
<td>Relatively old and so very mature</td>
<td>This concept is few years old and so relatively mature</td>
<td>Still in development stage so immature.</td>
</tr>
<tr>
<td>The use of SQL</td>
<td>Extensive supports SQL</td>
<td>OQL is similar to SQL, but with additional features like Complex objects and object-oriented features.</td>
<td>SQL3 is being developed with OO features incorporated in it</td>
</tr>
<tr>
<td>Advantages</td>
<td>Its dependence on SQL, relatively simple query optimization hence good performance</td>
<td>It can handle all types of complex applications, reusability of code, less coding</td>
<td>Ability to query complex applications and ability to handle large and complex applications</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Inability to handle complex applications</td>
<td>Low performance due to complex query optimization, inability to support large-scale systems</td>
<td>Low performance in web applications</td>
</tr>
<tr>
<td>Support from vendors</td>
<td>It is considered to be highly successful so the market size is very large but many vendors are moving towards ORDBMS</td>
<td>Presently lacking vendor support due to vast size of RDBMS market</td>
<td>All major RDBMS vendors are after this so has very good future</td>
</tr>
</tbody>
</table>

Source: International Data Corporation, 1997 [34]
Chapter 5 – Information Storage Mechanisms

Database Architecture of ORDBMS and the future

Dr. Stonebraker lists five architectural options for ORDBMS databases:

- Supply plug-in code to make function calls to other applications.
- Add separate API's and server subsystems to support object functionality.
- Simulate specialised object-relational functionality in a middleware layer.
- Completely redesign the database engine.
- Add a new object-oriented layer to support rich datatypes atop a proven relational database engine.

One of the benefits of ORDBMSs is their ability to scale well. Oracle 8i, released by the Oracle Corporation, is designed to manage large amounts of information. Oracle 8i is expected to help Dow Jones manage its complex high capacity databases. ORDBMSs also have drawbacks. The architecture of object-relational model does not lend itself well to high-speed web applications. However, such advantages as increased storage capacity, greater access speed, and the ability to manipulate object databases, ORDBMSs are set to dominate the database market. The support from major DBMS manufacturers and its features will make ORDBMSs the database technology of the future.

5.4 Selecting a Storage Solution for the KNP

Although the advantages of using an ORDBMS approach would be significant, as has been outlined above, for the KNP implementation the author has chosen to use the RDBMS approach to implement the database section of the project for the following reasons:

RDBMS technology is the industry standard. It is well known. It is in existence for a substantial period of time. It is easy to attain the skills necessary to master the technology if one applies oneself to doing so.

For the project implementation Microsoft SQL Server 7 was chosen as the RDBMS for the following reasons:
- It is an enterprise level RDBMS with support for security, integrity, scalability and redundancy.
- It integrates well with other Microsoft products (e.g. IIS 5 & Windows 2000 Server).
- It databases can be queried from web applications.
• It can store and manipulate all the text information used in this project.

• It is today, becoming a widely used database technology.

• It can be accessed through MS Access. MS Access comes as part of the Microsoft Office product family, which most office employees would be familiar with, making the learning curve shorter in implementing the system. MS Access is covered as a module on the ECDL course. Park staff could be trained on using MS Access by taking one of these courses.

5.5 Conclusions

The author examined the various database methodologies available today. While acknowledging the benefits an Object Relationship system could bring to the implementation of this project it was felt that no commercially available industry recognised solution could be sourced to meet the requirements of the KNP. The author compromised on the functionality of an Object-Relational system for the reliability offered by Relational DBMS. The use of a relational system will have to be supplemented with the aid of File Storage mechanisms which RDBMSs unlike ORDBMSs are unable to query. The author recommended SQL7 above other RDBMSs as it has the ability to takes advantage of the authentication and security mechanisms offered by Windows 2000 Server which is an integral part of the network infrastructure of the project.
CHAPTER 6

PROJECT IMPLEMENTATION

This chapter focuses on the project implementation. The chapter begins by clearly distinguishing between the academic implementation which is being carried out by the author of the project and a commercial implementation of the project for which the author offers advice on its implementation. The academic implementation will use the industry standard three tier model. The author next summarises the technologies used to implement the project including ASP which will be one of the core technologies used in the implementation. The Date model for the project is outlined. A perspective of the hardware and software required for the project follows this. The deployment strategy for this hardware is explained. The author then describes a strategy for the conversion of diverse media types to a digital format that can be utilised by the project software. The author then provides a visual presentation of the custom software that was designed for the academic implementation of the project. Following this the steps required to upload digital media to the new system are outlined. The penultimate step of the implementation involves the author recommending a deployment strategy for the hardware requirements for kiosk and wireless devices. Finally the author outlines a strategy for testing the new system.
6.1 Introduction

At this point the reader will begin to appreciate the enormity of the scale of resources in both human terms and capital/monitory outlay which will be required to bring this Project to a successful conclusion. In this chapter the author details the various iterative stages which the KNP authority might wish to undertake to develop the full system. The completed working system is referred to as the Business Implementation in the documentation. The author however has developed a sample down scale model of the project for demonstrative purposes and refers to this as the Academic Implementation.

These two distinct implementation scenarios of the project, which are presented together in this chapter, are the result of conclusions reached throughout the project and are previously outlined in relevant chapters and in the Appendices. These conclusions will be referenced appropriately throughout this chapter. The Business Implementation includes all aspects of a successful deployment of a complete IT solution for the KNP. The layout of this chapter is not a true reflection of the project deployment as non-dependent activities can be run in parallel; hence the deployment schedule will be presented in Gantt Chart format to complement the layout shown below.

Figure 6.1 below illustrates an example of such a Gantt Chart.

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Start</th>
<th>Finish</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>01/02/2001</td>
<td>01/03/2001</td>
<td>4.2w</td>
</tr>
<tr>
<td>2</td>
<td>Researching of information</td>
<td>01/03/2001</td>
<td>03/04/2001</td>
<td>8.6w</td>
</tr>
<tr>
<td>3</td>
<td>Locations of the information points and research into kiosk</td>
<td>01/03/2001</td>
<td>30/03/2001</td>
<td>4.4w</td>
</tr>
<tr>
<td>4</td>
<td>Communications Medium</td>
<td>01/03/2001</td>
<td>01/05/2001</td>
<td>8.8w</td>
</tr>
<tr>
<td>5</td>
<td>Database Technology</td>
<td>01/03/2001</td>
<td>01/05/2001</td>
<td>8.8w</td>
</tr>
<tr>
<td>6</td>
<td>Requirement for developing and maintaining the KNP IT infrastructure</td>
<td>02/04/2001</td>
<td>01/06/2001</td>
<td>9w</td>
</tr>
<tr>
<td>7</td>
<td>Project Implementation</td>
<td>02/04/2001</td>
<td>13/07/2001</td>
<td>15w</td>
</tr>
<tr>
<td>8</td>
<td>Conclusions</td>
<td>02/07/2001</td>
<td>13/07/2001</td>
<td>2w</td>
</tr>
</tbody>
</table>

The project implementation will include all aspects of the academic portion of the project being implemented by the author as well as all necessary information required by the KNP to complete the successful deployment of the project in a business environment. As well as the business implementation outlined by the author of this thesis the KNP authority would need to commission propagation surveys and initiate assistance from outside consultants.
6.2 Conversion of Media to Digital Format

As outlined earlier in this thesis a vast amount of information will need to be researched from various sources and in turn converted into digital format. Since this research and conversion is a once-off procedure it would not be viable for the KNP Authority to purchase the required equipment and in turn train the Park staff in its use. The recommended approach is that the Park staff will research, adapt, and edit the required material for presentation under the supervision of a project manager. This material will then be presented to a specialist scanning and multimedia conversion company, which will deliver the information in its required medium (i.e. digital). Upon the conversion of the material into digital format the material may be delivered to a specialist linguistic company for delivery to multilingual formats e.g. English, French, German and Italian.

Note: Although, due its sheer scale, the KNP authority will outsource the initial conversion of the required information for dissemination to the kiosks. It will need to purchase a scanner and a digital camera to carry out subsequent updating of material. The staff will require training in the use of these technologies also.

6.3 Custom Software Development

Continuous detailed consultation would normally be required between the development team and the KNP authority for a business development solution for this project. Since the author’s development is an academic one, the author took it upon himself to develop and implement the requirements for the software solution. The author recommends that if KNP implement a business solution for this project they should endeavour to consult the developers of the software solution throughout all the stages of the software development.

6.3.1 Three-Tier Architecture

The project implementation will utilise a Three-Tier Architecture approach, which is outlined as follows: Presentation Layer, Business Rules Layer and Data Access Layer.

Presentation:

The Presentation Layer will consist of information displayed from a Web browser utilising technologies including DHTML, HTML and VBScript. The pages are dynamically created from information passed to the Presentation Layer from the Business Layer (The code is to be found in Appendix C). The volume of pages required is reduced by using intelligent business logic to identify which kiosk is calling the code and using a standard template for all the kiosks.

Business Rules:
The technologies used in the Business Layer include Active Server Pages (ASP) and VBScript. An example of a Business Rule would include:

- If there is no human interaction with the kiosk for three minutes then display a screensaver.
- If time is five o’clock display message “Gates will close in an hour’s time”.
- If the location of the kiosk is Knockreer then call on the Data Access Layer to retrieve from the database the information for Knockreer and pass the information to the Presentation Layer.

**Data Access:**

The technologies utilised by the Data Access Layer include ActiveX Data Objects (ADO), Structured Query Language (SQL) and Active Server Pages (ASP). The Data Access Layer is responsible for accepting requests for data from the Business Rules Layer and retrieving and presenting this information from a database utilising ADO and SQL to complete this process. Again as already stated previously, the pages are described in detail in the Appendices, including the code. [35]

Figure 6.2 below illustrates an example of Three- Tier Architecture namely Presentation, Business and Data Tier.

<table>
<thead>
<tr>
<th>(i) Presentation Layer:</th>
<th>PC running IE5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>with HTML, DHTML</td>
</tr>
<tr>
<td>(ii) Business Layer:</td>
<td>IIS</td>
</tr>
<tr>
<td></td>
<td>ASP, VBScript, JavaScript,</td>
</tr>
<tr>
<td>(iii) Data Layer:</td>
<td>DBMS</td>
</tr>
<tr>
<td></td>
<td>ADO SQL</td>
</tr>
</tbody>
</table>

Figure 6.2 Three- Tier Architecture Using IIS & IE5
6.3.2 Active Server Pages (ASP)

ASP is a core technology used in the implementation of this project. ASP executes on the server and returns the results to the client (i.e. Web Browser). ASP pages will be programmed using Visual Basic Script, which displays and calls information from the Database using ActiveX Data Objects (ADO) as the method of calling the data. ActiveX Data Objects are the most up to date methodology that VBScript uses to call the data. The project will use Structured Query Language (tells the database exactly what is required) embedded in the VBScript to call the data from the database. The author chose ASP as there is native support from Microsoft for ASP in IIS.

The author used Dynamic Hypertext Markup Language (DHTML) and other technologies to make the pages visually appealing. DHTML is used to create dynamic aesthetic content i.e. changing the color of buttons, menus etc. DHTML is a combination of custom HTML tags and JavaScript. DHTML also utilises Cascading Style Sheets (CSS) which will give a familiar ‘look and feel’ to the site. [36]

6.3.3 Configuring the Database

An integral part of any software implementation is to develop a robust, reliable and scaleable data model for the project. The data model for this project is developed using information discussed in Chapter 5 on storage mechanisms.

Figure 6.3 below illustrates an example of the KNP data model.

![Figure 6.3 Relationship Diagram of KNP Data Model](image-url)
6.3.4 Implement the Database

The steps involved in creating the KNP database include:

- Installing and configuring the database software, creating the database structure (Tables, Fields, Relationships and insuring referential integrity).
- Inputting information for test purposes.

The database contains information for the Zones of the KNP.

It is envisaged that:

(i) While each Kiosk is not being used, a default page will be displayed which will require user interaction to proceed into the real Park information presentation.
(ii) The user is then presented with a splash screen displaying general information on the KNP.
(iii) This screen will fade out automatically after five seconds and will display a segmented page to provide detailed KNP information on its specific Zone Location and links to detailed information on the other Zones within KNP, which the visitor may also wish to visit subsequently. A map to show the present location of the visitor will also be displayed.

In the Academic Implementation the client/kiosk will be capable of running Internet Explorer (IE) and Netscape Web browsers.

The screen will display a menu of the flag icons of Ireland, France, Germany and Italy, for the purpose of offering the visitor a choice of language options. The character set used in this project is Unicode Data Types which will support the multilingual features of the project implementation.

It is worth noting that:

- When writing code, it is important to code for touch screens (Presentation Layer) i.e. Large areas are needed for the user to “click on.” If the touch screen users are required to submit information, they must be given options since they cannot type in the information.
• The Academic Implementation of the project will use static HTML pages and dynamic ASP pages.

6.4 Servers and Operational Software – Requirements
Ordering and Configuration

6.4.1 Server Hardware Requirements
The set of servers required in the KNP base-station at Muckross House is as follows:

| Server 1 | Mail Server (MS Exchange for Visitors and KNP staff with 50-client licence)  
| Up continuously – (twenty-four hours – seven days a week)  
| Backup Domain Controller (BDC)  
| Domain Name System (DNS), Windows Internet Name Server (WINS) (Windows 2000 Server) |
| Server 2 | Primary Domain Controller (PDC) (Windows 2000 Server) |
| Server 3 | Firewall, Proxy (Rapture MS Proxy Server 2.0 and Windows NT 4.0) |
| Server 4 | Intranet Server (IIS5 and SQL Server 7.0 with Windows 2000 Server) |
| Server 5 | Demilitarised Zone (DMZ) and Server for external Website (IIS5 and SQL Server 7.0 with Windows 2000 Server) |

Note: The author proposes to use a Monitor Switch (circa £80) to cut down on costs of monitors as one monitor will suffice in the Server Room.

Redundancy
Consists of

• Backup tape mechanism

• Redundant Array of Inexpensive Disks (RAID) 5 on critical servers

• Uninterrupted Power Supply (UPS) on each server The details of the Specifications and Costings for the Hardware and Operational Software of the KNP IT Infrastructure are described in Appendix B.
6.4.2 Installation of Windows 2000 Server with Internet Information Services 5 (IIS 5)

In order to accomplish the Academic Implementation of the project the author had to learn the steps involved in both, installing Windows 2000 Server and configuring IIS services to run on top of it. This was necessary for the execution of the ASP pages on the server. A full explanation of this configuration is detailed in Appendix D at the back of this report.

6.4.3 Installation and Configuration of SQL Server 7

SQL Server 7 was chosen as the RDBMS for the Academic Implementation phase of the project as it delivers the necessary stable environment required to manage the complex data involved in this project. A full explanation of this configuration is described in Appendix E at the back of this report.

6.5 Deployment of Network Hardware and Software

6.5.1 The Killarney National Park LAN Wireless Network Topology

The KNP wireless topology will consist of Point to Point connectivity in a Star Topology. Thus each Zone will operate with an independent connection to ensure reliability of service. For delivery of service, 'line of sight' is required from the Muckross House Base Station to each Zone. Propagation surveys will need to be commissioned to determine this. Figure 6.4 below illustrates an example of such a Wireless LAN.
A 10 Zone FHSS solution (wireless) servicing 4 Kiosks and multiple iPAQs per zone would require 10 separate radio links from the Muckross House Base-station. Each FHSS link delivers 3Mbps.

Ten Wireless Bridges (WB10d), nine * 24dBi Directional antennae and one * 7dBi Omni-directional antenna would be located at Muckross House.

One Access Point (AP 40d), one 24dBi Directional antenna and one * 7dBi Omni-directional antenna would be located at each of the ten Zones.

**Note:** In this scenario the location of an Access Point (rather than a Station Adapter) at each Zone is to accommodate the use of four Kiosks (or more) and multiple iPAQs.

The network and server infrastructure will have been purchased and configured at this stage. These will now need to be deployed to make up the KNP IT infrastructure. The internal cabling and external LAN wireless environments need to be installed both in Muckross House and around the Park respectively.

**6.5.2 Muckross House Base Station**

The internal network in Muckross House will consist of a main *Server Room*, which will be wired using a combination of Cat 5 and fibre optic cable. A switch will be placed in the room to connect all the network nodes present in the room together. This will be achieved using a Patch Panel, which will have the connections from the network nodes coming from the back, and drop leads completing the connection to the switch. A switch will also be placed in the attic of Muckross House, which will be connected to the switch in the Server Room using a fibre optic backbone connection. This attic switch will have each of the ten Wireless Bridges (WB10d), connected to it using Cat 5 drop leads. The Wireless Bridges will in turn be connected, using coax cable to the nine * 24dBi Directional antennae and the one * 7dBi Omni-directional antenna camouflaged in the valleys of the roof of Muckross House.

Several KNP staff PCs will be located throughout Muckross House. These will all be located within 100 metres of the Server Room and hence can be accommodated by the switch in the Server Room. A wall socket being installed near each PC will achieve the connection. The connection is then traced back to the patch panel in the Server Room.
using Cat 5 cable. Drop leads are used to connect both the PC's network card to the wall socket and the patch panel to the switch. The servers will need to be introduced to the KNP Network. The network will in turn have to be tested to ensure that all servers and network hardware are functioning correctly.

6.5.3 Ten Information Zones throughout the KNP-Wireless LAN

Kiosks, in clusters of four (or more), are located at each of ten Visitor Information Zones located throughout the KNP. At a particular Zone each of the four Kiosks are connected via Cat 5 drop leads to an Access Point (AP 40d). The Access Point in turn, is connected using coax cable to one 24dBi Directional antenna and one * 7dBi Omni-directional antenna located approximately 15 metres from it. The 7dBi Omni-directional antenna caters for the delivery of visitor information to multiple iPAQs for a radius of 500 metres.

6.5.4 Access Point (AP) and Wireless Bridge (WB) Configurations

In order to accomplish the Academic Implementation of the project the author had to learn the steps involved in configuring an Access Point (AP 40d) on a server, and a Wireless Bridge (WB10d) on a client computer /kiosk. A full explanation of these configurations is detailed in Appendix F at the back of this report.
6.6 Server Deployment onto the Network Infrastructure

Figure 6.5 below illustrates an example of Application Deployment Overview

![Application Deployment Overview Diagram]

*Figure 6.5 Application Deployment Overview*
6.7 Custom Software is Deployed to Server

Once the network infrastructure is operational in the Park the custom written software is uploaded in two phases to the Park’s Internal IIS Server. In the first phase various ASP and HTML WebPages are deployed and configured for use on the KNP IIS Server. The IIS Server is also fine-tuned to meet the needs of the custom deployment. This will include the setting up of virtual directories etc. Components are deployed on the server.

The Academic Implementation of the project will consist of the following:

- Visual Basic COM+ component to interpret the location of a Kiosk.
- Visual Basic COM+ component to E-mail E-cards for visitors.
- ASP pages to retrieve data from the KNP Database, call components, implement Business Logic and present the information to the visitor in a visually appealing format.

A full explanation of the functionality of each ASP page along with the code is included in Appendix C. The code and full explanation for each component is also included in this appendix also.

The following include samples of the Screen Captures form the Academic Implementation:
1) Welcoming Splash Screen - Intro Screen

The screen shot above is the default screen for the academic implementation of the project. The screen is shown when each booth comes on-line. It is also the screen that the application will default to if there has been inactivity for 15 minutes or more. This screen does not contain any database connectivity; its function is to be simple and fast loading to catch the eye of the Park visitor. The screen contains one button. When the visitor clicks on the button they are brought to the main screen for the zone that they are located at. The zone’s location is determined by business logic in the application.

Figure 6.6 Welcoming Splash Screen
2) Current Location in the Park- Intro Screen for the particular Zone location.

![Image of Knockreer Zone]

Figure 6.7 Current Location in the Park- Knockreer Zone

When the visitor clicks the button on the introduction screen and the business logic decides which Zone he/she is at. The application displays a page welcoming the visitor to the individual booth with a screen that contains a series of pictures of landmarks, wildlife and scenery from that information zone. The screen contains JavaScript with a built in timer that automatically brings the user to the main information page for the zone after 30 seconds. Alternatively the user could have clicked any number of hyperlinks available to them to go to the main information page before the thirty second period had elapsed.
3) Knockreer Zone Home Page

Knockreer Booth

The user is now in the main information screen for the booth. As can be seen from the above screen shot the main information page is divided into three columns, with one row going across the width of the screen on top.

The left of the screen contains a menu, which is dynamically created from a database of links. This allows the menu to be customised for each individual zone. Under a menu is a map of the Park; when this is clicked a menu of the whole Park appears on the screen with the other zones clearly marked on it. This column remains visible throughout the session regardless of what page the user opens.

The middle column of the screen is where the bulk of the information is presented to the user. This information will vary depending on the links the user has clicked. The content will usually hyperlink to more detailed information when the user clicks on the “more” link. Again, the middle column is dynamically created with the information being drawn from a database. This allows a generic shell, which the user can become familiar and
comfortable with, while all the time, the business logic of the application is dictating what can be displayed.

The right column is not used in every page but is occasionally used as in the case of this screen shot where the subject matter clearly needs to be sub divided to guide the visitor through the site and maximise their satisfaction from viewing the content of the site. The above screen shot shows the right column being used to divide the information for the zone into fauna, flora, and local information. Again all this information is dynamically created.

The row stretching the width of the screen on top, tells the visitor which zone they are located at, in this case Knockreer. It also contains a ticker, which provides information to the user about closing times, special deals, etc. This can be updated at a moment’s notice by a member of the Park’s staff. There is also the option to view the site in multiple languages by clicking one of the international flags.

4) Other Information Points/ Zones.

**Knockreer:**

Knockreer House and its surrounding gardens command panoramic views of Lough Leane, Innisfallen Island and the surrounding majestic sandstone enveloping mountains. Nearby, Cluich Mochuda was used as a Mass rock site during the Penal Laws. A flat stone, with two deep hollows marks this spot. The rainwater, which fills... [more]

**Muckross:**

This area of the National Park comprising of mountains, woodlands and lakes, has Muckross House as its focal point. This magnificent Victorian Mansion is beautifully situated amidst spectacular scenery on the shores of the Middle Lake. The Gardens at Muckross House are renowned worldwide for their beauty. Its rock gar... [more]

**Old Boat House Nature Trail:**

From the longest route to the shortest - this trail is less than a kilometre and yet it is an interesting introduction into the vegetation and wildlife of Killarney’s National Park. It starts at the 19th century boathouse below Muckross Gardens and continue around the small peninsula near Muckross Lake. [more]
This screen presents all the information points available throughout the Park. It includes a synopsis of the zone as well as a graphic of an attraction in the zone. By clicking any of the “more” links in the zone information the visitor can learn information about the zone. Again this screen was dynamically created from information in the KNP database.

5) Muckross Zone

![Muckross Zone](image)

**Figure 6.10 Zone Muckross**

When the user clicks on one of the links to go to another zone, they are presented with the same shell only the content has been completely altered to show information on the zone which they clicked on. In this case Muckross House. The home button on the menu on the left column will bring them back to the home zone (Knockreer in this case).
6) Park Map to Other Zones

Figure 6.11 Park Map to Other Zones

The screen shot above outlines the map that is displayed of the park when the visitor clicks on the map on the left column. It contains a complete map of the entire park with the areas that the each zone covers clearly outlined. By clicking on any of the zones the visitor can go to information on that zone.
7) Visitor Feedback from the Site

![Image of the feedback page]

This screen shot is of the feedback page, which has been designed to work without the aid of a keyboard. The user merely presses on the option they want to pick and then submits them.

*Figure 6.12 Visitor Feedback from the Site*
8) Zone Muckross – Wildlife

The screen shot above shows the page that is displayed when the visitor clicks the Wildlife link from the menu on the right column of the main information page. It will contain information on wildlife present in the zone. The delivery medium will include Video, Authorware, Text and graphics, to bring a complete multimedia experience to the visitor.
9) The animals can be clicked on for more information including videos

Figure 6.14 More Information on Animals including Videos

The animals can be clicked on for more information including videos. The shot above illustrates Macromedia Authorware in action on the Knockreer booth.
10) Local Information within the Zone

Innisfallen Island
Innisfallen is the largest of the islands on Loch Léin (the lake of learning). It may have received its name from Faithlinn, son of King Aedh Dáma, who died in 631. Long ago this abbey was a very famous university. Princes from Ireland, England, Scotland, and Wales came here to learn. Parts of the Annals of Innisfallen were hand-written here. The original manuscript is now in the Bodleian Library, Oxford, England. We believe that Brian Boru, the last High King of Ireland, went to school here. At that time, the Viking pirates were very powerful in Ireland. When Brian became High King, he got most of the other Irish leaders to fight against these pirates. At the Battle of Clontarf (Dublin) in 1014, the Irish beat these Vikings. In 1652, the monks had to leave Innisfallen Island when near by Ross Castle was captured by Cromwellian soldiers led by General Ludlow. In 1973, Mr and Mrs John Mc Shane formerly of Killarney House generously presented the island to the people of Ireland.

Figure 6.15 Local Information

The local information link can be clicked on again from the right column in the main information page. This will contain useful information on the local attractions within the zones.
11) Select an E Post Card

A Selection of E-Cards is available for visitors to send free of charge to their friends and relatives from an Information point. The purpose of the E-Cards is to promote the Park around the world.
The screens above show how the visitor can select an e-card. The images are taken from the KNP. After selecting an image (an e-card) the user can then add personal greetings and submit the card which is emailed free of charge by the KNP to whoever the visitor intends.

In the second phase the Data Model is put in place by means of a SQL Server script which will create all tables, views and procedures for use on the SQL Server. All the necessary Open Database Connectivity (ODBC) connections are configured for the application to run on the new environment.
6.8 Input Scanned and Live Digital Data- Upload and Input to System

The data, having been prepared in digital format by a Scanning Company is now ready for input into the live system. This, along with the data that was required to be typed into the system would consist of such a large amount of data that it would constitute The KNP authority leasing out the contract to input the data to a specialist data entry company. This contract would be similar in many ways to the scanning contract with Park staff being involved in the data entry process so that they would learn the techniques involved in data entry and would be able to process the lower volume of day to day data.

6.9 Order, Deploy and Configure Kiosks and iPAQs

The Academic implementation of the project is going to simulate the functionality of a kiosk by using a Home PC to access the KNP web server using Internet Explorer 5.5. Below are the steps that the author recommends that the park carry out to successfully deploy the kiosks within the park.

The initial step here would be to conduct a study to determine the infrastructural shortcomings of the Zones. This would include the availability of electricity at each zone and also how to protect the natural integrity of the surrounding zone in the preparation of its construction. A civil engineer would also have to inspect each Zone to ensure that all requirements and safety regulations are met for the construction of a multiple-kiosk facility (semi-open kiosk shelter) and to facilitate public access to the kiosks.

The kiosk specifications are set out and the kiosks are ordered. The kiosks are delivered to Muckross House where they are configured initially to operate on the park LAN and to ensure that they can receive web pages form the KNP web server. The configuration process includes making the kiosks members of the Park Domain. The configuration of other network information including pointing the kiosk to a DHCP server so as to facilitate the kiosk receiving a dynamic IP address. Internet Explorer 5.5 is installed on each kiosk and pointed to the KNP proxy server with the home page on the browser being set to the KNP web server. While the kiosks are still in Muckross House and connected to the KNP LAN via a Wired Connection, the web site is vigorously tested to ensure that the kiosk software is functioning correctly. Each kiosk is assigned a Domain username and password with which the park staff member logs in when testing each kiosk. This is due to the business logic in the implementation requiring login information to determine which kiosk is requesting information.

Once this has being completed the kiosks are deployed to the relevant zones throughout the Park and are connected to the wireless network running in the Park. The kiosks are then tested again to ensure that all this equipment is functioning correctly.
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As the purchasing and configuration of the kiosks is taking place the iPAQs are also being purchased, configured and tested in parallel. This will include installing and configuring the wireless network cards in the iPAQs (e.g. assigning the iPAQs their IP addresses either Statickly or Dynamically). The iPAQs come with Internet Explorer preinstalled and all that remains to be done is for the Web browser to be pointed to the KNP proxy server and the KNP web pages tested on the iPAQs.

As the kiosks are being deployed to each zone the iPAQ devices are also brought to each zone to determine if they can function correctly at these.

Figure 6.18 below illustrates the KNP Network Infrastructure

![KNP Network infrastructure diagram](image)

*Figure 6.18 KNP Network Infrastructure*
6.10 Test system on Kiosks and iPAQs

With most of the IT infrastructure now in place around the Park and throughout Muckross House the Park staff can now begin the final phase of the implementation, by rigorously testing all the IT systems within the Park. This can be achieved on a phased basis. Initially Park staff will bring up all Servers and ensure that applications are pointing to live data. Staff will also be located throughout the Park and will bring up each kiosk until all servers and kiosks in the Park are functioning simultaneously. Finally to simulate the maximum exposure environment on the IT infrastructure within the Park, the KNP authority would request that pupils from each of the local schools would man a zone under the supervision of Park staff and teachers. The teachers located at each Zone will be allocated iPAQs for the duration of their visit to the Park. Statistical information could be gathered from this exercise from a number of sources including, computer logs as well as Park staff on the ground collecting information on human interaction with the kiosks and iPAQs. This is vital information which could be used by the Park IT staff to determine and rectify any possible bottlenecks in the system.

6.11 Test System on WWW

The public Website for the KNP will be hosted internally on a Demilitarised Zone (DMZ) located at Muckross House. Initially the public Website will be tested on the internal LAN in Muckross House before it is deployed to the Internet. Once this deployment takes place local community members with an interest in both IT and the Park will be asked to review the site and feedback from them will be collected and if necessary implemented by Park staff.

Note: The KNP authority will not need to hire a usability tester for its software as the contract for the custom written software will include the contracting company having an obligation to ensure the usability of the software.

6.12 Launch

The system is now fully implemented, installed and tested for use in a Business environment. All that remains for the KNP authority to do is to launch the system and ensure maximum media exposure for the official opening of the new visitor service.
6.13 IT TRAINING AND REQUIRED SKILLS OF THE PARK STAFF

6.13.1 Outsourcing the Initial Development and Implementation

The initial development and implementation of the project would be outsourced to several specialist IT Companies who would work in conjunction with the Park staff to implement the IT infrastructure for the Park. (The initial development and implementation of the KNP IT infrastructure is discussed in more detail in Chapter 7) As part of any contract with any third party company either a member of the KNP staff would be trained in the maintenance of the system or a maintenance agreement would be built in to the contract.

When the project is fully functional the two areas where IT intervention would still be required are:

- The upkeep and maintenance of information on the KNP Website
- The maintenance of the hardware and operational software within the Park.

6.13.2 Upkeep and Maintenance of Information on the KNP Database

In the day to day updating of the KNP Website information, knowledge of the information content is more important than IT skills. Hence the software solution provided to the Park will lend itself to be easily updateable requiring only a minimal knowledge of IT. This task can easily be carried out by a member of the Park staff who would be more knowledgeable on the information content than a person from an IT background.

The basic IT skills required by the Park staff can be delivered from the following two sources:

- ECDL (European Computer Driving Licence) courses which will provide a good generic foundation on I.T. skills including word-processing, spreadsheets, E-mail etc. By agreement, a special module on MS FrontPage, outside the scope of the ECDL would be provided for the KNP staff.
• Specialist training involving the use of the KNP’s custom built software solution. The company chosen to implement the KNP software solution will provide this training.

6.13.3 Maintenance of Hardware and Operational Software within the Park

The task of maintaining the hardware and operational software within the Park can be segmented into two areas. Firstly a System Administrator will need to be employed by the Park to maintain the integrity, security, scalability and functionality of the KNP system. She/he would need a team of IT support technicians to ensure the smooth operation of the Park’s IT infrastructure.

• Integrity

The integrity of the system will be insured through the System Administrator clearly defining the rolls of the Park staff within the system and maintaining system logs to ensure accountability for the actions of the use of the system by the Park Staff.

• Security

The security of the system will be insured through the System Administrator taking the necessary precautions to ensure that no unauthorised access to the system occurs. This will include both hardware and software intrusions. This is discussed in greater detail in Chapter 7.

• Scalability

As the number of visitors to the Park increases there may be a need to increase the size of the IT infrastructure within the KNP system. In any event the System Administrator will have to monitor the network, hardware and operational software resources of the system and have a plan of action in place to accommodate any possible bottle- necks in these resources.

• Functionality

The System Administrator’s terms of employment would dictate what the KNP authority would regard as an acceptable percentage of downtime incurred in any one year. To minimise the downtime, the System Administrator should ensure that the maximum amount of redundancy is in place. This will include, Redundant Array of Inexpensive Disks (RAID), Uninterrupted Power Supply (UPS) etc. In the case of ultimate disaster the
System Administrator will be required to have the necessary back-up procedure implemented so that the system can be restored with the minimal loss of data.

Of course, as part of their ongoing development, the System Administrator and the IT support team will be expected to keep their skills updated by attending appropriate courses and being prepared to keep up with the latest technological advancements and be ready to implement these if necessary and feasible.

In addition to the above measures, the Park Rangers will be required to perform routine maintenance and inspections of the remote information points. The training to perform these duties will be supplied by the companies contracted to install the equipment.

### 6.14 Conclusions on Project Implementation (Business/Academic Implementation)

The implementation phase of this project has included information on the Academic Implementation, which is being carried out by the author as well as the author’s recommendations for a Business Implementation for the Project. If more resources were available to the author the Academic Implementation would have mirrored the Business Implementation more closely. However the author has endeavoured to replicate as closely as possible the Business Implementation of the project particularly through the use of a wireless LAN on the hardware side and the use of industry standard software such as: Windows 2000, IIS and SQL Server.
In this chapter the author looks back on the contents of this report, both from a research and an implementation viewpoint and draws several conclusions and recommendations from it.
Quite an extensive repository of archival material exists on the KNP’s. Practically 100% of this material is in paper format. Converting it into Digital Format would require major investment in time and resources.

Since the scale of this research and conversion is a once-off procedure it would not be viable for the KNP Authority to purchase the required equipment and in turn train the Park staff in its use. The recommended approach is that the Park staff will research, adapt, and edit the required material for presentation under the supervision of a project manager. This material will then be presented to a specialist scanning and multimedia conversion company, which will deliver the information in its required medium (i.e. digital). Upon the conversion of the material into digital format the material may be delivered to a specialist linguistic company for delivery to multilingual formats e.g. English, French, German and Italian.

Continuous detailed consultation will be required between the KNP authority and the Custom Software development team, throughout all the stages of the software development for a satisfactory business development solution for this project.

Interactive Touchscreen Information Kiosks and iPAQs Pocket PCs are the author’s recommended information delivery mediums.

Why choose Kiosks?

- Kiosks are suitable for location in an indoor or outdoor environment.
- Kiosks are robust.
- The intuitive software, which is installed on the kiosks, means that they can be operated independently by visitors, thus negating the need for intervention by Park guide-staff, which in the long term will result in major savings on labour costs.
- The design of the kiosks can be customised to suit the KNP’s requirements.
- A kiosk allows one to restrict access to the underlying computer by using input devices such as touch screens.
- Kiosks cater for diverse users such as those with disabilities e.g. the visually impaired.
- Kiosks offer a multimedia environment such as graphics, sound and video.
- Kiosks can be multilingual activated at the touch of a button.
- Kiosks can utilise power management features to be operational in the long summer evenings after the KNP staffs have finish for the day.
• Kiosks consume reduced quantities of electricity as they can remain in standby mode until user intervention occurs.

The kiosk solution the author has chosen is based on using a smart client architecture environment without the use of replication. This solution was chosen for the following reasons:

• Smart clients offer greater functionality over thin clients.

• Smart clients use less bandwidth in the exchange of information.

• If the server “goes down” smart clients can use cached material to remain functioning whereas the effects of a down server on a thin client are instantaneous.

• Kiosks running smart clients, function using open standard protocols, whereas thin client kiosks use proprietary standard protocols.

The following are the author’s recommended physical and application requirements of the kiosks for use within the Killarney National Park.

From a purely physical viewpoint this author recommends that the KNP kiosk be

• *Indoor in semi-open shelters*- due to the heavy annual rainfall which Killarney receives

• *Accessible to all visitors*, including the physically handicapped such as those wheelchair bound.

• *Network-enabled* to ensure interconnection of all kiosks is possible and a facility to send e-cards is available

• *Attractive* looking within the Park setting

• *Robust*, have a *heavy-duty construction* and be *vandal resistant*

• Equipped with *Built-in Speakers* for information dissemination

The overall requirements from a kiosk application viewpoint are that they should be

• *multimedia-enabled* to entice and excite the visitor

• *touchscreen-enabled* to facilitate user interaction

• equipped with a *Voice-activated capability for the visually impaired visitor.*
Chapter 7 – Conclusions and Recommendations

The kiosk should have a high hardware specification in order to support the above requirements

Direct Internet Access is not required on the kiosk as the kiosk’s only purpose on the Killarney National Park LAN is to provide multimedia information to the Park visitor and not Internet Café type facilities.

The KNP authority should consider the provision of separate, dedicated Internet kiosks in the Park to generate valuable revenue by entering into joint ventures with such companies as Eircom or Esat.

iPAQs are the author’s preferred handheld device to be used in combination with kiosks for the following reasons:

- iPAQs are IEEE 801.11 compliant and can operate in the licence free ISM bandwidth.
- The availability to the Park visitor of both Kiosks and iPAQ devices will complement each other.
- The kiosks do not allow the visitors to roam the Park freely with the information presented in front of them at all times which is a facility that may be required by the more enthusiastic visitor to the Park. However this iPAQ facility will incur a charge.
- The use of iPAQs will complement the kiosks which themselves will offer an alternative less intrusive method of information access.

The availability of iPAQs for rent to the visitor will require the intervention of Park staff to operate the system.

A Web Based Interface is the author’s preferred interface for this project for the following reasons:

- Web uses HTTP protocol. Its strengths include:
  - The protocol scales well. (e.g. Yahoo receives millions of Hits per day)
  - Tested and used protocol.
  - Offers features such as Proxy and caching support.
- HCI (Human computer Interaction)
  - People are familiar with a Web interface. (Millions of people access the Web daily.
  - Staying within users’ comfort zone.
• Well-established Web programming methodologies will mean that the system can be developed to a high standard.

• Costs can be reduced, as Browser Licenses are free, which means no costs will be incurred on the client.

• A Web browser can be used as a multimedia tool, which can allow for the combination of Text, Graphics, Video and Sound when presenting information to the visitor.

• Browsers are an accepted standard whereas multimedia applications such as Macromedia Authorware and Director are proprietary systems.

• A web browser can be displayed on iPAQs

Of primary concern of course, from the outset of this project is how the desired IT infrastructure should be put in place, in the highly sensitive natural environment which a National Park is, by its very nature. The author recommends the installation of a wireless carrier infrastructure as it will cause minimum environmental interference in the KNP.

Wireless was chosen as the preferred Communications Medium as it offers the following advantages in the KNP context:

• Provides an excellent solution for difficult links in the KNP setting.

• Links are up continuously.

• Does not need a physical route.

• Easily deployed flexible network solutions.

• Can relocate the equipment without difficulty.

• High Speed Seamless Roaming can be achieve in Wireless LANs

• Distances of up to 15km are easily achieved for wireless links.

• Wireless links provide a secure and reliable network solution.

• High Bandwidth (3 Mbps or 11 Mbps) with high data throughput is available.

• Fully compliant with IEEE 802.11
• A Radio Licence is not required as Spread Spectrum Technology operates in the Licence Free 2.4 – 2.4835 GHz Industrial Scientific & Medical (ISM) band. ("2.4 GHz")

• Can replace expensive leased lines of low bandwidth.

• Cheapest Communications Medium option in the KNP context.

• No expensive annual rental charges are incurred.

• A large number of systems can be collocated.

Most wireless LAN systems use spread-spectrum technology. Spread-spectrum technology comes in two forms, namely Direct Sequence Spread Spectrum (DSSS) or Frequency Hopping Spread Spectrum (FHSS) systems. DSSS has the advantage of providing higher capacities than FHSS (3Mbps as opposed to 11 Mbps), but it is a very sensitive technology, influenced by many environment factors (noises, interference, etc.). The best way to minimise such influences is to use the technology in point to point applications. DSSS point to point systems can take advantage of the high capacity, without paying the high price of environment influences.

On the other hand, FHSS is a very robust technology, with little influence from noises, reflections, other radio stations or other environment factors. In addition, the number of simultaneously active systems in the same geographic area (collocated systems) is significantly higher than the equivalent number for DSSS systems. All these features make the FHSS technology the one to be selected for installations designed to cover large areas where a big number of collocated systems is required and where the use of directional antennae in order to minimise environment factors influence is impossible.

FHSS is the chosen wireless technology for the KNP due to its reliability, robustness, security and functionality. Its collocation features allows for the required 10 systems to be collocated at the Muckross House Base Station.

The use of this technology (FHSS) allows for a number of implementation options to optimise delivery of Park information to the visitor. One could, where feasible, seek to deliver blanket wireless coverage of the whole KNP by providing a network of broadcast footprints throughout the entire area. Park information could then be accessed via the WLAN anywhere with any device carrying a WLAN card. This could be a kiosk, PC, Laptop, Personal Organiser (PALM), Pocket PC etc. However, at present, this could prove to be a very costly solution. The following is an example of a potential ‘down-scalable’ Business Implementation options for the KNP system:

• Merely provide wireless service to a number of Kiosks at each of the 10 information Zone.
• Provide a combination of kiosks and handheld devices (iPAQs) at each of the 10 information Zone.

The author recommends the second ‘down- scalable’ option for the Business Implementation of this project. The combination of both types of devices (kiosks and iPAQs) per Information Zone offers the KNP authority a flexible mechanism of delivering Park information to the visitor, without incurring the considerable cost of blanket covering the Park in wireless cellular footprints.

It is envisaged that within the Killarney National Park (KNP) there will be 10 diversely located Visitor Information Delivery Points (with 4 information kiosks and multiple iPAQs at each of these zones). The specific locations of the identified ten information zones were chosen as they represent the areas of highest visitor traffic generation. In this way it is hoped to maximise the level of information dissemination to the visitors. Each of the chosen ten zones is located at an existing entrance / exit point to the KNP. Concomitantly, the electricity infrastructure already exists at each of the chosen zones to power the kiosks etc.

The KNP wireless topology will consist of Point to Point connectivity in a Star Topology, with Muckross House as the Base Station. (Muckross House was chosen as the Base Station as it is the focal point of the KNP.) Thus each Zone will operate with an independent connection to ensure reliability of service. For delivery of service, ‘line of sight’ is required from the Muckross House Base Station to each Zone. Propagation surveys will need to be commissioned to determine this for each Zone.

The KNP Authority may decide initially to establish the IT infrastructure to deploy the recommended 10 diversely located Visitor Information Delivery Points- with 4 kiosks and multiple iPAQs at each Zone in the first installation. Alternatively it may decide to establish the IT infrastructure on a phased basis over a number of years, by for example establishing 4 or 5 visitor Information points initially and increasing their number as resources become available to it.

As wireless technology advances and as costs reduce the KNP authority in the future should examine the feasibility of blanket covering the Park in cellular footprints so as to offer greater access to visitor information.

Due to the continuing rapid changes in IT technologies, the author recommends that the KNP authority commission outside consultants prior to embarking on the Business Implementation of this major project e.g. At present FHSS systems use a channel of 1 MHz. to transmit at rates of up to 3 Mbps. However as a result of last summer’s decision by the Standards Activity Board (SAB) of the IEEE to allow FHSS to operate in the 2.4 GHz band with 5MHz channels, FHSS systems operating at 15 Mbps are expected on the market shortly.
Specific visitor information on KNP will in theory need to be updated on a daily basis. Pages that change regularly can easily be updated on a Database and called from it. Object Oriented Database or Object Relational Database would be an optimal solution for the KNP project if a stable platform to run them on existed. Relational DBMS is the chosen technology in this project. The multimedia data access implementation portion of the project will have to be supplemented with file system access methodologies.

RDBMS technology is the industry standard. It is well known. It is in existence for a substantial period of time. Microsoft SQL Server 7 is recommended by the author as the RDBMS for this project, primarily because of its support for security, integrity, scalability and redundancy and for its ability to integrate well with other Microsoft products.

A system administrator will need to be employed by the Park to maintain the integrity, security, scalability and functionality of the KNP system. She/he would need a team of IT support technicians to ensure the smooth operation of the Park's IT infrastructure.

The system administrator's terms of employment will dictate what the KNP authority would regard as an acceptable percentage of downtime incurred in any one year. To minimise the downtime, the System Administrator should ensure that the maximum amount of redundancy is in place. In the case of ultimate disaster the System Administrator will be required to have the necessary back-up procedure implemented so that the system can be restored with the minimal loss of data.

Of course, as part of their ongoing development, the System Administrator and the IT support team will be expected to keep their skills updated by attending appropriate courses and being prepared to keep up with the latest technological advancements and be ready to implement these if necessary and feasible.

In addition to the above measures, the Park Rangers will be required to perform routine maintenance and inspections of the remote information points. The training to perform these duties will be supplied by the companies contracted to install the equipment.

In the day to day updating of the KNP Database, knowledge of the information content is more important than IT skills. Hence the software solution provided to the Park will lend itself to be easily updateable requiring only a minimal knowledge of IT. This task can easily be carried out by a member/s of the Park staff who would be more knowledgeable on the information content than a person from an IT background.

The basic IT skills required by the Park staff can be delivered from the following two sources

- ECDL (European Computer Driving Licence) courses which will provide a good generic foundation on I.T. skills including word-processing, spreadsheets, e-mail etc. By agreement, a special module on MS FrontPage, outside the scope of the ECDL would be provided for the KNP staff.
• Specialist training involving the use of the KNP's custom built software solution. The company chosen to implement the KNP software solution will provide this training.

Due to its sheer scale, the KNP authority should outsource the initial conversion of the required information for dissemination to the kiosks. The Park however will need to purchase a scanner and a digital camera to carry out subsequent updating of material. The staff will require training in the use of these technologies also.

The author recommends that the KNP host its own Website/s on site. The site/s would be hosted on a server that is located on a separate network from the KNP internal network called a DMZ (Demilitarised zone) network. The benefits of using this system include the KNP's ability to dictate the hardware and software requirements on the external server (i.e. Windows 2000 Server with IIS). This would make the transfer of data between the internal and external server run seamlessly as both servers would be running on the same environment. The disadvantages of this method would include the KNP having to employ staff with the necessary skills to implement and maintain this environment.

The KNP Website is an important feature of the system from both an internal and external viewpoint. Externally, there is a need to advertise the goods on offer at KNP to would-be clients and those interested enough to visit the KNP site. Hence, depending on the visitor's connection mode the following options should be considered.

• For people with DSL links offer them full access to text and multimedia content. Possibly, offer them the choice to download the MM content first and then browse, as the database is always live. The same technology that was used in downloading information to the kiosks is enabled here also.

• For people with slow connections offer a text only version and some graphics without the heavy MM content. Upon paying a small mail order subscription, a CD ROM of Park's MM content, can be acquired and used in conjunction with the KNP site on offer to them.

As Dúchas manages a total of 6 National Parks countrywide, this statutory body might consider the development of a National networked interactive information environment for all its Parks i.e. network all the Parks from a National Centralised Base Station.
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4GuysFromRolla.com offers ASP articles, FAQs, message boards, tips and reviews more.
15 Seconds - resource for developers working with Microsoft Internet Solutions.
LearnASP.com - resource site with tutorials for new users, articles, links, and book reviews by Charles Carroll
ASP Lists - newsgroup and email lists on various topics, and in multiple languages.
ASP Alliance - components, tools, and networking lists.

AvantGo Software

www.avantgo.com
www.oneandone.co.uk

Internet Access via Satellite

http://www.armstrong-electronics.ie
Digicom SA - VSAT, Internet access, and network connection services.
StarGuide Digital Networks - designs and manufactures products for multimedia applications including multi-channel radio broadcast and video program distribution, financial news distribution, and worldwide Internet access service

Kiosk Technology

Research on Smart Kiosks

DigitEyes: Vision-Based Human Hand Tracking

Product Resource Guide for Kiosk applications e.g. card readers, software developers, speech input/output, enclosures
http://www.kioskcom.com/kc_prg.php

Provides a detailed listing and description of Kiosk products.
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**Netkey** - provides Internet kiosks used for sales, marketing, and customer service.
**Electronic Keyboards, Inc.** - makers of custom control units for industry, medicine, and business, and adapted keyboards for the physically challenged.

**MontegoNet** - provider of interactive touch screen kiosks for public settings.
**Public Access** - specializes in kiosks for outdoor, high traffic, and unattended areas.
**Retail Results Corporation** - distributes dynamic Internet kiosks.

**Microsoft Developer Resources**

Microsoft digital library – msdn.microsoft.com
Microsoft knowledge based /troubleshooting – www.microsoft.com/technet

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JavaScript com - resource for tutorials, scripts.
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APPENDICES
APPENDIX A1

Modern Day Collection of References on KNP
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APPENDIX A2

Historical Collection of References on KNP
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<th>AUTHOR</th>
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APPENDIX B

SPECIFICATIONS AND COSTINGS FOR THE HARDWARE AND OPERATIONAL SOFTWARE OF THE KNP IT INFRASTRUCTURE
B – Specifications and Costings for the Hardware and Operational Software of the KNP IT Infrastructure

Layout

Server Specifications

Server 1 (www.dell.com - quotations dated 16-06-2001)
Mail Server (MS Exchange for Visitors and KNP staff with 50-client licence)
Up continuously – (twenty-four hours – seven days a week)
Backup Domain Controller (BDC)
Domain Name System (DNS), Windows Internet Name Server (WINS) (Windows 2000 Server)

Server 2 (www.dell.com - quotations dated 16-06-2001)
Primary Domain Controller (PDC) (Windows 2000 Server)

Server 3 (www.dell.com - quotations dated 26-06-2001)
Firewall, Proxy (Rapture MS Proxy Server 2.0 and Windows NT 4.0)

Server 4 (www.dell.com - quotations dated 16-06-2001)
Intranet Server (IIS5 and SQL Server 7.0 with Windows 2000 Server)

Server 5 (www.dell.com - quotations dated 16-06-2001)
Demilitarised Zone (DMZ) and Server for external Website (IIS5 and SQL Server 7.0 with Windows 2000 Server)

Note: The author proposes to use a Monitor Switch (circa £80) to cut down on costs of monitors as one monitor will suffice in the Server Room)

Redundancy

Consists of
- Backup tape mechanism
- Redundant Array of Inexpensive Disks (RAID) 5 on critical servers
- Uninterrupted Power Supply (UPS) on each server

Switches (Total: 3) http://cisco.comstore.com – quotation dated 17-06-2001
1*Switch for server room
1*Switch for Attic
1*Switch for DMZ
APPENDIX B - Specifications and Costings for the Hardware and Operational Software of the KNP IT Infrastructure

- **Routers** (Total: 2) ([http://cisco.com](http://cisco.com) – quotation dated 17-06-2001)
  - 1* Router for LAN
  - 1* Router for DMZ

- **Cabling** (Installation Contract) ([www.ardtec.com](http://www.ardtec.com) – quotation dated 15-06-2001)
  - CAT 6 cable
  - Fibre

- **Leased line** ([www.eircom.net](http://www.eircom.net) – quotation dated 10-05-2001)

**IP Address**

- **FHSP Wireless Infrastructure** ([www.wireless.ie](http://www.wireless.ie) – quotations dated 20-05-2001)
  - 10* Point to Point FHSP Wireless connections.

- **Conduits** (Installation Contract) ([www.ardtec.com](http://www.ardtec.com) – quotation dated 15-06-2001)

- **Cabinet** (Installation Contract) ([www.ardtec.com](http://www.ardtec.com) – quotation dated 15-06-2001)

- **Drop Leads** (Installation Contract) ([www.ardtec.com](http://www.ardtec.com) – quotation dated 15-06-2001)

- **Servers**
  - **Server 1**
    - **Mail Server** (MS Exchange BDC, DNS, WINS, Windows 2000 Server)
      - Dell PowerEdge 4400
      - Standard Features: ServerWorks Departmental ServerSet III LE Chipset
      - Provision for dual Pentium III Xeon processors
      - Up to 4GB PC133 SDRAM (via 8x512MB when available) on a 133MHz system bus
      - Integrated Intel PRO/100+ adapter
      - Two USB ports
      - Seven PCI expansion slots: two 64bit/66MHz, four 64bit/33MHz, one 32bit/33MHz
      - Storage Expansion for up to eight 1" hot-plug Ultra3 160MB/s SCSI hard drives and a further two 1" drives in an optional media bay (10 total)
      - Two built-in Ultra160 SCSI controllers (for hard drives)
      - One Ultra/Narrow SCSI (for CD-ROM and tape drives)
      - Hot-Plug Redundant Cooling Fans and Power Supplies with individual Power Cords
      - Supplied with CD-ROM drive, Performance Keyboard, Microsoft Mouse & 3.5" Floppy Drive.
- Certified for clustering with support for both PowerVault Fibre & SCSI external storage.
- The Dell OpenManage suite to enable automated/rapid operating system installation, and complete network management with IT Assistant.
- Enhanced OpenLine (24x7) telephone based technical support and 30-day Getting Started Support for new installations
- Maintenance Service: 3 Years Next Business Day On-site
- Rack Mount Kit: Tower Chassis
- Hot-Plug Power Supplies: 2 non-redundant 320W power supplies
- Processor(s)/Cache: One Intel Pentium III Xeon 933MHz processor with 256K cache
- Memory: 512MB PC133 SDRAM (4x128MB 133MHz DIMMs) (+ IEP IR£638)
- Monitor: Dell E551 Value 15" (13.80" VIS) FST Monitor (Midnight Grey) (+ IEP IR£134) * only monitor in configuration (monitor switch used)
- Main Bay Hard Drive Backplane: 2x4 Bay Ultra160 1" hard drive backplane
- 1st Main Bay Hard Drive: 9GB 7,200rpm 1" hot-plug Ultra160 SCSI hard drive
- 2nd Main Bay Hard Drive: 9GB 7,200rpm 1" hot-plug Ultra160 SCSI hard drive (+ IEP IR£252)
- 3rd Main Bay Hard Drive: 9GB 7,200rpm 1" hot-plug Ultra160 SCSI hard drive (+ IEP IR£252)
- Internal Hard Drive RAID Configuration: RAID 5 - requires three or more hard drives of equal type/size
- Internal Tape Backup or Hard Drives (Media Bay): PV100T 20/40GB DDS-4 LVD DAT internal unit (+ IEP IR£599)
- On Board RAID: 128MB Ultra160 PERC 3/Di embedded RAID (+ IEP IR£276)
- Tape Backup Software: CA ARCserve 2000 NT/W2K Standard Suite (+ IEP IR£299)
- APC Smart-UPS Un-interruptable Power Supplies: 950W Rack-Mount APC Smart-UPS 1400 RM 3U (Kit) (+ IEP IR£599) gracefully bring down and keep alive for 30 mins in power cut
- Additional Network Card(s): Intel Pro gigabit Plus Ethernet PCI card (+ IEP IR£47)
- Factory Installed Operating System: Microsoft Windows 2000 Server with 10 CALs - member, NTFS (+ IEP IR£669)

(www.dell.com -quotations dated 16-06-2001)  
IR£15,330 + vat = IR£18,366

Server 2 Dell PowerEdge 2400
PDC (Windows 2000 Server)

- Standard Features: ServerWorks Entry ServerSet III LE Chipset
- 6 expansion slots: 5x 64bit PCI and 1x 32bit PCI/ISA
- Provision for enabling on-board RAID with 64MB cache

-B(iii)-
- Storage Expansion for up to six 1" hot-plug LVD SCSI hard drives. Two integrated SCSI Controllers: One LVD SCSI & one Ultra/Narrow controller.
- Supplied with CD-ROM drive, Performance Keyboard, Microsoft Mouse & 3.5" Floppy Drive.
- Certified for clustering with support for both PowerVault Fibre & SCSI external storage.
- Enhanced OpenLine (24x7) Telephone based technical support and 30-day Getting Started Support - Technical support for new installations.
- Maintenance Service: 3 Years Next Business Day On-site
- Rack Mount Kit: Tower Chassis
- Processor(s): Single Pentium III 733/133MHz 256K cache
- Hot-Plug Power Supplies: One Non-Redundant 330W Power Supply
- Memory: 256MB PC133 SDRAM (1x256MB 133MHz DIMMs) (+ IEP IRE212)
- Main Bay Hard Drive Backplane: 1 x 6 Hot Plug LVD Backplane for 1 inch height drives only
- 1st Main Bay Hard Drive: 9GB 7,200rpm 1" Ultra 3 U160 SCSI hard drive
- 2nd Main Bay Hard Drive: 9GB 7,200rpm 1" Ultra 3 U160 SCSI hard drive (+ IEP IRE252)
- 3rd Main Bay Hard Drive: 9GB 7,200rpm 1" Ultra 3 U160 SCSI hard drive (+ IEP IRE252)
- Internal Hard Drive RAID Configuration: RAID 5 - requires three or more hard drives of equal type/size
- Internal Tape Backup or Hard Drives (Media Bay): PV100T 20/40GB DDS-4 LVD DAT internal unit (+ IEP IRE599)
- On Board RAID: 64MB PERC 2/Si embedded RAID (+ IEP IRE205)
- Additional Network Card(s): Intel Pro gigabit Plus Ethernet PCI card (+ IEP IRE47)
- Factory Installed Operating System: Microsoft Windows 2000 Server with 10 CALs - PDC, NTFS (+ IEP IRE622)

(www.dell.com -quotations dated 16-06-2001) IRE3,748 + vat = IRE4,497.60

Server 3

FIREWALL, PROXY Rapture ms proxy server 2.0, (Windows NT 4)
- Standard Features: ServerWorks ServerSet LE 3.0 chipset with 133MHz FSB processor and memory support. Maximum memory support of 2GB
- 6 33Mhz PCI expansion slots: 4 x 64bit, 2x32 bit (no ISA slots)
- Dual Peer PCI buses
- Embedded ATI RAGE XL,4Mb SDRAM Video
- Storage Expansion for up to four 1" LVD SCSI Hard Drives (max. 144Gb internal storage either 7200 or 10K RPM). Integrated LVD SCSI Ultra 3 Dual Channel integrated controller
- Supplied with 20/48X CD-ROM drive, Performance Keyboard, Microsoft Mouse & 3.5" Floppy Drive
- Enhanced OpenLine (24x7) Telephone based technical support and 30-day Getting Started Support - Technical support for new installations
- Maintenance Service: 3 Years Next Business Day On-site
• Processor(s)/Cache: One Intel Pentium III 800MHz processor with 256K cache
• Memory: 256MB PC133 SDRAM (2x128MB 133MHz DIMMs) (+ IEP IR£212)
• 1st Main Bay Hard Drive: 9GB 7,200rpm 1" Ultra160 SCSI hard drive
• Tape Backup Software: Veritas BackUp Exec 8.0 NT/W2K Standard Suite (+ IEP IR£295)
• Additional Network Card(s): Intel Pro gigabit Plus Ethernet PCI card (+ IEP IR£47)
• Operating System Windows NT 4.0

(www.dell.com - quotations dated 16-06-2001) IR£1,645 + vat = IR£1,974

Server 4
Intranet Server (IIS5 and SQL Server 7.0 with Windows 2000 Server)

• Standard Features: ServerWorks Entry ServerSet III LE Chipset
• 6 expansion slots: 5x 64bit PCI and 1x 32bit PCI/ISA
• Provision for enabling on-board RAID with 64MB cache
• Storage Expansion for up to six 1" hot-plug LVD SCSI hard drives. Two integrated SCSI Controllers: One LVD SCSI & one Ultra/Narrow controller.
• Supplied with CD-ROM drive, Performance Keyboard, Microsoft Mouse & 3.5" Floppy Drive.
• The Dell OpenManage suite to enable automated/rapid operating system installation, and complete network management with IT Assistant.
• Certified for clustering with support for both PowerVault Fibre & SCSI external storage.
• Enhanced OpenLine (24x7) Telephone based technical support and 30-day Getting Started Support - Technical support for new installations.
• Maintenance Service: 3 Years Next Business Day On-site
• Rack Mount Kit: Tower Chassis
• Processor(s): Single Pentium III 733/133MHz 256K cache
• Hot-Plug Power Supplies: One Non-Redundant 330W Power Supply
• Memory: 256MB PC133 SDRAM (2x128MB 133MHz DIMMs) (+ IEP IR£212)
• Main Bay Hard Drive Backplane: 1 x 6 Hot Plug LVD Backplane for 1 inch height drives only
• 1st Main Bay Hard Drive: 9GB 7,200rpm 1" Ultra 3 U160 SCSI hard drive
• 2nd Main Bay Hard Drive: 9GB 7,200rpm 1" Ultra 3 U160 SCSI hard drive (+ IEP IR£252)
• 3rd Main Bay Hard Drive: 9GB 7,200rpm 1" Ultra 3 U160 SCSI hard drive (+ IEP IR£252)
• Internal Hard Drive RAID Configuration: RAID 5 - requires three or more hard drives of equal type/size
• Internal Tape Backup or Hard Drives (Media Bay): PV100T 20/40GB DDS-4 LVD DAT internal unit (+ IEP IR£599)
APPENDIX B - Specifications and Costings for the Hardware and Operational Software of the KNP IT Infrastructure

- Additional Network Card(s): Intel Pro gigabit Plus Ethernet PCI card (+ IEP IR£47)
- Factory Installed Operating System: Windows 2000 with IIS server with CD & Documentation (+ IEP IR£126)

(www.dell.com -quotations dated 16-06-2001)  IR£6,094 + vat = IR£7,312.80

**Server 5**

DMZ (Demilitarised Zone) and Server for External Website (Windows 2000 with IIS web server, SQL Server 7.0)

- Standard Features: ServerWorks Entry ServerSet III LE Chipset
- 6 expansion slots: 5x 64bit PCI and 1x 32bit PCI/ISA
- Provision for enabling on-board RAID with 64MB cache
- Storage Expansion for up to six 1" hot-plug LVD SCSI hard drives. Two integrated SCSI Controllers: One LVD SCSI & one Ultra/Narrow controller.
- Supplied with CD-ROM drive, Performance Keyboard, Microsoft Mouse & 3.5" Floppy Drive.
- The Dell OpenManage suite to enable automated/rapid operating system installation, and complete network management with IT Assistant.
- Certified for clustering with support for both PowerVault Fibre & SCSI external storage.
- Enhanced OpenLine (24x7) Telephone based technical support and 30-day Getting Started Support - Technical support for new installations.
- Maintenance Service: 3 Years Next Business Day On-site
- Rack Mount Kit: Tower Chassis
- Processor(s): Single Pentium III 733/133MHz 256K cache
- Hot-Plug Power Supplies: One Non-Redundant 330W Power Supply
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- Additional Network Card(s): Intel Pro gigabit Plus Ethernet PCI card (+ IEP IR£47)
- Factory Installed Operating System: Windows 2000 with IIS server with CD & Documentation (+ IEP IR£126)

(www.dell.com -quotations dated 16-06-2001)  IR£6,094 + vat = IR£7,312.80

-B(vi) -
Total cost for servers
System IR£32,911 20% IR£39,493.20
Total Delivery Charge IR£180 20% IR£216
Total IR£33,091 - IR£39,709.20
Price to pay excl. VAT Price to pay incl. VAT
Amount Payable IR£33,091 IR£39,709.20

Switches
3 * Cisco Catalyst 2900 Switch @ £4,800 each

(£12,000 + VAT £2,400) Total cost £14,400


Routers
2 * Cisco 2600 Multiservice Routers @ £1,886.57 each.

(£3,144.28 + VAT £328.63) Total cost £3,773.14


Cabling (Installation Contract)
Cat 6- 1000m @ 0.35p per metre £350
Gigabit Fibre cable 10m @ £5 per meter £50

(£400+VAT £80) Total cost £480

Leased Line

256k line £1,500 + VAT per annum

IP address obtained with Leased Line.

(£1,500+VAT£300)  Total cost £1,800

(www.circom.net – quotation dated 10-05-2001)

FHSP Wireless Infrastructure

10* Point to Point FHSP Wireless connections @ £5,500 each.
Quotation includes Site Surveys and Installation

(£55,000 + VAT£11,000)  Total cost £66,000

(www.wireless.ie -quotations dated 20-05-2001)

Conduits  (Installation Contract)
Patch panels
Drop leads
Wall Sockets
Fibre Drop Leads
X25 Serial cables (Cables to connect switches and routers together)
Server room £200
10 rooms at £3 per room  £30

(£230 + VAT£46)  Total cost £276


Cabinet  (Installation Contract)

1 * 10U Cabinet for Server Room

(£199.84+VAT£39.96)  Total cost £239.80

APPENDIX B - Specifications and Costings for the Hardware and Operational Software of the KNP IT Infrastructure

➢ **Drop Leads** (Installation Contract)

100 cat6 2m drop leads @£1 each

(£83.34+VAT£16.66)  
Total Cost £100


Note

**Server Room** (Electricity Supply)

A separate Electrical Specification & Costing would need to be undertaken in order to upgrade the Electricity Supply Infrastructure in the proposed Server Room

---

**Total Cost**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Servers</td>
<td>(£33,091+VAT£6,618.20)</td>
<td>£39,709.20</td>
</tr>
<tr>
<td>2. Switches</td>
<td>(£12,000 + VAT £2,400)</td>
<td>£14,400.00</td>
</tr>
<tr>
<td>3. Routers</td>
<td>(£3,144.28 + VAT £628.86)</td>
<td>£3,773.14</td>
</tr>
<tr>
<td>4. Cabling</td>
<td>(£400+VAT £80)</td>
<td>£480.00</td>
</tr>
<tr>
<td>5. Leased line + IP Address</td>
<td>(£1,500+VAT £300)</td>
<td>£1,800.00</td>
</tr>
<tr>
<td>6. Wireless Connections</td>
<td>(£55,000 + VAT £11,000)</td>
<td>£66,000.00</td>
</tr>
<tr>
<td>7. Conduits</td>
<td>(£230 + VAT £46)</td>
<td>£276.00</td>
</tr>
<tr>
<td>8. Cabinet</td>
<td>(£199.84+VAT£39.96)</td>
<td>£239.80</td>
</tr>
<tr>
<td>9. Drop Leads</td>
<td>(£83.34+VAT £16.66)</td>
<td>£100.00</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>(£105,648.45+VAT £21,129.69)</td>
<td>£126,778.14</td>
</tr>
</tbody>
</table>
APPENDIX C

Code for the Academic Implementation of the Project
# Appendix C - Code for the Academic Implementation of the Project

## C - Code for the Academic Implementation of Project

<table>
<thead>
<tr>
<th>Name:</th>
<th>SendMail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Component that takes an email message from an ASP page, processes it and delivers it to a virtual SMTP server using the CDONTS component.</td>
</tr>
<tr>
<td>Project:</td>
<td>MSc in Computing in Education</td>
</tr>
<tr>
<td>Date:</td>
<td>6th July 2001</td>
</tr>
<tr>
<td>Creator:</td>
<td>John Clifton</td>
</tr>
<tr>
<td>Notes:</td>
<td>This component is written in Visual Basic 6.0</td>
</tr>
</tbody>
</table>

### Option Explicit

```vbs
Option Explicit

Public Function SendMail(s_from, s_to, s_subject, s_body) As String
    ' Declare variables
    Dim myCDONTSMail As CDONTS.NewMail ' Declare instance of CDONTS object
    Dim strFrom As String
    Dim strTo As String
    Dim strSubject As String
    Dim strBody As String
    strFrom = s_from
    strTo = s_to
    strSubject = s_subject
    strBody = s_body
    ' Create the CDONTS NewMail object
    Set myCDONTSMail = CreateObject("CDONTS.NewMail")
    ' Set the Reply-To header of the NewMail object:
    myCDONTSMail.Send strFrom, strTo, strSubject, strBody
    Set myCDONTSMail = Nothing
    SendMail = "success"
End Function
```

-C(i)-
Appendix C – Code for the Academic Implementation of the Project

Name: LocationMap
Description: This page calls business logic which decides where the booth is located based on login information.
Project: MSc in Computing in Education
Date: 6th July 2001
Creator: John Clifton
Notes: This page also contains a timeout

```vbscript
<% @ LANGUAGE="VBSCRIPT" %>
<!—#include file="Connections/connKNP.asp" —>
<%
' *** The following code is being used to identify the location of each booth
' *** Code is being moved to component
Dim xMember
Dim TheForm
Dim m_tempvar
m_tempvar = "false"
If Request.ServerVariables("LOGON_USER") = "" Then
    Response.Status = "401 Authorization Required"
    Response.End
else
    xMember = Request.ServerVariables("LOGON_USER")
End If
%
' *** Create a recordset called rsBooth
set rsBooth = Server.CreateObject("ADODB.Recordset")
rsBooth.ActiveConnection = mm_connKNP_STRING
m_sql = "SELECT * FROM tblBooth where LoginName = "" + xMember + ""
rsBooth.Source = m_sql
rsBooth.CursorType = 0
rsBooth.CursorLocation = 2
rsBooth.LockType = 3
rsBooth.Open
rsBooth_numRows = 0
%
<html>
<head>
<title>Untitled Document</title>
</head>
<body onload=setTimeout("location.href='mainframenew.asp'", 30000) bgcolor="#D3D37E">
<div align="center">
    <center>
        <table border="0" cellspacing="7" bgcolor="#D3D37E">
            <tr>
                <td>
                    <font face="Arial" size="5" color="#9F8C09"><b>You are currently located at</b><br>
                    <h2 align="center"><a href="mainframenew.asp"><img src="knpmainnew.png" width="559" height="466" border="0"></a></h2>
                </td>
            </tr>
        </table>
    </center>
</div>
<p>&nbsp;</p>
</body>
</html>
```

-C(ii)-
Appendix C - Code for the Academic Implementation of the Project

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Project</th>
<th>Date</th>
<th>Creator</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife</td>
<td>This page retrieves the wildlife information for a database</td>
<td>MSc in Computing in Education</td>
<td>6th July 2001</td>
<td>John Clifton</td>
<td></td>
</tr>
</tbody>
</table>

```html
<html><head></head><body bgcolor="#FFFFFF" text="#000000">
<table width="100%" border="0" bgcolor="#FFFFCC" cellspacing="6">
<tr><td width="73%" height="121"><b><%= rsWildlife.Fields.Item("WildlifeName").Value %>&nbsp;</b><%= rsWildlife.Fields.Item("WildlifeDesc").Value %></td>
<td width="27%" height="121" valign="middle">
<p align="center"><a href="pine6.mpeg"><img src="%= rsWildlife.Fields.Item("Wildlifeimage").Value %" width="139" height="108" align="absmiddle" border="0"><br>
Click on image to view video</a><br>
<font size="2"><a href="file:///C:/Inetpub/wwwroot/PARK/pineau.a5r">Authorware version</a></font></p>
</td></tr>
</table>
</body></html>
```
Appendix C – Code for the Academic Implementation of the Project

<!-----------------------------------------------------------------------------------------------------------------------------------------
Name: mainframewer
Description: This page is a frameset page that calls all the top, left and middle frames
Project: MSc in Computing in Education
Date: 6th July 2001
Creator: John Clifton
Notes: This page calls: knpmenu.asp, booth.asp, header.asp

%>
<html>
<head>
<title>Killaney National Park Information Point</title>
</head>
<frameset rows="64,*" framespacing="0" frameborder="0">
    <frame name="banner" scrolling="no" noresize target="contents" src="header.asp?% response.write m_x %"><frameset cols="163,*">
        <frame name="contents" target="main" src="knpmenu.asp" scrolling="no" noresize>
        <frame name="main" src="booth.asp?% response.write m_x %" target="_top">
    </frameset>
</noframes>

<p>This page uses frames, but your browser doesn't support them.</p>
</body>
</html>

-C(iv) -
Appendix C – Code for the Academic Implementation of the Project

Name: KNPMenu
Description: This page is a dynamically created menu from a database.
Project: MSc in Computing in Education
Date: 6th July 2001
Creator: John Clifton
Notes:

<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
<html><head>
<meta http-equiv="Content-Language" content="en-ie">
<meta http-equiv="Content-Type" content="text/html; charset=windows-1252">
<title>KNPMENU</title>
</head>

<script language="JavaScript1.2">function over_effect(e,state){
if (document.all)
source4=event.srcElement
else if (document.getElementById)
source4=e.target
if (source4.className=="menulines")
source4.style.borderStyle=state
else{
while(source4.tagName!="TABLE")
source4=document.getElementById? source4.parentNode : source4.parentNode
if (source4.className=="menulines")
source4.style.borderStyle=state
}
}

</script>

<!----#include file="Connections/connKNP.asp" -->

set rsMenuURL = Server.CreateObject("ADODB.Recordset")
rsMenuURL.ActiveConnection = mm_connKNP_STRING
m_sql = "SELECT * from tblURLs"
rsMenuURL.Source = m_sql
rsMenuURL.CursorType = 0
rsMenuURL.CursorLocation = 2
rsMenuURL.LockType = 3
rsMenuURL.Open()
rsMenuURL_numRows = 0
rsMenuURL_numRows = rsMenuURL_numRows + Repeat1_numRows
Dim Repeat1_index
Repeat1_index = 0
Dim Repeat1_numRows
Repeat1_numRows = -1

<!-- Javascr i pc. Modified from code taken with thanks
and with consent from www.DynamicDrive.com -->

<html>
<head>
<style>
.menulines{border:2.5px solid #F0F0F0;}
.menulines a{text-decoration:none; color:black;}
.MenuTable { border: #C9C9C9; border-style: solid; border-top-width: 1px; border-right-width: 1px; border-bottom-width: 1px; border-left-width: 1px}
</style>
</head>

<!- Javascript to make menu dynamic
//Modified from code taken with thanks
and with consent from www.DynamicDrive.com -->

</html>
Appendix C – Code for the Academic Implementation of the Project

```html
<!-- Code snippet removed for brevity -->
</html>
```

-C(vi) -
Appendix C - Code for the Academic Implementation of the Project

<!------------------->
Name: feedback
Description: This page passes info from the visitor back to the KNP Database
Project: MS in Computing in Education
Date: 6th July 2001
Creator: John Clifton
Notes:

<!language="VBSCRIPT"%>
<%--#include file="Connections/connKNP.asp" -->

' *** Edit Operations: declare variables
m_editAction = CStr(Request("URL"))
If (Request.QueryString <> "") Then
  m_editAction = m_editAction & "?" & Request.QueryString
End If

' boolean to abort record edit
m_abortEdit = false

' query string to execute
m_editQuery = 

%>

' *** Insert Record: set variables
If (CStr(Request("m_insert")) <> "") Then

  m_editConnection = m_connKNP_STRING
  m_editTable = "tblFeedback"
  m_editRedirectUrl = "http://localhost/PARK/booth.asp?id=1000"
  m_fieldsStr = "select|value|select2|value|select3|value"
  m_columnsStr = "usefulness!,none,'|nationality|',none,'|Age|',none,'""

  ' create the fields and columns arrays
  m_fields = Split(m_fieldsStr, ".")
  m_columns = Split(m_columnsStr, ".")

  ' set the form values
  For i = LBound(m_fields) To UBound(m_fields) Step 2
    m_fields(i+1) = CStr(Request.Form(m_fields(i)))
  Next

  ' append the query string to the redirect URL
  If (m_editRedirectUrl <> "" And Request.QueryString <> "") Then
    If (InStr(1, m_editRedirectUrl, '?', vbTextCompare) = 0 And Request.QueryString <> "") Then
      m_editRedirectUrl = m_editRedirectUrl & "?" & Request.QueryString
    Else
      m_editRedirectUrl = m_editRedirectUrl & "&" & Request.QueryString
    End If
  End If

End If
%

' *** Insert Record: construct a sql insert statement and execute it
If (CStr(Request("m_insert")) <> "") Then

  ' create the sql insert statement
  m_tableValues = ""
  m_dbValues = ""
  For i = LBound(m_fields) To UBound(m_fields) Step 2
    FormVal = m_fields(i+1)
    m_typeArray = Split(m_columns(i+1), ",")
    Delim = m_typeArray(0)
    If (Delim = "none") Then Delim = ""
  Next

  m_tableValues = m_tableValues & FormVal & Delim
  m_dbValues = m_dbValues & FormVal & Delim

  ' execute the sql insert statement
  Dim conn As Object
  Set conn = CreateObject("ADODB.Connection")
  conn.Open "Provider=Microsoft.JET.OLEDB.4.0;Data Source=tblFeedback.mdb;Persist Security Info=False"
  conn.Execute m_tableValues & m_dbValues, m_editQuery

End If
%

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Appendix C - Code for the Academic Implementation of the Project

AltVal = m_typeArray(1)
If (AltVal = "none") Then AltVal = ""
EmptyVal = m_typeArray(2)
If (EmptyVal = "none") Then EmptyVal = ""
If (FormVal = "") Then
    FormVal = EmptyVal
Else
    If (AltVal <> "") Then
        FormVal = AltVal
    Elseif (Delim = ") Then ' escape quotes
        FormVal = ") & Replace(FormVal,"\"","") & ""
    Else
        FormVal = Delim + FormVal + Delim
    End If
End If
If (i <> LBound(m_fields)) Then
    m_tableValues = m_tableValues &"
    m_dbValues = m_dbValues &"
End if
m_tableValues = m_tableValues & m_columns(i)
m_dbValues = m_dbValues & FormVal
Next
m_editQuery = "insert into " & m_editTable & " (" & m_tableValues & ") values (" & m_dbValues & ")"
If (Not m_abortEdit) Then
    ' Parse the Insert
    Set m_editCmd = Server.CreateObject("ADODB.Command")
m_editCmd.ActiveConnection = m_editConnection
m_editCmd.CommandText = m_editQuery
m_editCmd.Execute
m_editCmd.ActiveConnection.Close
If (m_editRedirectUrl <> "") Then
    Response.Redirect(m_editRedirectUrl)
End If
End If

<html>
<head>
<title>Untitled Document</title>
</head>
<body bgcolor="#FFFFFF" text="#000000">
<table border="1" bordercolor="#34261B" cellspacing="0" align="center" width="398">
<tr>
    <td>
        <table width="106%" border="0" bgcolor="#ECE2D9" height="156" align="center">
            <tr>
                <td>
                    <div align="center"><b><font color="#000000">Feedback / Information</font></b></div>
                </td>
            </tr>
            <tr>
                <td>
                    <form name="form1" method="POST" action="<%=m_editAction%>">
                        Please rate the usefulness of this Information Point.
                        <select name="select">
                            <option>1</option>
                            <option>2</option>
                            <option>3</option>
                            <option>4</option>
                            <option>5</option>
                        </select>
                        Please State your nationality
                        <select name="select2">
                            <option>Ireland</option>
                        </select>
                    </form>
                    <p>
                        Feedback / Information
                    </p>
                </td>
            </tr>
        </table>
    </td>
</tr>
</table>
</body>
</html>
Appendix C – Code for the Academic Implementation of the Project

```html
<option>England</option>
<option>France</option>
<option>USA</option>
<option>Spain</option>
</select>

<p>Age Group
<select name="select3">
<option>0 -18</option>
<option>19-25</option>
<option>26 - 34</option>
<option>35 -59</option>
<option>60 - 75</option>
</select>
</p>
<br>
<hr size="1" width="60%">
<form align="center">
<br>
<input type="submit" name="Submit" value="Submit">
<input type="hidden" name="m_insert" value="true">
</form>
</td>
</tr>
</table>
</body>
</html>
```
Appendix C – Code for the Academic Implementation of the Project

<html>
<!--#include file="Connections/connKNP.asp" -->
<% set rsBooth = Server.CreateObject("ADODB.Recordset")
rsBooth.ActiveConnection = m_connKNP_STRING
rsBooth.Source = "SELECT * FROM tblBooth"
rsBooth.CursorType = 0
rsBooth.CursorLocation = 2
rsBooth.LockType = 3
rsBooth.Open()
rsBooth_numRows = 0
%>

' *** Recordset Stats, Move To Record, and Go To Record: declare stats variables

' set the record count
rsBooth_total = rsBooth.RecordCount

' set the number of rows displayed on this page
If (rsBooth_numRows < 0) Then
    rsBooth_numRows = rsBooth_total
Elseif (rsBooth_numRows = 0) Then
    rsBooth_numRows = 1
End If

' set the first and last displayed record
rsBooth_first = 1
rsBooth_last = rsBooth_first + rsBooth_numRows - 1

' if we have the correct record count, check the other stats
If (rsBooth_total <> -1) Then
    If (rsBooth_first > rsBooth_total) Then rsBooth_first = rsBooth_total
    If (rsBooth_last > rsBooth_total) Then rsBooth_last = rsBooth_total
    If (rsBooth_numRows > rsBooth_total) Then rsBooth_numRows = rsBooth_total
End If
%

Set m_rs = rsBooth
m_rsCount = rsBooth_total
m_size = rsBooth_numRows
m_uniqueCol = "BoothID"

%>

' *** Move To Record and Go To Record: declare variables

If (m_paramIsDefined And m_rsCount <> 0) Then
    param = Request.QueryString(m_paramName)
    If (param = m_uniqueCol) Then
        Set m_rs = Server.CreateObject("ADODB.Recordset")
        m_rsCount = rsBooth_total
        m_size = rsBooth_numRows
        m_uniqueCol = "BoothID"
        m_paramName = "boothid"
        m_offset = 0
        m_atTotal = false
        m_paramIsDefined = false
        If (m_paramIsDefined <> "") Then
            m_paramIsDefined = (Request.QueryString(m_paramName) <> "")
        End If
        %>
        ' *** Move To Specific Record: handle detail parameter
        If (m_paramIsDefined And m_rsCount <> 0) Then
            ' get the value of the parameter
            param = Request.QueryString(m_paramName)
            ' find the record with the unique column value equal to the parameter value
-C(x) -
AppendixC – Code for the Academic Implementation of the Project

m_offset = 0
Do While (Not m_rs.EOF)
    If (Cstr(m_rs.Fields.Item(m_uniqueCol).Value) = param) Then
        Exit Do
    End If
    m_offset = m_offset + 1
    m_rs.MoveNext
Loop

' if not found, set the number of records and reset the cursor
If (m_rs.EOF) Then
    If (m_rsCount < 0) Then m_rsCount = m_offset
    If (m_size < 0 Or m_size > m_offset) Then m_size = m_offset
    m_offset = 0
    ' reset the cursor to the beginning
    If (m_rs.CursorType > 0) Then
        m_rs.MoveFirst
    Else
        m_rs.Close
        m_rs.Open
    End If
End If
End If

%>
<%
' - -T c Ro;cord: i*
If (m_rsCount = -1) Then
    ' walk to the end of the display range for this page
    i = m_offset
    While (Not m_rs.EOF And (m_size < 0 Or i < m_offset + m_size))
        m_rs.MoveNext
        i = i + 1
    Wend

    ' if we walked off the end of the recordset, set m_rsCount and m_size
    If (m_rs.EOF) Then
        m_rsCount = i
        If (m_size < 0 Or m_size > m_rsCount) Then m_size = m_rsCount
    End If

    ' if we walked off the end, set the offset based on page size
    If (m_rs.EOF And Not m_paramIsDefined) Then
        If (m_offset > m_rsCount - m_size Or m_offset = -1) Then
            m_offset = m_rsCount - (m_rsCount Mod m_size)
        Else
            m_offset = m_rsCount - m_size
        End If
    End If
End If

    ' reset the cursor to the beginning
    If (m_rs.CursorType > 0) Then
        m_rs.MoveFirst
    Else
        m_rs.Requery
    End If

    ' move the cursor to the selected record
    i = 0
    While (Not m_rs.EOF And i < m_offset)
        m_rs.MoveNext
        i = i + 1
    Wend
End If

-C(xi) -
Appendix C – Code for the Academic Implementation of the Project

```vbscript
' *** Move To Record: update recordset stats
' set the first and last displayed record
rsBooth_first = m_offset + 1
rsBooth_last = m_offset + m_size
If (m_rsCount <> -1) Then
    If (rsBooth_first > m_rsCount) Then rsBooth_first = m_rsCount
    If (rsBooth_last > m_rsCount) Then rsBooth_last = m_rsCount
End If

' set the boolean used by hide region to check if we are on the last record
m_atTotal = (m_rsCount <> -1 And m_offset + m_size >= m_rsCount)

rsBooth.Close()
```

```html
<html>
<head>
<title>Untitled Document</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
</head>
<body bgcolor="#FFFFFF" text="#000000">
<p>%(rsBooth.Fields.Item("BoothName").Value)%></p>
<p>Location: %(rsBooth.Fields.Item("BoothLocation").Value)%</p>
</body>
</html>
```
Appendix C – Code for the Academic Implementation of the Project

```vbscript
<!DOCTYPE HTML>
<html>
<head>
    <title>Code for the Academic Implementation of the Project</title>
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
</head>
<body>
    <!-- Code here -->
    <pre>
        <![CDATA[
            <% LANGUAGE="VBSCRIPT" %>
            <!--#include file="Connections/connKNP.asp" -->
            <%
                set rsBooth = Server.CreateObject("ADODB.Recordset")
                rsBooth.ActiveConnection = m_connKNP_STRING
                rsBooth.Source = "SELECT * FROM tblBooth"
                rsBooth.CursorType = 0
                rsBooth.CursorLocation = 2
                rsBooth.LockType = 3
                rsBooth.Open()
                rsBooth_numRows = 0
            %>
            <%
            ’ *** Recordset Stats, Move To Record, and Go To Record: declare stats variables
            ’ set the record count
            rsBooth_total = rsBooth.RecordCount
            ’ set the number of rows displayed on this page
            If (rsBooth_numRows < 0) Then
                rsBooth_numRows = rsBooth_total
            Elseif (rsBooth_numRows = 0) Then
                rsBooth_numRows = 1
            End If
            ’ set the first and last displayed record
            rsBooth_first = 1
            rsBooth_last = rsBooth_first + rsBooth_numRows - 1
            ’ if we have the correct record count, check the other stats
            If (rsBooth_total <> -1) Then
                If (rsBooth_first > rsBooth_total) Then rsBooth_first = rsBooth_total
                If (rsBooth_last > rsBooth_total) Then rsBooth_last = rsBooth_total
                If (rsBooth_numRows > rsBooth_total) Then rsBooth_numRows = rsBooth_total
            End If
            %>
            <%
            ’ *** Move To Record and Go To Record: declare variables
            Set m_rs = rsBooth
            m_rsCount = rsBooth_total
            m_size = rsBooth_numRows
            m_uniqueCol = "BoothID"
            m_paramName = "boothid"
            m_offset = 0
            m_atTotal = false
            m_paramIsDefined = false
            If (m_paramName <> "") Then
                m_paramIsDefined = (Request.QueryString(m_paramName) <> ")
            End If
            %>
            <%
            ’ *** Move To Specific Record: handle detail parameter
            If (m_paramIsDefined And m_rsCount <> 0) Then
                ’ get the value of the parameter
                param = Request.QueryString(m_paramName)
                ’ find the record with the unique column value equal to the parameter value
                m_offset = 0
            %>
        ]]>
    </pre>
</body>
</html>
```
Do While (Not m_rs.EOF)
    If (CStr(m_rs.Fields.Item(m_uniqueCol).Value) = param) Then
        Exit Do
    End If
    m_offset = m_offset + 1
    m_rs.MoveNext
Loop

' if not found, set the number of records and reset the cursor
If (m_rs.EOF) Then
    If (m_rsCount < 0) Then m_rsCount = m_offset
    If (m_size < 0 Or m_size > m_offset) Then m_size = m_offset
    m_offset = 0
End If

' reset the cursor to the beginning
If (m_rs.CursorType > 0) Then
    m_rs.MoveFirst
Else
    m_rs.Close
    m_rs.Open
End If
End If

%>
<%
' *** Move To Records; if we dont know the record count, check the display range
If (m_rsCount = -1) Then

' walk to the end of the display range for this page
i = m_offset
While (Not m_rs.EOF And (m_size < 0 Or i < m_offset + m_size))
    m_rs.MoveNext
    i = i + 1
Wend

' if we walked off the end of the recordset, set m_rsCount and m_size
If (m_rs.EOF) Then
    m_rsCount = i
    If (m_size < 0 Or m_size > m_rsCount) Then m_size = m.rsCount
End If

' if we walked off the end, set the offset based on page size
If (m_rs.EOF And Not m_paramIsDefined) Then
    If (m_offset > m_rsCount - m_size Or m_offset = -1) Then
        If ((m.rsCount Mod m_size) > 0) Then
            m_offset = m_rsCount - (m.rsCount Mod m_size)
        Else
            m_offset = m_rsCount - m_size
        End If
    End If
End If

' reset the cursor to the beginning
If (m_rs.CursorType > 0) Then
    m_rs.MoveFirst
Else
    m_rs.Requery
End If

' move the cursor to the selected record
i = 0
While (Not m_rs.EOF And i < m_offset)
    m_rs.MoveNext
    i = i + 1
Wend
End If
%>
Appendix C – Code for the Academic Implementation of the Project

```<%  
' *** Move To Record: update recordset stats
  
' set the first and last displayed record
  rsBooth.first = m_offset + 1
  rsBooth.last = m_offset + m_size
  If (m_rsCount <> -1) Then
      If (rsBooth.first > m_rsCount) Then rsBooth.first = m_rsCount
      If (rsBooth.last > m_rsCount) Then rsBooth.last = m_rsCount
  End If

  ' set the boolean used by hide region to check if we are on the last record
  m_atTotal = (m_rsCount <> -1 And m_offset + m_size >= m_rsCount)
%>

<html>
<head>
<title>Untitled Document</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
</head>
<body bgcolor="#FFFFFF" text="#000000">
<p><%=rsBooth.Fields.Item("BoothName").Value%></p>
<p>Location: <%=rsBooth.Fields.Item("BoothLocation").Value%></p>
</body>
</html>
<% rsBooth.Close() %>`
Appendix C – Code for the Academic Implementation of the Project

```html
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd">

<html><head>
</head>

<body>

<% LANGUAGE="VBSCRIPT" %>
<!--#include file="Connections/connKNP.asp" -->

<% set rsbooth = Server.CreateObject("ADODB.Recordset") %>
rsbooth.ActiveConnection = m_connKNP_STRING
rsbooth.Source = "SELECT * FROM tblBooth"
rsbooth.CursorType = 0
rsbooth.CursorLocation = 2
rsbooth.LockType = 3
rsbooth.Open()
rsbooth.numRows = 0
%

Dim Repeat1__numRows
Repeat1__numRows = -1
Dim Repeat1__index
Repeat1__index = 0
rsbooth_numRows = rsbooth_numRows + Repeat1__numRows
%

' *** Go To Record and Move To Record: create strings for maintaining URL and Form parameters:

' create the list of parameters which should not be maintained
m_removeList = "&index=
If (m_paramName <> "") Then m_removeList = m_removeList & "&" & m_paramName & "="
m_keepURL="":m_keepForm="":m_keepBoth="":m_keepNone=""
' add the URL parameters to the m_keepURL string
For Each Item In Request.QueryString
    NextItem = "&" & Item & "="
    If (InStr(1,m_removeList,NextItem,1) = 0) Then
        m_keepURL = m_keepURL & NextItem & Server.URLencode(Request.QueryString(Item))
    End If
Next

' add the Form variables to the m_keepForm string
For Each Item In Request.Form
    NextItem = "&" & Item & "="
    If (InStr(1,m_removeList,NextItem,1) = 0) Then
        m_keepForm = m_keepForm & NextItem & Server.URLencode(Request.Form(Item))
    End If
Next

' create the Form + URL string and remove the initial '4' from each of the strings
m_keepBoth = m_keepURL & m_keepForm
if (m_keepBoth <> "") Then m_keepBoth = Right(m_keepBoth, Len(m_keepBoth) - 1)
if (m_keepURL <> "") Then m_keepURL = Right(m_keepURL, Len(m_keepURL) - 1)
if (m_keepForm <> "") Then m_keepForm = Right(m_keepForm, Len(m_keepForm) - 1)

' a utility function used for adding additional parameters to these strings
Function m_joinChar(firstItem)
    If (firstItem <> "") Then
        m_joinChar = "&"
    Else
        m_joinChar = ""
    End If
End Function
%>

</html>

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Appendix C – Code for the Academic Implementation of the Project

```html
<head>
<title>Untitled Document</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
</head>
<body bgcolor="#FFFFFF" text="#000000">
<table width="600" border="0" bordercolor="#0082FF" cellpadding="0" cellspacing="0">
  <tr>
    <td valign="top" colspan="2" bgcolor="#004891" height="22">
      <div align="left"><b><font color="#FFFFFF"><%=rsbooth.Fields.Item("BoothName").Value%>: </font></b>&nbsp;</div>
    </td>
  </tr>
  <tr>
    <td valign="top" width="429" height="100">
      <p><br>
      <%=Left((rsbooth.Fields.Item("Description").Value),320)%><font color="#0000FF">&nbsp; &nbsp; <a href="mainframenew.asp?m_keepNone &m_joinChar(m_k;eepNone) &"id=" & rsbooth.Fields.Item("BoothID").Value %>"><font color="#0000FF">[more...]</a></font></p>
      <p><font color="#0000FF"><br>
      <br>
      </font></p>
    </td>
    <td width="155"><img src="<%=rsbooth.Fields.Item("Picture1").Value%>" width="128" height="109" align="top"><br>
  </td>
  </tr>
  <%-
    Repeat1_index=Repeat1_index+1
    Repeat1_numRows=Repeat1_numRows-1
    rsbooth.MoveNext()
  %>
</table>
</body>
</html>
<rsbooth.Close()>
```
**Appendix C – Code for the Academic Implementation of the Project**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Forestry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>This page contains information on flora individual to each booth</td>
</tr>
<tr>
<td>Project:</td>
<td>MSc in Computing in Education</td>
</tr>
<tr>
<td>Date:</td>
<td>6th July 2001</td>
</tr>
<tr>
<td>Creator:</td>
<td>John Clifton</td>
</tr>
<tr>
<td>Notes:</td>
<td></td>
</tr>
</tbody>
</table>

```vbscript
<%@LANGUAGE="VBSCRIPT"%>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
<title>Untitled Document</title>
</head>
<body bgcolor="#FFFFFF" text="#000000">
<table width="100%" border="1">
<tr>
<td width="73%" height="12" valign="top">
<b>Forestry Name</b>
</td>
<td width="27%" height="12" valign="top">
<p align="center"><a href="pine6.mpeg"> </a><br>
<%= rsWildlife.Fields.Item("Image").Value %>
</p>
</td>
</tr>
</table>
</body>
</html>
```
Appendix C – Code for the Academic Implementation of the Project

```vbnet
<!--% @ LANGUAGE="VBSCRIPT" -->
<!—#include file="Connections/connKNP.asp" —>
<%
set rsBooth = Server.CreateObject("ADODB.Recordset")
rsBooth.ActiveConnection = m_connKNP_STRING
rsBooth.Source = "SELECT * FROM tblBooth"
rsBooth.CursorType = 0
rsBooth.CursorLocation = 2
rsBooth.LockType = 3
rsBooth.Open()
rsBooth_numRows = 0
%
' *** Recordset Stats, Move To Record, and Go To Record: declare stats variables

' set the record count
rsBooth_total = rsBooth.RecordCount

' set the number of rows displayed on this page
If (rsBooth_numRows < 0) Then
  rsBooth_numRows = rsBooth_total
Elseif (rsBooth_numRows = 0) Then
  rsBooth_numRows = 1
End If

' set the first and last displayed record
rsBooth_first = 1
rsBooth_last = rsBooth_first + rsBooth_numRows - 1

' if we have the correct record count, check the other stats
If (rsBooth_total <> -1) Then
  If (rsBooth_first > rsBooth_total) Then rsBooth_first = rsBooth_total
  If (rsBooth_last > rsBooth_total) Then rsBooth_last = rsBooth_total
  If (rsBooth_numRows > rsBooth_total) Then rsBooth_numRows = rsBooth_total
End If
%
' *** Move To Record and Go To Record: declare variables

Set m_rs = rsBooth
m_rsCount = rsBooth_total
m_size = rsBooth_numRows
m_uniqueCol = "BoothID"
m_paramName = "id"
m_offset = 0
m_atTotal = false
m_paramIsDefined = false
If (m_paramName <> "") Then
  m_paramIsDefined = (Request.Querystring(m_paramName) <> ")
End If
%
' *** Move To Specific Record: handle detail parameter

If (m_paramIsDefined And m_rsCount <> 0) Then

  ' get the value of the parameter
  param = Request.Querystring(m_paramName)

  ' find the record with the unique column value equal to the parameter value
```
Appendix C – Code for the Academic Implementation of the Project

m_offset = 0
Do While (Not m_rs.EOF)
    If (Cstr(m_rs.Fields.Item(m_uniqueCol).Value) = param) Then
        Exit Do
    End If
    m_offset = m_offset + 1
    m_rs.MoveNext
Loop

' if not found, set the number of records and reset the cursor
If (m_rs.EOF) Then
    If (m_rsCount < 0) Then m_rsCount = m_offset
    If (m_size < 0 Or m_size > m_offset) Then m_size = m_offset
    m_offset = 0
End If
End If

' reset the cursor to the beginning
If (m_rs.CursorType > 0) Then
    m_rs.MoveFirst
Else
    m_rs.Close
    m_rs.Open
End If
End If

' if we don't know the record count, check the display range
If (m_rsCount = -1) Then
    i = m_offset
    While (Not m_rs.EOF And (m_size < 0 Or i < m_offset + m_size))
        m_rs.MoveNext
        i = i + 1
    Wend
End If

' if we walked off the end of the records set, set m_rsCount and m_size
If (m_rs.EOF) Then
    m_rsCount = i
    If (m_size < 0 Or m_size > m_rsCount) Then m_size = m_rsCount
End If

' if we walked off the end, set the offset based on page size
If (m_rs.EOF And Not m_paramIsDefined) Then
    If (m_offset > m_rsCount - m_size Or m_offset = -1) Then
        If ((m_rsCount Mod m_size) > 0) Then
            m_offset = m_rsCount - (m_rsCount Mod m_size)
        Else
            m_offset = m_rsCount - m_size
        End If
    End If
End If

' reset the cursor to the beginning
If (m_rs.CursorType > 0) Then
    m_rs.MoveFirst
Else
    m_rs.Requery
End If

' move the cursor to the selected record
i = 0
While (Not m_rs.EOF And i < m_offset)
    m_rs.MoveNext
    i = i + 1
Wend
End If

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AppendixC – Code for the Academic Implementation of the Project

```sql
--
' set the first and last displayed record
rsBooth_first = m_offset + 1
rsBooth_last = m_offset + m_size
If (m_rsCount <> -1) Then
  If (rsBooth_first > m_rsCount) Then rsBooth_first = m_rsCount
  If (rsBooth_last > m_rsCount) Then rsBooth_last = m_rsCount
End If

// Modified from code taken with thanks and with consent from www.DynamicDrive.com
<script language="JavaScript1.2"> var scrollerwidth=300 var scrollerheight=25 var scrollerbgcolor='#D3D37E' //set below to '' if you don't wish to use a background image var scrollerbackground='' var messages=new Array() messages[0]='<font face='Arial' font size='1' href= 'http://localhost/park' class= 'LINKNEW'>Park closing at 5PM</a>' messages[1]='<font face='Arial' font size='1' href= 'http://localhost/park' class= 'LINKNEW'>KNP</a>'
if (messages.length>1) i=2 else i=0
function move1(whichlayer){ tlayer=eval(whichlayer) if (tlayer.top>0&&tlayer.top<5){ tlayer.top=0 setTimeout("move1(tlayer)",3000) setTimeout("move2(document.main.document.second)",3000) return 1 } if (tlayer.top=tlayer.document.height*-1){ tlayer.top=-5 setTimeout("move1(tlayer)",100) }
```
Appendix C – Code for the Academic Implementation of the Project

```javascript
else {
  tlayer.top = scrollerheight
  tlayer.document.write(messages[i])
  tlayer.document.close()
  if (i == messages.length - 1)
    i = 0
  else
    i++
}

function move2(whichlayer) {
  tlayer2 = eval(whichlayer)
  if (tlayer2.top > 0 & tlayer2.top <= 5) {
    tlayer2.top = 0
    setTimeout("move2(tlayer2)", 3000)
    setTimeout("move1(document.main.document.first)", 3000)
    return
  } else {
    tlayer2.top = scrollerheight
    tlayer2.document.write(messages[i])
    tlayer2.document.close()
    if (i == messages.length - 1)
      i = 0
    else
      i++
  }
}

function move3(whichdiv) {
  tdiv = eval(whichdiv)
  if (tdiv.style.pixelTop > 0 & tdiv.style.pixelTop <= 5) {
    tdiv.style.pixelTop = 0
    setTimeout("move3(tdiv)", 3000)
    setTimeout("move4(second2)", 3000)
    return
  } else {
    tdiv.style.pixelTop = scrollerheight
    tdiv.innerHTML = messages[i]
    if (i == messages.length - 1)
      i = 0
    else
      i++
  }
}

function move4(whichdiv) {
  tdiv2 = eval(whichdiv)
  if (tdiv2.style.pixelTop > 0 & tdiv2.style.pixelTop <= 5) {
    tdiv2.style.pixelTop = 0
    setTimeout("move4(tdiv2)", 3000)
    setTimeout("move3(first2)", 3000)
    return
  } else {
    tdiv2.style.pixelTop = scrollerheight
    tdiv2.innerHTML = messages[i]
    if (i == messages.length - 1)
      i = 0
    else
      i++
  }
```

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Appendix C – Code for the Academic Implementation of the Project

tdiv2.style.pixelTop = scrollervheight
tdiv2.innerHTML = messages[i]
if (i == messages.length - 1)
i = 0
else
i++
}
}

function startscroll(){
if (document.all){
move1(first2)
second2.style.top = scrollervheight
second2.style.visibility = 'visible'
}
else if (document.layers){
document.main.visibility = 'show'
move1(document.main.document.first)
document.main.document.second.top = scrollervheight + 5
document.main.document.second.visibility = 'show'
}
}

window.onload = startscroll

</script>

</table>

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Appendix C – Code for the Academic Implementation of the Project

<!-
Name: parkmap
Description: This is the park map with linked zone information on map
Project: MSc in Computing in Education
Date: 6th July 2001
Creator: John Clifton
Notes: This is the park map with linked zone information on map

<html>
<head>
<title>Untitled Document</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
</head>

<body bgcolor="#FFFFFF" text="#000000" leftmargin="0" topmargin="0">
<table width="97%" border="0" cellspacing="4">
<tr>
<td><img src="lakes2.jpg" width="622" height="475" border="1" usemap="#Map"></td>
</tr>
</table>
<map name="Map">
  <area shape="rect" coords="338, 301, 552, 398" href="mainframnew.asp?id=1002" target="_top">
  <area shape="rect" coords="438, 201, 452, 498" href="mainframnew.asp?id=1003" target="_top">
  <area shape="rect" coords="138, 101, 352, 198" href="mainframnew.asp?id=1004" target="_top"></map>
</body>
</html>
APPENDIX D

Installation of Windows 2000 Server with IIS 5
D – INSTALLATION STEPS For WINDOWS 2000 SERVER

Requirements:

A network server requires high specifications.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>333 Mhz Pentium II processor</td>
</tr>
<tr>
<td>RAM</td>
<td>256 MB</td>
</tr>
<tr>
<td>Hard Disk</td>
<td>6 GB</td>
</tr>
<tr>
<td>Drives</td>
<td>CD-ROM - if not installing across a network</td>
</tr>
</tbody>
</table>

Background

In order to accomplish the practical Implementation Phase of my project I had to learn the steps involved in both installing Windows 2000 Server and configuring IIS service to run on top of Windows 2000 Server. This was necessary for the execution of my ASP pages.

Step 1

Turn on the Server Machine
Place **WINDOWS 2000 SERVER CD** in CD Drive.
Press any key to boot from CD.
Press the Enter key to set up **WINDOWS 2000 SERVER**.
Accept the Licensing Agreement.

Step 2

Partition Information Next
To create a Partition Press C
We created a 5 GB partition.
Press the Enter key to format partition

Step 3

Prompted to choose the file system to format the partition.
Using NTFS (New Technology File System) or FAT (File Allocation System)
Choose NTFS for security and performance reasons. (IIS requires NTFS security to function correctly for authentication and security.)
Press the Enter key – The **WINDOWS 2000** installer starts to format.
Status bar prompts that set up is formatting.
Set up copies installation files to the hard drive and displays status.
Appendix D – Installation of Windows 2000 Server with IIS 5

Step 4
Prompted to press the Enter key to reboot the machine.
Remove the WINDOWS 2000 SERVER CD from CD Drive. Then, once the boot up sequence advances past the boot up stage and reads from the hard drive, place the CD in the disk drive and press the Enter key.

Step 5
Personalising Your Software:

Name: xxx  
Organisation: xxx  
Licencing Mode: • per server (20)  
Computer Name: (less than 9 characters) MUCKROSS

Administrator Password: (Leave the Administrator Password field blank until the machine set up phase because installing software requires many reboots and you would have to type in the password each time software is installed.)

Step 6
Select WINDOWS 2000 SERVER Components

Choose
→ Accessories and Utilities (all)
→ Cluster Service (all)
→ Internet Information Services-IIS (all)
→ Management and Monitoring Tools (all)
→ Message Queuing Service (all)
→ Networking Services (all)
→ Window Media Services (all)

Click Next
Time Zone: Choose GMT
Click Next
Set up installs the selected Components

Step 7
Networking Settings: Select Custom Settings
Click Next

Networking Components
I chose

→ Client for Microsoft Networks
→ File and Print Sharing for Microsoft Networks
→ Internet Protocol TCP/IP

Highlight the Internet Protocol and click on the Properties button.

Use the following:

- IP Address: 10.43.2.99 (e.g.)
- Subnet mask: 255.0.0.0
- Default gateway: 10.43.1.25

Click Next

Step 8
Workgroup or Computer Domain
Choose Workgroup for the moment as the Domain will be configured later in WINDOWS 2000 SERVER

Click Next

Displays: Installing Components with a status bar.

Step 9
Performing Final Tasks

→ Installs Start Menu Items
→ Registers Components
→ Saves Settings
→ Removes any temporary files used.

Step 10
Completing the WINDOWS 2000 set up wizard.

You are prompted to remove the WINDOWS 2000 CD
Remove the CD.
Click on the Finish button to restart your computer.
## D 1 – Configuration Steps for IIS 5

### Step 1
From the Start Menu:
Start > Programs > Administrative Tools > Internet Services Manager

### Step 2
Web Site Creation
Right click on Machine Name: name > new > web site.
When the Web site Creation Wizard is displayed click on the Next button.
- Type description of web Site: Killarney National Park
- Give the IP Address of the Site: 10.43.2.99
- Port 80 is the Default for HTTP
- Host header for this Web site: www.KillarneyNationalPark.com
- Web Site Home Directory Path: c:\knp

Click Next

### Step 3
Web Site Access Permissions

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>Read (Allows users to read Web page)</td>
</tr>
<tr>
<td>✓</td>
<td>Run Scripts (Allows ASP to work)</td>
</tr>
<tr>
<td>⚠</td>
<td>Execute (Allows Common Gateway Interface CGI to work)</td>
</tr>
<tr>
<td>⚠</td>
<td>Write (Allows users to write to Web Server)</td>
</tr>
<tr>
<td>⚠</td>
<td>Browse (Allows users to browse directories)</td>
</tr>
</tbody>
</table>

Note: The above permissions were chosen as they facilitate the functionality of the methodologies used in the implementation the project while minimising exposure to security vulnerabilities. Since the implementation of the project relies primarily on ASP technology rather than CGI scripting the author chose to deny access to the execute permission and instead allow access to the runs script permission. Permissions on access rights to individual files are set using New Technology File System (NTFS) and will be left to the discretion of the author of the files.

IIS is now prepared to host the WebPages. All that remains to be done is for the WebPages to be uploaded to the specified location of the Home Directory Path.
APPENDIX E

Installation and Configuration
of Microsoft SQL Server 7.0
Appendix E – Installation and Configuration of Microsoft SQL Server 7.0

E – Installation and Configuration of Microsoft SQL Server 7.0

Step 1
Log on to the server as administrator and set up an account for SQL Server. The account will take the form of
Username SQLService
Password xxxxxxxxxx
This account will be a member of the group Domain Users as well as being given local administrative rights.

Step 2
Insert the SQL Server compact disk. When the SQL dialog box appears click on install SQL 7 Components.

Step 3
Click Database Server Standard Edition.

Step 4
Next the installation wizard appears and SQL Server’s installation is completed using the following information:

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Method</td>
<td>Local Install</td>
</tr>
<tr>
<td>Licence Agreement</td>
<td>I accept</td>
</tr>
<tr>
<td>Name</td>
<td>KNP</td>
</tr>
<tr>
<td>Company</td>
<td>Duchas</td>
</tr>
<tr>
<td>Setup Type</td>
<td>Custom</td>
</tr>
<tr>
<td>Program Files</td>
<td>Default</td>
</tr>
<tr>
<td>Data Files</td>
<td>\Data_Svr$\SQLDATA\</td>
</tr>
<tr>
<td>Components and Sub-components</td>
<td>Accept Default</td>
</tr>
<tr>
<td>Character Set</td>
<td>1252/ISO Character Set</td>
</tr>
<tr>
<td>Sort Order</td>
<td>Dictionary Order Case Sensitive</td>
</tr>
<tr>
<td>Unicode Collation</td>
<td>General Unicode</td>
</tr>
<tr>
<td>Network Libraries</td>
<td>Named Pipes, TCP/IP Sockets, Multiprotocol</td>
</tr>
<tr>
<td>SQL Server Service Account</td>
<td>Same for each and auto Start Services</td>
</tr>
<tr>
<td>Service Settings</td>
<td>Domain User Account</td>
</tr>
<tr>
<td>Username</td>
<td>SQLService</td>
</tr>
<tr>
<td>Domain</td>
<td>KNP_Domain</td>
</tr>
<tr>
<td>Password</td>
<td>xxxxxxxxxx</td>
</tr>
<tr>
<td>Licencing Mode</td>
<td>Per Server(Plus Internet)</td>
</tr>
<tr>
<td>Number of Licences</td>
<td>20</td>
</tr>
</tbody>
</table>

Note: When installing SQL Server it is important that one chooses the correct values for the environment as posthumously changing such values as character sets requires SQL Server to be reinstalled. A Restart of the Computer for SQL Server to function correctly is required.
APPENDIX F

Wireless Bridge Configuration
F - WIRELESS BRIDGE CONFIGURATION

Frequency Hopping Spread Spectrum (FHSS) Wireless Technology

Academic Solution

The licence free Industrial, Scientific and Medical (ISM) band ranges from 2.4 GHz to 2.4835 GHz (83.5 MHz). For FHSS systems, IEEE 802.11 defines 79 different hops for the carrier frequency. Using these 79 frequencies, IEEE 802.11 defines 78 hopping sequences (each with 79 hops) grouped in three sets of 26 sequences each (Hopping Sequence). In the nomenclature these three sets are known as Hopping Set 1, 2 and 3 respectively.

![Frequency Hopping Spread Spectrum](image)

Fig 1 Frequency Hopping Spread Spectrum

Hardware Requirements

Client Server Requirements
PC (A) Configured as a Server
PC (B) Configured as a Client/Kiosk

Wireless Hardware
1* Access Point (AP 10d)
1* Wireless Bridge (WB 10d) (or alternatively an SA10 or an SA40)

Antennae
4* Omni-directional Internal dBi Antennae (two for each of the above units)
**Network Cards**
3COM 10/100 PCI Ethernet cards

**Configuration Cable**
Breezecom Terminal Emulation Lead for use with Windows HyperTerminal.

**Cross Over Patch Leads**
2* Standard Cat 5 Drop Leads terminating with RJ45 connections for use with BreezeNET PRO.11 Configuration Software.

**Software Requirements**
One may choose Windows HyperTerminal or BreezeNET PRO.11 Configuration Software to configure the wireless units. Windows HyperTerminal is command line based whereas BreezeNET PRO.11 Configuration Software ([available from http://www.breezecom.net](http://www.breezecom.net)) is Windows based and is thereby more user-friendly to configure. The author chose BreezeNET PRO.11 Configuration Software as it allows one to monitor the wireless link/s and to check and easily amend the configuration if the need arises.

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**F1 - Access Point (AP 10d) Configuration**

**Step 1 - Install BreezeNET PRO.11 Configuration Software**
Install BreezeNET PRO.11 Configuration Software on PC to allow one to configure AP.

**Step 2 - Set MAC Address / IP Address**
This step sets the MAC Address and the IP address and other IP parameters of the AP. The MAC Address is available from the back of the unit or can be obtained using HyperTerminal. The IP address is within the range of IP addresses used by the KNP network.

<table>
<thead>
<tr>
<th>MAC Address</th>
<th>00-20-D6-01-Fd-69</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP Address</td>
<td>10.43.2.11</td>
</tr>
<tr>
<td>Subnet Mask</td>
<td>255.0.0.0</td>
</tr>
</tbody>
</table>

Click **OK**

Ping IP Address of unit i.e.10.43.2.11 to check if it accepts that address.
**Step 3 - Set location of Unit**
The location of the unit is an optional field in the set-up process. It is there purely to aid administrators in identifying the AP for maintenance purposes.

| Set Location of Unit | Muckross |

**Step 4 - Wireless LAN Parameters**
The Hopping Set/Sequence parameters consist of 3 Hop Sets, each of which is made up of 26 sequences. These can only be set from an AP and not from a Wireless Bridge. The ESSID which stands for Extended Service Set Identification is the most important parameter in the set-up. It is important that both the AP and the WB use the same ESSID for the devices to communicate successfully. The Transmit Diversity exists to use either the left or right antenna or as in the case of this project both antennas. The mobility setting is used where mobile devices are used to roam between Access Points. The Load Sharing setting is used to distribute traffic in equal proportions in high volume areas where more than one Access Point may be used.

| Hopping Set | 3 (The 3 in this case refers to the 3rd Hopping Set) |
| Hopping Sequence | 5 (The 5 refers to the 5th of the 26 Hopping Sequences in the 3rd Hopping Set) |
| ESSID | KNPSets1 (KNPSets1 is the Proprietary name of the link i.e. the Link ID and is Case Sensitive) |
| Maximum Data Rate | 3 (FHSP delivers a 3Mbps radio link) |
| Transmit Diversity | Both Antennas (Two Omni-directional Internal dBi Antennae are being used on this AP) |
| Mobility | Stationary (The devices in this case are stationary and are not roaming) |
| Load Sharing | Off (The Link is a Point to Point connection and is not being shared) |

Click **Apply** to reset the AP 10d’s factory default settings and to accept out new settings.
### F2 - Wireless Bridge (WB 10d) Configuration

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Use the above PC with the BreezeNET PRO.11 Configuration Software already installed to configure the WB.</th>
</tr>
</thead>
</table>
| Step 2 | **Set MAC Address / IP Address**  
MAC Address: 00-20-D6-04-A5-46 (available from back of unit)  
IP Address: 10.43.2.10  
Subnet Mask: 255.0.0.0  
Click OK  
Ping IP Address of unit i.e. 10.43.2.10 to check if it accepts that address. |
| Step 3 | **Set location of Unit** Knockreer (Identifies the location of the WB10d) |
| Step 4 | **Wireless LAN Parameters**  
The AP 10d issues its *Hopping Set* and the *Hopping Sequence* to the WB10d.  
**ESSID**  
KNPSet1 (KNPSet1 is the Proprietary name of the link. It is important that both the AP and the WB use the same ESSID)  
**Maximum Data Rate**  
3 (FHSP delivers a 3Mbps radio link)  
**Transmit Diversity**  
Both Antennas (Two Omni-directional Internal dBi Antennae are being used on this AP)  
**Mobility**  
Stationary (The devices in this case are stationary and are not roaming) |
Load Sharing  

Off  
(The Link is a Point to Point connection and is not being shared)

Click Apply to reset the WB10d’s factory default settings and to accept our new settings.

Connection Verification
Both Units then reset and the green light illuminates the WL NK indicator on the WB to indicate that a wireless link is established.

A Received Signal Strength Indicator (RSSI) dialog box which measures the strength of the radio signal received at the WB is displayed (not at the AP as it is the AP that transmits the signal). An RSSI showing a rate of minus 80 dBm to zero indicates a perfect 3Mbps-radio Frequency Hopping Spread Spectrum link.