ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHHOL OF INFORMATION STUDIES FOR AFRICA

INFORMATION RESOURCE SHARING AT ILRI: THE POTENTIAL FOR INTRANET SOLUTION

A Thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Information Science

By Shimelis Getu Assefa

June, 1998

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INFORMATION RESOURCE SHARING AT THE INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE (ILRI): THE POTENTIAL FOR INTRANET SOLUTION

By

Shimeles Getu Assefa

Name and Signature of Members of the Examining Board

Ato Getachew Birru, Chairman, Examining Board

Dr. Lishan Adam, Advisor

Ato Tamrat Bayle, Advisor

Dr. J. Furner, External Examiner

DEDICATION

This thesis is dedicated to the late brother,

Wondowossen Getu, who's living, had been a source of strength for me.

ACKNOWLEDGEMENT

There are many people behind the production of this thesis who deserve mention.

First and foremost, I would like to thank the ILRI staff and management for all kinds of support they extended. My special gratitude must go to Ato Abraham Bekele, head of Computer Services and Mr. Paul Neate, head of publications, who were interfacing my study from ILRI side. They were always very enthusiastic to answer all of my questions. Trying to keep the list reasonably short, I may forget someone whose assistance had been wonderful and therefore I would like to thank all of the staff in the computer services, Library/Information services, training, and publications.

A special thanks goes out to Dr. Lishan Adam, thesis advisor, for his enthusiastic and ongoing advice for improvement to better shape the thesis report since the beginning. Despite his tight time, his quick and constructive remarks were very helpful to complete the thesis report as it appears now. Thanks also go out to Ato Tamrat Bayle, my thesis co-advisor for his useful suggestions to work within the scope of this study.

There are also many people who deserve to make the shortlist. I am especially indebted to Ato Gebreselassie Gebre Ananya and Dr. Dawit Bekele for their quick 'Yes' to provide me their valuable Windows NT advanced server software. I would also like to thank Ato Azene Zenebe, my colleague in office, who was passionate to extend support.

I do not want also to escape this opportunity without saying thank you to the staff of SISA. Special gratitude is extended to Ato Tesfaye Birru and Ato Sissay Fisseha who were exemplary to impart insightful thoughts during my stay in the school.

Last, but not least, I would like to thank my families who were always behind my success. I would also like to thank the multitude of friends and relatives for their consistent concern to me.

ABSTRACT

It is a well thought idea that the present day electronic information communication has recreated the world anew. Though different historical routes can be traced to arrive at today's information communication and exchange, no single achievement equals the Internet and WWW for global communication and information sharing to reach the stage of development we are experiencing today. Recently, organizations confronted with complexity, upward scaling, competitive environment, have started to adopt Internet-Web technology as an efficient mechanism to manage and share their information resources.

With this view, this thesis is an attempt to improve ILRI's information resource sharing system by way of Intranet solutions. ILRI has experienced organizational complexity and upward scaling over the past recent years. A research institute with African coverage has now transformed itself into an international institute with a scope spanning the whole of the developing world. Given ILRI's existing set up, the work reported in this study investigated the information resource-sharing infrastructure at ILRI, based in Addis Ababa, Ethiopia.

Considering the fact that Intranet solution requires an investigation of content, network infrastructure, and access, this work has first reviewed ILRI's available resources in these lines. The outcomes of the survey work were reported along with identified problems and requirements. Based on existing information and network infrastructure and based on the needs and requirements identified through the survey work, attempt was made to design the kind of Intranet solution that can address the contemplated need. The design focused on reengineering existing

information and network infrastructure to fit into the Intranet solution. Where changes are required and what the changes involve is discussed.

In an attempt to demonstrate the potential use of Intranet solution, specific applications were selected to develop the prototype. Static and dynamic web publishing through the web was demonstrated. The prototype development was based on Windows NT advanced server software 4.0 platform, Microsoft client for TCP/IP, Internet Information Server (IIS), Microsoft Internet Server Application Program Interface (ISAPI), dbf and access (mdb) ODBC drivers, visual basic programming, JavaScript, Active Server Pages, Internet Database Connection (IDC) files and HTML extension (htx files), Microsoft FrontPage, HoTMetaL PRO, HTML, and SunWEB Intranet design method.

Finally, implementation plans and how to proceed issues were discussed. Conclusion and recommendation were also made to synthesize the whole exercise attempted in this study and to suggest what needs to be done for Intranet deployment in ILRI as well as further research area along similar lines.

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CHAPTER I

INTRODUCTION

1.1 Background to the Research Problem

Organizations have long recognized the importance of information in facilitating their activities to achieve their goals. Because of the strategic value of information to organizations, different kinds of information systems have been built over time in organizations. Some examples include financial information systems, materials management systems, management information systems, executive information systems, research information systems, etc.

Information systems are the backbone of organizational knowledge base. The activities of organizations can be described in terms of the associated information contained. Each segment of activity is integrated and coordinated within the organization through the information exchanged. If different entities make decisions based on different knowledge base, it is hard to obtain a unified image of the organization and at the same time it is unlikely to attain organizational goal. Organizations have used different techniques to share their knowledge base. Conventionally, the main technique used has been dependent on paper based delivery, such as inter-office memos, forms, newsletters, policy guidelines, procedure manuals, posters, brochures, leaflets, and through departmental meetings. Following the advent of Local Area Networks, organizations began to exchange electronic mails, send files or download files, share folders, and maintain a bulletin board service and share information.

Recently, implementation of Internet and Web technologies in organizations information systems

have been discovered as an effective way of sharing organizations knowledge base. Organizations that had LAN or WAN infrastructure then began to upgrade their network communication service to Internet standard. This again prompted the conversion of data into Web format. The application of Internet-Web technology as institution wide information delivery has also spurred the development of Internet based information system for the internal work force (now widely known as Intranet). ***Intranet*** is an Internet technology applied within an organization. The study outlined below focuses on potential use of Intranet technology in institutions in developing countries using a case study of the International livestock Research Institute (ILRI).

1.2 Statement of the Problem

The study emerged from a need for distribution of information to researchers and scientists at ILRI. The staffs of ILRI and various research teams are distributed all over the world and generate enormous amount of information to be shared among their colleagues and worldwide. ILRI's one of the three programs, SPAN, has produced a document entitled "Strategy and Programs for ILRI Information Resources: 1998-2010." In this document it was indicated that ILRI is planning to develop a strong information service, that can become a knowledge broker that matters, the first choice for people wanting information on animal agriculture in developing countries.

In addition the document stated the fact that priorities for the delivery of its services and products will be the intramural users of ILRI. In this strategy and program document for ILRI information services, it was clearly stated how the information service is to be set up and headed. The following paragraphs are extracted from this document:

"ILRI will move to Internet publishing, adopting a system to distribute

(electronically) and publish (by the end user), rather than the existing process of publish and distribute using hard copies. A set of outline policies is provided for the free distribution of publications and information services to some, and sale to others"

The document further proposed:

"... high quality knowledge broker for intra- and extramural users within the specific domain of animal agriculture"

"... develop and mount ILRI databases on the Internet"

"... create a virtual global information service for animal agriculture"

"... the use of Internet related technologies to empower internal and external users to better utilize in-house and external databases, sources and systems".

During the last two years ILRI's operational activities has doubled. For example there were over 45 projects in 1997 compared to 20 in 1996 (table 1-2).

Table 1-1

ILRI's Project activities in the years 1996 & 1997

Program Area	Number of main Projects and Activities	
	1996	1997
Conservation of Biodiversity	4	2
Production Systems Research	5	20
Utilization of tropical feed resources	2	5
Animal Health Improvement	3	7
Livestock Policy Analysis	3	5
Strengthening collaboration with NARS	3	6
Total	20	45

However, the infrastructure to deliver information has not been improved. Although new interest has been expressed by the management and the staff at ILRI to share data and improve collaboration, the technological and organizational infrastructure that can bring the desired need has not been established.

Scientific collaboration among ILRI researchers and others worldwide has also been growing during the last two years. Several projects being implemented by ILRI involve scientific

networks, users, national agricultural systems and research institutions.

The need for sharing information for scientific collaboration is thus obvious. In addition to the increasing growth of activities, ILRI has developed over the past 24-year's of its existence, a strong base of scientific collaboration. Under the three main programs operating, there are several projects running simultaneously and there is a great interdependence of activities within programs and between programs. The following table illustrates the three main programs and involved projects within the programs along with collaborators and beneficiaries to whom the end product will be delivered.

Table 1-2

Program & Project Activities by type of collaboration

Program Area	Project Areas	Collaborators & Product delivery
Bioscientific Research	Ruminant Feed, Genetics, & Health	ILRI partners, NARS partners, scientific networks; system linkages & users
Sustainable production Systems	Farming Systems, Ecology, & Socio-economics	ILRI partners, NARS partners, ARI partners, scientific networks, Outsourcing, & users
SPAN	Capacity development for strengthening NARS	List of Collaborators & Product delivery are shown below[1]

The amount of information produced at ILRI has been also growing rapidly necessitating

1

- ILRI partners: ILRI research programs
- NARS partners: developing country universities, information services & libraries, livestock research institutes; NARS scientists & NGOs including CARE international, dairy Goat Project (GTE, Kenya), Farm Africa, Organic manure management network, World vision; ASARECA; SACCAR; CORAF
- ARI partners: developed country universities & relevant research/training institutes & networks; CABI; FAO
- Scientific networks: international information networks & livestock research networks
- System linkgaes: CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, IRRI, IPGRI, ISNAR, WARDA, ICTP, ITC, CIRDES, ICIPE; ecoregional & system-wide programs
- Outsourcing: LARD, Lesotho; MARTS, Malawi; MAC, Swaziland; Ministry of Agriculture, Tanzania; MAFF, Zambia; University of Zimbabwe; IAR & AUA, Ethiopia
- Users: NARS, other CGIAR centers and ILRI research programs.

effective management and new ways of sharing it. During the last two years, scientific papers and databases were growing rapidly. For example 6 annual reports and 205 papers were produced in 1997 compared to 5 annual reports and 125 papers in 1996 (table 1-3). The total number of bibliographic records of ILRI's information services is over 109,000 in 1997 (table 1-4).

The study was thus designed to:

- Investigate the type of Intranet solution that can be best matched with the existing system
- Examine the adequacy of the existing infrastructure for ILRI information resource sharing need
- Investigate the degree of data redundancy
- Determine the type of Intranet design alternative that satisfies ILRI's requirement
- Demonstrate the essential features of Intranet solution to ILRI context

The implication of such complex activities is reflected on the amount of information generated as a by-product and the number of stakeholders who need to share these products. The study was designed to identify adequate infrastructure and mechanism to allow all parties share their knowledge. The tables below show the amount of information generated and the number of database records maintained.

Table 1-3

Publications produced by ILRI staff in the year 1996 & 1997

TYPE OF PUBLICATION	QUANTITY PRODUCED 1996	1997
Annual reports	5	6
Newsletters	3	8
Project protocols & funding requests	2	6
Manuals	2	7
Training modules	1	-
Glossary	1	-
Proceedings	3	18
Papers in peer reviewed journals	75	125
Books and chapters from books	3	2
Papers in proceedings	50	80
Program documents	6	8

The following table describes the types and number of databases created and maintained by the information services only.

Table 1-4

Databases maintained by ILRI information services (as of June 1997)

Name of databases	Description	Number or records contained
Bibliographic database	An in-house database of library holdings	109,000
Time-series database	A database of statistical information on livestock production & trade 7 human population	406,587
Publications database	A database of ILRI publications	4391
Reprint database	A collection of reprints relevant to ILRI programs from journals the library does not subscribe to	4963
Institutional database	Global database of libraries 7 information systems for animal agriculture	280
Mailing database	A database of addresses' for product & service delivery worldwide	1500

After reviewing the large volume of ILRI's activities and the information output thereby, this thesis argues that the existing client server LAN infrastructure does not support the information

sharing need of ILRI. ILRI in its present shape where its workgroups are distributed throughout the world, the type of information system that needs to build should be the one that fulfills the information resource sharing need.

1.3 Justification

A review of experiences in other parts of the world reveals now organizations have recognized the Internet-Web technology as a great way to share information internally. ILRI has also recognized such a need as it is indicated in its document titled "Strategy and Programs for ILRI Information Resources: 1998-2010." By establishing Intranet, ILRI could attain the following benefits.

- **Easy deployment**: the Intranet solution requires as one of its core component a LAN or WAN infrastructure to be in place and ILRI can easily deploy the Intranet implementation over its LAN.
- **Cost**: Intranet is a low cost solution because for a small to medium range applications, many of the server programs and development tools are freely available on the Internet (MATTHEW & STONES: 1996)
- **Collaboration:** ILRI's workgroups are distributed throughout the world and there is a strong scientific collaboration and Intranet is a viable solution for such kind of organizational set up
- **Improvement:** the amount of information generated and the number of dispersed databases available in ILRI can be made easily accessible institution-wide through the Intranet solution by providing a single access point
- **Facilitates cooperation and partnership:** ILRI has a close work relationship with 16 CGIAR centers and its partnership network with national agricultural systems can be supported by the Intranet implementation.

- **International participation:** ILRI can gain full participation in the global network of agricultural information system when it links its Intranet site to the Internet.

1.4 Objective

1.4.1 General

The main objective of this study is to approach the prevailing information resource sharing need at ILRI with Intranet tools, techniques and software. The study reviews organizational information flow (process), geographical distribution of workgroups, and nature of collaboration to re-engineer the traditional publishing and paper based information delivery to a Web based information delivery. The study also examines the current network infrastructure in order to propose the most up-to-date and optimum solution for collaboration, resource sharing and global networking at ILRI.

1.4.2 Specific

- Review the superstructure of ILRI as it relates to its programs, projects and activities
- Review available digitized information resources within ILRI
- Review existing LAN infrastructure in light of Internet standard network communication service
- Survey the information resource sharing requirement within ILRI
- Examine suggested approaches and experiences elsewhere regarding Intranet design
- Determine the type of applications, services, or protocols which could be considered for implementation
- Design a prototype to demonstrate how Web pages and databases can be accessed through an internal Web server presence on the network (LAN)
- Develop a logical map of the Intranet solution deployment

1.5 Significance of the Study

ILRI has shown interest over the past 2 years to exploit the Internet Web technology for the information services it provides to its intramural users as a top priority. When this research proposal was presented, the ILRI management and the SPAN program director, (one of the three programs in ILRI whose activity ranges from publishing, training, information services to collaborative efforts with national agricultural systems) had expressed their agreement.

This study can, therefore, play a role in the institute's strategic initiative to put the Internet-Web technology at the heart of its information services. Intranet solution can be very incremental, it can be started small and scaled high later depending on the need. Therefore, the output of this study can serve as a basis for institution-wide Intranet deployment at a later stage.

Intranet solution for organizational information resource sharing is a recent discovery and it is particularly a new experience for Ethiopia. Therefore, this study would serve as a foundation for organizations and institutions planning to build Intranet technology.

1.6 Background to the Research Environment

1.6.1 Establishment

International Livestock Research Institute (ILRI) was established in 1974 under the name of International Livestock Center for Africa (ILCA). The center had a Head Quarter office in Addis Ababa, Ethiopia before it is renamed as ILRI and transferred to Nairobi in 1995, with a wide global mandate. Its research sites are located in highland and semi-arid zones of Ethiopia, humid and subhumid zones of Nigeria, subhumid and semi-arid zones of Mali, semi-arid zone of Niger and subhumid zone of Kenya. As stated in an ILCA unpublished leaflet, ILRI was aimed to:

> "...assist the efforts of countries in tropical Africa to increase the sustained yield and output of livestock products and to improve the quality of life of the people in this region." (Page, 3).

The new ILRI incorporates the resources of the former International Laboratory for Research on Animal Diseases (ILRAD, Kenya) and the International Livestock Center for Africa (ILCA, Ethiopia). As part of its move out of Africa, ILRI has taken a first step initiative in 1996 to open regional sites in Asia and Latin America.

ILRI is sponsored by the Consultative Group on International Agricultural Research (CGIAR), an informal association of 53 public and private sector members from the south and north. The CGIAR was established in 1971 with an aim to improve the quantity and quality of food production in developing countries. With a mission to promote sustainable agriculture for food security in developing countries, CGIAR provides financial assistance to 17 independent and autonomous member institutions.

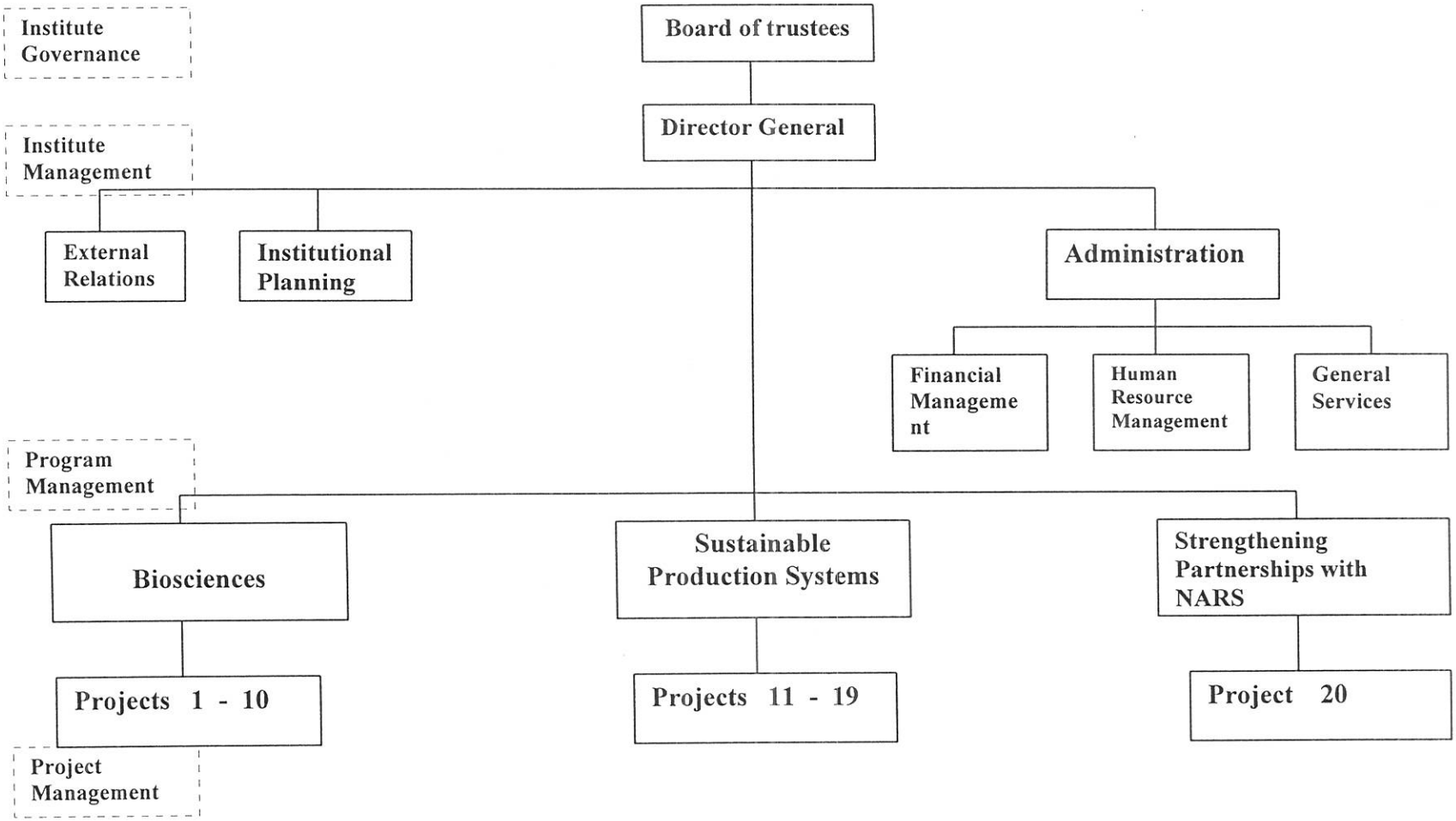
1.6.2 Management Structure

ILRI has four management levels. At the top, there is a Board of trustees whose members are drawn from the CG secretariat and government ministries. The board of trustees is responsible for the entire institute governance. It has a director general responsible for the management of the Institute. The Director General (DG) works in close collaboration with the heads of Administration, planning and external relations office. There are also program directors responsible for respective programs. Each program has several projects. At the lower end, the project coordinators and the operational staff are responsible for field projects and operational activities of the institute.

Figure 1-1 shows schematic diagram for the organizational structure of ILRI

The research is therefore designed to implement an Intranet within the above organizational framework. It accesses documents, task, process and nature of collaboration within the management structure shown next page.

FUNCTIONAL STRUCTURE



1.7 Methodology

1.7.1 General

Hypertext links are the elements that make Intranet sites dynamic and useful. A well conceived site structure can enhance the users' sense of control, while a weak structure can quickly frustrate even the most patient users. Because users see only one part of the site at a time, they build a mental picture or 'roadmap' to help navigate. According to Lynch of the Yale Center for Instructional media (htttp://info.med.yale.edu/caim/Style Manual_Top.HTML), he emphasizes that users need functional continuity as well as graphic continuity. The choice of an appropriate interface metaphor reverts to the all-important basic interface design principle of knowing the audience and making them feel comfortable and confident.

1.7.2 Intranet Design Methodology

Many organizations and business companies have already deployed an Intranet solution to enhance the ability of their workforce to access information that is important for their day-to-day business. The IT industries are the forerunner companies to discover Intranet as an improved method of information sharing and exchange. In their deployment effort, these organizations have used different but related methods, many of which are unique to their specific business objectives. This thesis has considered the following three methodologies developed by three different IT companies:

1. SunWEB Intranet method (BERNARD, 1996)
2. The Amdahl Intranet methodology (Mastering Intranet for Windows NT/Windows 95, 1997)
3. The Silicon Graphics Intranet navigation foundation (Mastering Intranet for Windows NT/Windows 95, 1997)

A brief comparative evaluation of each of these methods is provided below

1.7.2.1 SunWEB Intranet Methodology

The SunWEB is an Intranet deployment designed for its own engineers to publish and communicate information among themselves. It is now regarded as the world's largest in terms of server count, from zero to 3,000 servers in two years time. The methodology used at Sun Microsystems grew out of the difficult conditions that made it nearly impossible to keep track of all the information available. As time passed, Web content became increasingly difficult to use and manage. To help solve the problem, they created a focus group to analyze and solve the problem. Their solution was a professionally designed central menu system where information could be listed by category. It is this solution that they called SunWEB.

The SunWEB Intranet method provides three views of the system: an organizational view (the different companies in the sun worldwide organization), a functional view of the company (corporate, research, sales, marketing, etc.), and a geographical view (all the different sun locations throughout the world).

1.7.2.2 Amdahl Intranet Methodology

Amdahl has been a leader in the business use of Intranets since the late 1993. In fact, the company coined the term Intranet during the summer of 1994 to describe the use of Internet technology behind a corporate firewall. Amdahl's Intranet methodology helps a company design its Intranets by focusing on setting business and management requirements and building processes and skills through adaptive innovation, a process by which the entire business team evolves in response or adopts, rather than reacts, to constantly changing conditions.

Amdahl's Intranet methodology consists of four phases:

1. Executive awareness, introduces upper management to Internet and Web technologies and educates them on their significance
2. Goals clarification - identifies strategies and projects that planners will use to implement an Intranet infrastructure and meet its goals
3. Implementation planning - assesses the company's current environment (including organization, technical skills, and information status) and develops a plan
4. Infrastructure development - implements and develops the Intranet infrastructure, focusing on the technical management, and content issues.

1.7.2.3 The silicon graphics Intranet Navigation Foundation

Began in 1994 as an experimental project to deliver information-on-demand applications, Silicon junction now consists of more than 600 Web servers and 100,000 Web pages and gets thousands of 'hits' each day by more than 10,000 employees around the world.

Because of the magnitude of information that is available through Silicon junction, the team developed such navigation tools as the navigation bar, a search engine, and multiple views of information.

This thesis has used the SunWEB Intranet methodology for the following reasons:

- Hierarchies are a good way to break down a large set of ideas into related categories.
- Today's URLs (address locations for documents in the Intranet site) are developed to reflect the hierarchical file structure of many of the modern operating systems. This tends to make the majority of the Web tend toward a hierarchical mindset.
- By nature, the upper levels of a hierarchical structure are associated with general items, and

the lower items with depth of specialization. It is this cognitive method of drilling down to obtain more depth on a particular topic that is the hallmark of most thinking.

The usefulness of the SunWEB Intranet design methodology for the specific purpose of this thesis can be described as follows:

- ILRI's institutional characteristics where the workgroups are distributed throughout the developing world can be matched with the SunWEB's organizational view
- ILRI's scientific research and administrative support activities can be compared with the SunWEB's functional view of the Intranet design
- ILRI's partnership and collaborative effort which can be displayed to the user using the SunWEB's geographical view of the Intranet design
- The ease to categorize ILRI's institutional information resources by program/research/project/geography (as shown in the design section of 5.3.2 and user interface screen design of 6.3.4)

For the purpose of investigating the users' need and understanding the activities, processes and organizational set up, the following descriptive survey method is used.

1.7.3 Survey Method

The general aims of any survey work are to gather data as efficiently and accurately as possible, the more particular aims and purposes naturally vary according to other considerations. There is a strong association between these considerations and the goals of the research at hand. The goal of this particular study is to test how an Intranet solution can be deployed at ILRI. This kind of study involves investigating organizational processes, technical infrastructures and most of all generated information. Therefore, for the purpose of investigation of the tasks, processes,

infrastructure, digitized resources and nature of collaboration among various actors makes survey method as an appropriate tool.

As Pons: 1992, stated:

> "the type of survey selected depends much on, for example, how much is already known about the topic of study, which data need to be counted or measured precisely and which need only be gauged approximately, and whether a complete enumeration is thought necessary or whether a sample is considered adequate"

A descriptive survey method was used in this study because the survey was primarily concerned with getting answers of "how many?" "who?" and "what?" type of details from the survey respondent's.

1.7.4 Survey Instruments

1.7.4.1 Interview

This instrument is used as the chief means of collecting data from senior and high-level managers at ILRI. These groups of interviewees were selected to represent the three main programs, sub-programs, projects, departments, sections and units available at ILRI. The list of interviewees (appendix-1) and the interview guide (appendix-2) are annexed. This instrument had been selected as the chief means of data collection because majority of the facts sought by this study can not be formulated in a form of a question. For example, the end-user may not very well explain the organizational tasks, missions, objectives as the program directors do and also the end-user may not give as sufficient details as possible about the LAN technical infrastructure.

1.7.4.2 Questionnaire

This data collection method was used to get facts and opinions from the end-users side. In order

to get relevant and appropriate facts and data, ILRI employees who have a network account were identified as target population groups. These categories of the workforce are considered as the 'end-users' for the purpose of this study. The survey questionnaire is annexed (appendix 3)

1.7.4.3Observation

This survey instrument was used to supplement the facts collected through the above two techniques. In order to familiarize with particular characteristics of the electronic information exchange (software, hardware, and protocols used), the researcher was given a LAN account. This had given an opportunity to know closely ILRI's electronic communication infrastructure setup.

1.7.4.4 Document Review

In addition, important policy manuals, procedure statements, work plans, short and long-term plan documents were also reviewed in this study. The facts obtained in this document had helped to strengthen the collected data through the research instruments.

1.7.5 Sampling Method

Purposive sampling method was used in this study to select survey respondents from the targeted population. This type of sampling method falls under the non-probabilistic sampling method and did not require to determine sampling error. Purposive sampling is when the researcher selects a sample with a view to obtaining a cross-section of the population. This kind of sampling method is taken because of its application to this particular type of study. This means, the survey is focused only on the 'end-users' as described above because it is these groups which are thought to

possess the facts required by this study.

As Bailey: 1987 indicated purposive sampling is when "the researcher uses his or her own judgement about which respondents to choose, and picks only those who best meet the purposes of the study."

1.8 Prototyping

Prototyping was used as one approach to demonstrate the potential use of the Intranet solution with selected applications and services. To develop the prototype, four types of prototyping techniques were compared: an overview, the glitz, the trojan horse, and the straw man. Each type of prototyping use different approaches to show the potential use of an Intranet technology for organizational information sharing. In this study, the overview and the trojan horse prototyping technique were selected (chapter 6).

1.9 Scope and Limitation of the Study

The Intranet design as reported in this study is confined to ILRI Ethiopia. To cover the entire ILRI offices distributed throughout the developing world is out of the scope of this study. Neither is the scope of this study to design the whole services and applications that an Intranet capability will offer. The goal of this thesis is to give an overview of the Intranet implementation at ILRI based on the outcomes of the study. The scope is confined within the above limits mainly because of time and resource constraints. In addition the absence of wide area network at ILRI is also a limitation by its own which restricts this development from being tested on wide area scale.

1.10 Organization of the Thesis

1.10 Organization of the Thesis

This thesis contains seven chapters.

Chapter one is the 'Introduction chapter' and is intended to give a background statement on the domain of the research problem and the research environment. How the research is to be conducted, what methodology to use and techniques to follow were reported in this chapter. The introduction chapter also includes the objectives of this study, the justification and significance of the study and scope and limitations of this study.

Chapter two is devoted to the review of relevant literatures that will give a context within which this study is going to be conducted. The literature review gives a perspective as to how similar studies were conducted in other parts of the globe.

Chapter three is titled 'Intranet infrastructure at ILRI' and provides detailed information on the available infrastructure at ILRI. Based on the three components of an Intranet implementation: organizational issues, content, and technical infrastructure, this chapter gives a description of what is contained along these lines.

Chapter four is the 'requirement analysis and research findings' where the survey results are reported. Based on the discussion of the findings, problems and requirements are also described in this chapter.

Chapter five is the 'Intranet design'. Now that local conditions are studied, problems are identified and requirements known. The design chapter is, therefore, intended to seek the 'how-to' of solutions that can ally to the identified problems and requirements.

Chapter six is the prototype chapter. A full scale Intranet development is out of the scope of this study. Thus, an appropriate prototyping technique is used to give a shell as to how the actual work can be implemented later. In the prototype development, only specific applications and services are considered. An overview and the trojan horse prototyping techniques are used which gives the big picture for the entire implementation but selecting particular cases for demonstration.

Chapter seven is the last chapter and gives conclusion, and recommendation statements.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Resource sharing, no matter how it is achieved and regardless of the type of resources shared, has been in existence since the communal life. Our ancestors apart from sharing their means of production (for hunting and gathering) each member of the community had a way to share information. By sharing physical implements and information, members of the community were well aware of what they are doing and how they are doing it.

As man's activity grew and became more complex, people began to record their knowledge (reflecting nature, day-to-day activity, and innovation) to pass to the future generation. The invention of the Gutenberg movable type in 1501 was, therefore, a land mark in the history of knowledge recording and transfer. Modern organisations later began to keep their paper contained information in a systematic way. Again, when volume and complexity of work increased, organisations have begun to explore technological tools such as computers to assist them with collection, maintenance, and exchange of information.

These tools have also undergone substantial changes. According to "Delphi Consulting Group, Inc: 1997," man's use of these tools can be grouped into four phases:

- In the 1960s and 1970s, the mainframe era reflected a dominant command-and-control view of the organisation. Information was tightly controlled by a central Data Processing Department and consumed only by a select group of senior management.
- This era evolved into one of departmental computing, where each department could construct its own "island" of information under the control of its own programmers.
- The early 1980s liberated users by providing a PC on every desktop. Finally, everyone could control and process their own data.

- The steady growth of Local Area Networks and, more significantly, the Internet and Intranets, heralded an era in which not just information processing, but information sharing and communication have become the domain of all. Information can be distributed easily to whomever needs it with great ease. (Page 4)

2.2 The Internet/Www Landscape

The 1960s had demonstrated that computer based data processing activities were the domain of few technical "gurus" which served as an intermediary between users and the computer system. Before the end of the 1960s, however, a tremendous achievement have been recorded in the field of computer networks, the first packet was transported over the computer network. Data communication and information resource sharing had clearly become a fundamental part of how institutions, corporations, and individuals now perform their activities. World- wide networks gather data and technical information about all aspects of knowledge recorded in electronic format. Groups establish electronic mailing so they can share information. Hobbyists exchange programs for their home computers. Corporations keep service orders, customer records, inventory, and customer service information in large-scale client-server systems. The list goes on and on and it is impossible at this particular study to exhaustively enumerate all instances.

When LAN and WAN proliferated to become the mainstay of many of the large organisations and corporations, these networks were established to serve the needs of a single group, whether within an organisation (intra-enterprise) or between an organisation (inter-enterprise) level. Each independent establishment chose hardware technology that best addresses its communication problems. In the past couple of decades, however, the technology had evolved which makes it possible to interconnect many of these disparate establishments to function as a co-ordinated system. This technology which is called 'Internetworking technology' made possible for

computers to communicate independently of their original physical set up.

Internet development and deployment began in the 1960s and early 1970s under the auspices of the U.S. Department of Defence as a means to connect government agencies with research companies, contractors, and academic institutions. According to "Lynch & Rose (1993),"

> "The original purpose of the Advanced Research Projects Agency Network (ARPANET) was provide communication between computers in a way that permitted a very broad range interactions: remote login access to distant computers; sharing of files and other resources; an while not in the original plan, the use of inter-site electronic mail. In addition, an important go was to improve and expand computer research productivity through the sharing of resources" (page 4).

Other people believe that the Internet has its roots in Paul Baran's concepts who was working at RAND Corporation. Baran, who was considered by many as the father of networking presented his ideas in a series of reports published by RAND in the early 1960s. It was these ideas which later came to fruition through ARPANET. Internet has been in existence for nearly 30 years. The latest breakthrough began in 1989 with the creation of an Internet environment called the WWW, which is a software scheme for imposing order over the mass of free-form information on the Internet by organising it into easily understood "pages". This software technique which made the WWW such a powerful cyberhelper is known as 'hyperlinking'.

Long & Long: 1997 state that WWW is one of the tools that fuelled the growth of Internet.

> "The WWW is emerging as the foundation service on the Internet. That is, the downloadable FTP files, the Gopher and WAIS database, newsgroups, e-mail, and other Internet applications are being organised within and offered through WWW sites." (page 214)

The WWW, the Web for short is a "wide area hypermedia information retrieval system" aimed at giving universal access to a large universe of documents. It was began in 1989 when Tim Berners-Lee of CERN (European High-Energy Physics Centre) proposed the project to share

research and ideas throughout the organisation. Ever since the WWW grew to global hypermedia network connecting millions of computers and users.

2.3 Intranet Solution: a Short Retrospective

Organisations have long recognised the key role played by information. The degree of control and use of strategic information keeps organisations competitive. The urge for competitiveness is one of the factors that forced organisations to experiment with the deployment of Internet and Web technologies into their private networks. According to Telleen (1996):

> "There are immediate and compelling reasons for large organisations, public and private, to adopt Intranets. They have been struggling with a series of complex organisational scaling issues for decades, and not entirely by chance, the Internet technology applied to internal networks simplifies many of these issues. In addition, many organisations already have in place the infrastructures and attitudes required to adopt an Intranet. They have the need; they have the hardware; and the Internet technology is providing the software to make it all work. (Page 2)

Tellen is also credited for coining the term Intranet. He defines Intranet as:

> "a communication infrastructure that is based on the communication standards of the Internet and the content standards of the WWW. Therefore, the tools used to create an Intranet are identical to those used for Internet and Web applications. The access to information published on the Intranet is restricted to clients in the Intranet group. Historically this has been accomplished through the use of LANs protected by Firewalls." (Pages 2-3)

According to Hinrichs (1997), Intranet is associated with 'organisational intelligence' and states that

> "An Intranet represents organisation's "Intelligence". The purpose of this intelligence is to organise each individuals desktop with minimal cost, time and effort to be more productive, more cost efficient, more timely, and more competitive." (Page 2)

Hinrichs also offers a comparison between Information Systems maintained on Intranet and the traditional Local Area Networks. Traditional LAN was locked into proprietary system and a new team of programmers and software were always required when internal communication of all data

on the LAN is desired. With Intranet, however, no coding and conversions are required. While the traditional LAN requires comparable systems, Intranet connects people together, with Internet technology, using Web servers, Web browsers, and data warehouses in a single view that everyone can easily learn while still using their old software.

Although the Intranet was virtually non-existent in 1994, research has shown that the market for Intranet solutions have by far exceeded those for Internet. According to a paper presented at the INET'96 Meeting, Zona Research, Inc. predicts that in 1998 sales of Intranet tools will reach $8 billion, four times the size of the Internet server business.

2.4 Benefits of an Intranet Solution to an Organisation

Intranet deployment to an organisation's Information System is to enable Internet-Web technology implementation using the LAN/WAN as a backbone. This means depending on the need and the type of deployment, the organisation can benefit from the whole range of applications and services provided by the Internet-Web technology. These services and applications are sometimes refereed to as Internet software tools and technologies and include e-mail (TCP/IP e-mail), Telnet, FTP, Gopher, Finger, Usenet Newsgroup and WWW.

In general, organisations deploying an Intranet solution will reap the following benefits (NEWTON:1998)

- PUBLISHING SERVICES: which includes institution wide controlled and co-ordinated Webizing or HTMLizing of documents and also an option to user publishing where users will want to post their own content on Web servers without having to attain Webmaster status.
- COMMUNICATION & COLLABORATION SERVICES - which is a kind of dialogues via chat/newsgroup/bulletin board features and of course e-mail for private messaging among users across multiple platforms via open standards such as IMAP4, SMTP, MIME,

POP3, HTML, and HTTP.

- DATABASE ACCESS: which involves getting at critical data housed in institutional databases found disparately in different locations. This can be achieved via generic, universal ODBC linking or based on 'native' links directly to the DBMS or by strong and running Java or JavaScript, and CGI programs.
- SEARCH VEHICLES: this is to allow an internal use of search engine to search through thousands of pages spread across a bunch of Web servers. It is like an indexing and search engine that creates an internal yahoo! For the Institution Web sites.
- REPLICATION: this is a kind of service usually provided by proxy servers for replicating Web content, filtering access to Web pages, and caching frequently accessed pages to ensure high application performance and availability.
- ADMINISTRATION/MANAGEMENT : this is to allow authorised administrator to manage access, users, content and the servers themselves from any desktop on the TCP/IP network

2.5 Building an Intranet in Organisations

Designing and building an Intranet implementation in an organisation is very much tied to the specific business of the organisation concerned. The unique applications required and the system requirements as well as the unique network infrastructure of the organisation need to be investigated. There is no one-size-fits-all solution which precludes the fact that each Intranet is a custom implementation. there are, however, general rules and guidelines suggested. Many authorities provide a step-by-step procedures and considerations in building an Intranet. The eight important issues to consider before building an Intranet which is offered by Esplin, 1997, the Intranets How-to setting up shop five steps suggested in PC Magazine, 1996, and the 12-steps program offered by Guengerich, et al, 1997 are some instances.

In general, building Intranet in organisations involves four major elements: investigation of organisational process, study of content (information systems), investigation of the nature of collaboration and the infrastructure. A preliminary survey of information needs assessment so as to draw the organisational information map is important. The type of Intranet implementation to be developed could vary from one organisation to another organisation. The basic applications

and services an Intranet can support, however, remain fairly constant. According to (Telleen, 1996)

> "Constructing an effective Intranet infrastructure requires attention to 3 distinct areas: management, technical and content. Management consists of the roles, policies, processes and organisation needed to manage the life cycle of formal Intranet content. The technical infrastructure consists of the networks, hardware and software required to support content development, publishing and access. And, content requires processes to be developed to support special needs such as initial conversions, creation of database or application interfaces and development of 'glossy' pages for high impact." (page 2).

While the technical component could be an extension of already existing systems and network administration, the content is an extension of traditional technical publications, Public relations and programming processes and resources. The major applications of Intranet are "publishing, communication, and collaboration, network applications, and management." (http://home.netscape.com/comprod/server_central/query/idg/services.html)

(Delphi Consulting Group:1997) provides five areas of Intranet applications:

- Document applications: archival and/or distribution of internal documents
- Process applications: automating processes within an organisation
- Commerce applications: business-to-business information exchange, ramping as an alternative to EDI
- Knowledge applications: serving as a single point of access to the organisation knowledge base, databases, reports, and other information
- Collaborative applications: connecting and co-ordinating people and the information they needed to carry out joint work tasks (page)

2.5.1 Organisational Process

The Intranet deployment is not a mere exercise of putting up technology and software together. It is also an opportunity to define an organisation and display it for everyone to see it. By 'everyone' it is referred to the entire workforce of the organisation and if these workforce know what the organisation stands for, what the organisation's plans and strategic visions are, what the guiding organisational principles are, who the partners are, then it is clear for them to focus on

what their contributions are to the organisation.

From an organisational perspective, the key to the understanding of the Intranet information framework is the definition of several roles. According to Telleen, 1996, there are four important roles in an organisation regarding Intranet framework, "Users/Authors/Brokers/Publishers." The users are the actual consumers who access and view the information and these groups are those where the value is created and the ultimate requirements are defined. Authors are those who create the information, those who sit down and write. The authors are responsible not only for the creation of the information but also for structuring the information into reusable modules that exists in linear structure.

The brokers are those who provide key to finding information. These are usually the knowledge workers who are much concerned in delivering information access pathways. They take time to understand the users' decision process or pattern of information use and try to structure access pathways accordingly. Finally the publishers are those roles which make the information available. The publishers have different information access requirements which will assist them to manage, co-ordinate and communicate content in predictable and relatively efficient ways.

2.5.2 Content

According to Morris & Hinrichs, 1996 content is defined as:

> "knowledge, relationships or associations between information, clever navigation and orientation devices to help users explore the Intranet site effectively and includes overviews, descriptions, maps, biographies, location information, glossaries and indexes, accomplishments, goals and missions, opinions, FAQs, critiques, and testimonials, and of course much more." (Pages 32-34)

In general, the content served through an Intranet site ranges from formal information to the project/group information to the informal information. The formal information is the officially sanctioned and commissioned information of the organisation, that is the information with which the formal management infrastructure is most concerned. The second type of information, the project/group information is intended for use within a specific group. This kind of information is used to communicate and share ideas, co-ordinate activities or manage the development and approval of content that eventually will become formal. The informal information is like a personal folder/Web pages (sometimes known as the yellow pages) and this kind of information begins to appear on the Intranet site when authors and users find how easy it is to publish within the existing infrastructure.

Providing content to an Intranet site requires processes to be developed to support special needs including initial conversions (HTMLizing traditional documents), creation of databases or creation of application interfaces to an already existing databases(s) and development of "glossy" pages.

2.5.3 Network Infrastructure

The presence of an established network infrastructure is paramount to the deployment of Intranet solutions to an organisation domain. This network set up could be a LAN or WAN depending on the complexity and geographical location of offices in the organisation. In Intranet design, the most important characteristics of the network is its efficiency to promote performance of the Web. According to Padmanabhan and Mogul: 1994, "latency, bandwidth, congestion and protocols used" are the four important factors which largely determine the performance of the network. These factors largely determine how well and, most important, how fast a network

transfers data. Different sets of minimum requirements were set to meet the basic standard of these factors.

For organizations planning to migrate their IPX/SPX network into TCP/IP based network, there are several possibilities. one possibility could be to use IPX-to-IP gateway which allows to provide Intranet and Internet TCP/IP services on an IPX-only Local area Network. Two parts of this product must be used to enable the feature: the server NetWare Loadable Modules (NLMs) must be loaded and configured to provide the IPX to IP gateway function, and the client NLMs for Novell's Client 32 must be used to provide TCP transport via IPX (TCP/IPX) (BIERER, et al.: 1997)

The other possibility could be to run TCP/IP on the client side together with the IPX protocol to get an Internet/Intranet server. In fact TCP/IP is not a must for Intranet deployment unless an internal Web server presence is required. Netscape's Frequently Asked Questions Web page (http://www.netscape.com/comprod/at_work/faq.html) defines various alternatives to take into considerations at least for a basic Intranet implementation.

> "instead of being having a link like 'http://www.foobar.com/index.html' you can get a link that looks like 'file:\\c:\Website\index.html'. All links, references to graphics files, and everything else works fine. This would not necessarily apply to interactive features that use CGI scripts, java, Perl, etc (although there might be a way to get these to work also). Just put all the html files up on the Novell server, make sure that everybody's drives are mapped to a common standard, outfit all the clients with Netscape and Mozilla, and you have got a basic Intranet"

Currently, however, Novell has also started to ship Web server software with its Novell Netware 4.1, including a TCP/IP stack which is called IntranetWare. This configuration provides HTTP service and depending on the given set up, FTP, Gopher & other TCP/IP supported services can

be made possible. There are also some other companies besides Novell which make Web servers for NetWare.

In general, the network technology required to be present in the organisation should support the major capabilities offered by the Intranet design described above. If, however, the LAN or WAN exists but is not compliant to the above minimum requirements, it is important to switch the technology to the required standard to avoid unnecessary bottleneck. In addition to the physical network existence, the following hardware and software technologies are also essential requirements.

2.6 Web Server

At the heart of any Internet/Intranet implementation exists the Web server. By definition, the Web server is a computer with a connection to the Internet, with system software to run the computer and to connect to other systems on the Internet (Yeager & Mcgrath: 1997). These same authors describe a Web server by the following formula:

Web Server = Platform + Software + Information

While the platform consists of the computer hardware, the operating system and the network software, the software is the Web server software itself. The information is the content served or transported over the network.

2.6.1 The Computing Platform

There are several operating systems that Web servers may operate on within an Intranet. For PC and workstations-based Intranets, the most common are Unix and Windows NT. Novell has

started to crack the market by introducing Intranetware, but it remains to be seen how successful Novell will be in getting organisations to adopt this new platform (Lopez & Stephen: 1996). These authors predict that the development will continue for the near future, but that non-Unix based Intranet development will eventually win out. NT-based application development is one of the hottest technologies for the deployment of Intranets. While Windows NT still must prove its reliability in the area of mission-critical applications, it remains the easiest application platform for this type of application development.

Regarding the choice of OS platform, many of the authorities agree on UNIX, Microsoft NT and Novell Intranetware as the most viable choices. Although there are increasing inclination towards favouring Microsoft NT, particularly with a new generation of Intel processors, along with the release of advanced NT server version 4.0. Unix is still the platform of choice for truly large-scale systems. It has a well-deserved, solid reputation for power and scalability on numerous platforms. And Unix is particularly well suited for Web servers because it is the environment where FTP, Telnet, and TCP/IP were nurtured (Guengerich & Graham: 1997).

In general, there are certain desirable features which a Web server platform should support (Wehling: 1996)

- Hosting of multiple IP addresses
- Logging of requests
- A built-in scripting language
- Native image map handling
- Browser uploading of files
- Support for the windows CGI interface
- Native DBMS support
- Source code access
- Ability to act as a proxy server

2.6.2 Web Server Software

There are several dozens of Web server software available for selection, some free and others commercial. The choice for Web server software is largely dependent on many variables including the size of the Intranet, the applications to be implemented, the type of security needed, the number of users, the type of security needed, the number of users, the type of databases held, budget, etc. Though not comprehensive, the list of Web server software choices include Apache Server, Microsoft Internet information Server (IIS), Website O'Reilly & associates, Netscape SuiteSpot/Enterprise server, Purveyor WebServer, SafetyWEB server, and SuperWeb Server.

Of the many choices available, however, the free Apache Web server, which is based on the original NCSA HTTPd code, has become the single most popular Web server on the Internet exceeding the popularity of its competitors by wide margins. The July 1997 Netcraft Web server survey (www.netcraft.com) finds Apache used on 42.62% of the I,203, 096 Web servers surveyed. Microsoft's servers trails in second place at 16.90%, with netscape servers third at 11.76% using NSCA's Unix server, and 3% using other unix server software.

Apache 1.3 which entered public testing in the summer of 1997, supports windows NT and windows 95. For windows NT Perl development, Perl with ISAPI, is the recommended option. Both Perl and Microsofts's IIS are available for free. IIS ships with windows NT (beginning 4.0) and Perl is available from ActiveWare's Web site (Jepson: 1997). According to Yeager & McGrath, 1997, "the difference in the Web server software lies in the details of features provided. Some servers combine special search, navigation, or security services, some are suitable for small, locally used Web servers, and others provide the high performance needed for heavily used, major Web services."

A list of Web server software are available with performance comparison at the following sites :

http://www.Webcompare.com/server-main.html
http://www.w3.org/hypertext/WWW/servers.html
http://sunsite.unc.edu/chris/daemons/index.html
http://www.yahoo.com/computers_and-Internet/Internet/
World_Wide_Web/HTTP/servers

2.6.3 Browser

The choice of a browser required to load and view the Web information is again based on the need of the application at hand. The two most important leading browsers in use are Netscape and Microsoft Internet Explorer. The main evaluating criteria required in selecting browsers relates to their performance which include multimedia support (i.e., native sound/video, plug-ins), language support (i.e., HTML, Java), usability (i.e., user interface metaphor, online tools, help facilities) and vendor support. Other options for Web browser include: NCSA Mosaic (the original Web browser), Lynx (non-graphical browser, for Unix and DOS), MacWeb (for the Apple Mac environment), Cello (for Windows 3.1 platforms) and Hot Java (sun's browser to demonstrate Java applets).

2.7 Development Tools For Databases

As indicated above, the infrastructure basically consists of network technology, hardware and software. Content also generally consists of: structured (databases) and non-structured (flat files) information. Both categories of information are required to be served in the Intranet site. Following sections describe the development tools which will allow content development on the Intranet site.

Currently there are several tools available to assist developers with the many and varied tasks involved in developing content at Intranet sites. Intranet development tools evolved from basic utilities for building applets or screens and have become better at suiting the needs of business users. Intranet software often acts as the front end for databases of information, presenting that data to different users in different ways, as their needs require. The databases can be situated anywhere on the network, so the Intranet development tools must support SQL and ODBC databases. The Internet tools use diverse approaches to deliver information. Some programs use an API or CGI to link clients to a Web server. The forms and document made are displayed on browsers. Another technique involves stand-alone servers that work directly with the client software. The tools make it possible for virtually any user to write and maintain an application.

A recent survey (reported in LAN Times, Nov. 10, 1997) evaluated five well known development tools for ease of use, extensibility, manageability, and performance. The tools support for the integration of Java and Activex and the capability of creating more functional, user-friendly screens and input forms by using JavaScript or VisualBasic script. It was found out from the comparison that Bluestone software Inc. Sapphire/Web and Borland International Inc Intrabuilder tied for top honors with highest marks in two of the above four key ratings. But as the score indicates, there were no real losers in this comparison. These development tools have one common purpose to serve: providing a Web access solution to a database.

1. Single Tool Solutions

These are vendor offered solutions and they are promoted as a complete solutions for database integration into a Web application. Oracle Web server and Microsoft's front page are two broad-based packages available which provides Web server and DBMS all in one. These solutions are proprietary and not always flexible or extensible.

2. CGI

Common Gateway Interface or CGI is the standard program interface between Web servers and external programs. Each word in the acronym, 'CGI' helps to understand the interface (Telleen: 1996)

- Common : interacts with many different operating systems
- Gateway : provides users with a way to gain access to different programs, like databases or picture generators
- Interface : uses a well-defined method to interact with a Web server

CGI employs a three-tier client-server architecture; the first tier is the Web browser client, the second tier is the HTML Web server and the CGI applications, and the third tier contains the DBMS, TP monitors, and other resources required by the CGI applications. Once the CGI application is invoked, one can do almost anything that we can currently do with client-server applications. With CGI, the user can access new or existing applications and access (even update) a database. In this way, CGI allows to extend the organisation's service to the Web.

Invoking a CGI application can be done via a hypertext link (which references a script to be executed), by clicking on a submit button on an HTML form (in this case, Web page will contain an ACTION tag or through a SSI. Practically, CGI applications can be developed in any programming language. But c/c++ and PERL are the most widely used languages.

3. APIs

Application Program Interfaces are another option for connecting the Web and application server. The Netscape API (NSAPI) and Microsoft Internet server API (ISAPI) can be used with their respective Web servers to provide this collaboration (Guengerich, et al: 1997). Although it is similar to CGI solution, the API method substitutes the API extension DLL for the executable, which speeds the process considerably and thus improving perfromance.

4. GLs

This type of model is similar to the CGI solution shown above but it uses a fourth-generation language (4GL) in place of the executable (EXE). The tools used in this type of set up include Powerbuilder and Visual basic.

5. CGI Relays

In the classic three-tier environment, a client connects to an application server that in turn pulls data from the database. A flexible variation on three-tier computing exists in which the client talks to a Web server which may handle the request itself or activate connections to application servers or TP monitors to pull data from a database. running a separate application server next to the Web server can help to alleviate the problems associated with regular CGI scripting.

In this approach, the application server maintains persistent database connections, which gives it better response times, and can track state. Only a light CGI relay script (in C or C++) is required to link the Web and application servers, thereby improving performance. This approach can be applied to Netscape or Internet information server (IIS) to allow the application to run on a separate machine. An advantage of using the APIs, however, is that they run faster when executed.

6. Object Tool

Tools like NeXT WebObjects provide great deal of flexibility, portability, and extensibility by using an object-oriented approach with predefined libraries of objects. They also use the relay model

2.8 Authoring Tools for Web Publishing

These tools are basically used for content publishing. All Web pages are written in HTML, a

document description language which governs the way how a rich content should be displayed on the browser. The many forms of this universal language include HTML 1.0, HTML 2.0, HTML 3.0, HTML 3.2, HTML+, and NHTML (Netscape enhanced HTML). Designing a Web page for an Intranet can be done using one of the many editors available, some commercial others found as freeware. There are about six popular HTML editors (Wehling, et al: 1996) viz: Adobe PageMill, CorelWEB DESIGNER, HoTMetaL PRO, BBEDIT, Navigator Gold and Front Page (Microsoft). From the freeware editors available, Microsoft Internet Assistant is well cited.

In addition to these HTML editors, there are also other categories of tools which help Webpage designers integrate eye catching graphics. The two most important and widely supported formats are GIF and JPEG files (Wehling, et al: 1996). There are in fact hundreds of packages available which provide developers with practically all of the tools they need to create graphic images. According to Guengrich, et al,: 1997, the two most widely used graphic programs are Paintshop Pro by JSAC and Adobe Photoshop.

Plug-ins are also considered as important tools to extend the functionality of the browser. Plug-ins work in conjunction with Web browsers allowing Web clients to render and display formats not included in the regular line-up of features of the browser. Plug-ins offer content providers the capability to create applications to work with browsers so that users can view animation, listen to audio broadcasts, teleconference, and walk through 3-D images. According to Gunegercih, et al: 1997, some of the most popular plug-ins are progressive networks Realaudio, Macromedia shockwave, Adobe Acrobat Reader and Visual components Formula One/NET.

This chapter provided an outline of the technologies and tools required to build Intranet. The next chapter will consider the infrastructure and tools available at ILRI

CHAPTER III

INFORMATION AND NETWORK INFRASTRUCTURE AT ILRI

3.1 Introduction

This study attempts to develop Intranet solution by taking the ILRI in Ethiopia as a case and selecting specific applications of Intranet development. To maintain the logical flow of this study, in this chapter attempt will be made to describe ILRI in terms of the three major components of an Intranet design: Organizational framework, Content and Infrastructure. This description is, however, limited to the ILRI in Ethiopia for reasons explained in section 1.9 , chapter one. The source of data for this description is largely obtained through interview and browsing institutional documents.

3.2 Organizational Framework

ILRI has three main programs and support units that form its main organizational framework for the implementation of the Intranet. The three programs: Biosciences, sustainable production systems and strengthening collaboration with NARS (SPAN) provide research and research related activities on animal agriculture. Each program has projects based in Ethiopia or in the regional centers outside Ethiopia. This chapter is, however, an attempt to describe program and project activities that are fully or partially based in Ethiopia.

Table 3-1 provides a summary of main programs, sub-programs, project activities, and support units as of 1997.

Table 3-1, ILRI-ETH Program and Support Units

Programs/Sub Programs	Projects, Units, Departments
Biosciences/ • Animal Genetic Resources • Animal Health Improvement • Forage genetic Resources	• Characterization and conservation of indigenous animal genetic resources • Characterization and conservation of forage genetic resources • Genetic resistance to gastro-intestinal parasitism in small ruminants
Sustainable production Systems/ • Feed Resources • Livestock Policy Analysis program • Highlands • Impact Assessment	• Forage integration and natural resource management in crop-livestock systems in the tropical east African highlands • Livestock production strategies for managing natural resources at a watershed scale • Alternative sources of draught power. Use of crossbred cows for milk production and traction • Evaluation of alternative strategies for sustainable control of trypanosomiaiasis • Peri-urban dairy production: on-farm milk production potential of crossbred cows in the African highlands • Development of feeding and management systems for the different classes at dairy cattle in the African highlands • Global consultation, environment and human needs • Strategies to evaluate and match nutritional requirements of livestock exposed to fluctuating feed supply • Feed utilization for traction • Rumen microbiology for feed utilization enhancement • Competitiveness of smallholder dairy sectors • Livestock production, property rights and management of drought risks • Socio-economic and policy strategies for the sustainable delivery of animal health services in intensified peri-urban dairy systems.
Strengthening Collaboration with National Agricultural Systems (SCNARS)	• Training; Information services; Publications and • Cattle research network coordination (CORAF) livestock network • African small ruminant network (SRNET/SACCAR) livestock collaborative
Research Support	• Biometrics; Computer services; Nutrition and soil laboratories
Administration and Operations	• Budget • Finance; Personnel; budget; Procurement and store • Physical plant; General maintenance; Transport • Liaison and travel; Clinic; Housing and catering • Office services; Office upkeep • Hostels and laundry; Security; Cafeteria; Garden and grounds; Zebu club
Directorate and SPS	• DG's Office • External relations • internal audit

3.2.1 Bio-sciences Research Program

The Biosciences program deal with scientific fields such as cell and molecular biology; molecular and quantitative genetics; immunoparasitology; bovine immunology; epidemology; animal science; nutrition and breeding. The bio-scientific field in ILRI can be summed up in three main program areas: Ruminant genetics, ruminant health and ruminant feed resources.

3.2.2 Crop-Livestock Systems

The sustainable production system or crop-livestock systems focus on farming systems, ecology and socio-economics. Research in sustainable production systems is being carried out under nine project focussing on livestock policy analysis, systems analysis and impact assessment, livestock and the environment, livestock production under disease risk and market-oriented smallholder dairy. Research in this area is being carried out through partnerships with the crop centers of the CGIAR and their national partners, and the International Food Policy Research Institute (IFPRI).

3.2.3 Strengthening Collaboration With National Agricultural Research Systems

This program area is targeted to strengthen the capacity of national partners to collaborate in livestock research through training and information services. Known for short as SPNARS /SCNARS, this program strengthens partnership efforts with NARS through scientific networks, eco-regional consortia convened by CGIAR centers, multi-institutional initiatives, system-wide programmes and outsourcing.

In addition ILRI's SCNARS program has the following units and sections through which it delivers its activities and services.

- **Training:** the main objective of the training program is to increase the availability of skilled

personnel, to research, develop, and apply improved methodologies, through ILRI-based technical and higher training, provision of training materials, support to regional centers by provision of guest lectures and suitable training opportunities. The ILRI training has conducted for over 3000 NARS technicians and scientists, including over 250 PhD and MSc students (MTP:1998-2000, 3).

- **Information Services:** The main objectives of ILRI information services are:
  - the bibliographic description of conventional and non-conventional literature
  - the creation and maintenance of relevant databases that support the services provided to users
  - the provision of the information retrieval and dissemination services and
  - the enhancement of information handling capabilities of NARS.
- **Publications:** The main objective of the publication unit is to communicate the results of the research undertakings to a wide range of audiences, including CGIAR/TAC, NARS policy makers, scientific collaborators (including NGOs, PVOs, private vets etc), trainees, peer-group scientists (including those in related disciplines) and the general public (via the media).
- **Carnet:** One of the main reasons for ILRI's effort to strengthen partnership with NARS is the provision of support for Cattle Research Network Coordination (CORAF) Livestock Network.

3.2.4 Administration and Operation (Admin. and Op.)

The admin and operation is responsible to support the research programs by providing administrative and logistic assistance. The main operational units within Administration and operations are the Personnel, Finance, Budget, Procurement and Store, Physical Plant and Transport, and Liaison and Travel. The activities within these operations are highly interrelated

and can be summed as:

- Facilitation role to ensure resources (finance, material) are used efficiently
- Providing logistics and administration support
- Facilitating the recruitment of manpower

3.2.5 Technical Units

The main objective of the technical units is to support the research programs of ILRI with technological and infrastructural assistance. There are three technical units: Computer Services, the Biometrics, and the Laboratories

The computer service acquires, installs/runs, and maintains computer hardware and software. It administers the LAN. The Biometrics unit advises research programs on matters related to quantitative or statistical application during the research process. Any research that bears statistical manipulation can get assistance from the Biometrics unit. The Laboratories unit assists research programs by testing or conducting experiment on certain parameters or variables during a research process. ILRI has soil and nutritional laboratories.

3.2.6 Office Of The Directorate General

The office of the Directorate General (DG) is responsible for the entire institutional management. The external relations and internal audit form part of the Director General's office. Interfacing with all ILRI's stakeholders, representing ILRI in matters of external contact and providing general annual institutional report are some of the chief activities of the Director General office.

In addition to the above programs, projects and units, there are two independent but collateral

research programs within the premise of ILRI namely CIMMYT and ICRISAT. CIMMYT stands for Centro Internacional de Mejoramiento de Maiz Y Trigo, translated in English reads 'International Maize and Wheat Improvement Center'. ICRISAT stands for International Crops Research Institute for the Semi-Arid Tropics.

3.3 Overall Institutional Characteristics

As an international institute formed recently in September 1995, ILRI has restructured its organizational structure to respond to the global mandate of the new ILRI. This adjustment was dictated by several factors of which the following are the most important:

- multi-site, multi-partner projects: ILRI is implementing research in 12 sub-Saharan countries involving close partnerships with several international organizations.
- multidisciplinary, multi-cultural, multinational staff: ILRI currently employs about 800 nationally recruited Kenyan and Ethiopia staff, plus about 100 internationally recruited staff

multi-donor: ILRI receives funding from over 30 different countries and organizations.

3.4 Network Infrastructure at ILRI

The whole essence of the 'Intranet solution' is to deploy Internet-Web technology on organizational LAN at ILRI for effective information resource sharing. As the type of Intranet implementation can very much be dictated by the already existing infrastructure and content, this section describes the infrastructure for the implementation of an Intranet.

3.4.1 Overview Of ILRI Network Infrastructure

ILRI has a 10BaseT Ethernet LAN connecting 80386 and 80486 and Pentium PCs as file servers and workstations. The physical link is via 4-pair unshielded twisted pair cables within each building and fiber-optic cables between buildings. The network operating system is Novell

building and fiber-optic cables between buildings. The network operating system is Novell Netware. The LAN uses a star bus topology combined with a segmentation of the overall LAN by buildings and floors for easy management and expansion. Within buildings a structured wiring system is used. Each workstation is connected to the central computer room through 10 Mbits/sec Ethernet card. The 4-pair UTP cables terminate on an RJ-45 wall jack unit. The link between building runs from each office socket to building distribution frame located at the ground floor of each building. The configuration provides more than 100% redundancy because two cables are going to each office socket giving two active ports and two backup lines.

Between buildings fiber-optic cables provide 100Mbits/sec data transfer rate and electrical isolation in case of lightning etc. Thus makes an easy upgrade path to 100 Mbits/sec.

3.4.1.1 Hardware And Software

Server Hardware

ILRI network has two file servers, with the following specifications:

Server name	ILCA-HQ-2	ILRI-ETH-01
Brand	AST PREMIUM	AST MANHATTAN P SERIES 5090
Netware Version	Novell Netware V3.11 (100 user)	Novell Netware V3.11 (100 user)
Hard Disc	Capacity2 X 670 MB (duplexed)	2 X 1.3 GB (mirrored)
RAM:	12 MB	32 MB
Processor:	Intel 386/25	Intel P5-90
System Fault Tolerance:	Level II	Level II
Transaction Tracking	YES	YES
Connections Supported	100	100
Connections in use	64	99
Network Address	0000F002	0000F004
Active Profile	FINANCE and ADMIN	ILRI-ETH01

There are 150 IBM compatible 80486 Pentium PC workstations all running windows 95 operating system at ILRI compound. All are connected by western digital ethercard plus 10 Base T. other hardware for network management, backup, and distribution include:

- **Network Management** (1 AST Premium 386/25; 2 MB RAM; 1.2 and 1.44 MB FDD; 40 MB IDE HDD)
- **Data Distribution Equipment** (Synoptics 3030 concentrator; Synoptics retiming module; Synoptics 10BaseT module)
- **Cable Distribution Equipment** (Unshielded Twisted Pair category 5 cable within buildings; Fiber optic cables between buildings; RJ-45 wall jack unit)
- **Power Protection** (UPSs for file servers (Taesung 10000); UPSs for each concentrator (Taesung 10000); UPS for DAT (1 2.5 GB DAT drive for tape backup))

The network uses the following software for network management, standard user applications and utilities:

- **Novell Netware 3.1 - Network Operating System; Dbase IV 1.1 - Data Management; Freelance 3.1/4.0 – Graphics; Lotus 123 3.0 – Spreadsheet; Wordstar 6.0 - Word Processing; SAS – Statistical; ACCPAC PLUS - accounting software**
- **E-Mail And Communication (Network Courier 2.1b - Electronic Mail); Arcserve - tape backup software; Monitrix 1.1 - Netware Management; Sitelock - Anti-virus software;**
- **Utility** (Xtreenet - DOS Shell program)

3.4.1.2 Configuration Of The Network

Netware Volumes

In each of the two active servers, two netware volumes were created: SYS and USER. SYS volume is used to keep operating system files in SYSTEM directory, netware external command files in PUBLIC directory, and various application programs such as Dbase IV, Lotus 1-2-3, Freelance Graphics, Wordstar, SAS, SPSSS, etc. USER volume is used to keep LAN users' files under HOME directory. The following section shows the directory structure of the two file servers.

- DOMAIN: HEADQUARTER
- SERVER: ILCA-HQ-2
- VOLUME: SYS and USER

VOLUME	DIRECTORIES	SUB DIRECTORIES	FILES
SYS	APPS	Monitrix	pc
		Sitelock	11 files
		Utils	Netmon 2 files
		Xtnet	50 files
	BATCH	58 files	
	LOGIN	HP_Print	6 files
		38 filess	
	MAIL	5000020	1file
		8602002c	1 file
		F6020059	
	PUBLIC	Castelle	22 files
		Download	Ecoregig Spaform
		La	12 files
		Longmsg	1 file
		MSDOS	AST Tandon
		Scan	28 files
		Scanv	4 files
		Toolkit	39 files
		Utils	1 file
	SYSTEM	43000002.qdr	2 files
		Sitlock	1 file
	TUTOR	123tutor	22 files
		dbtutor	85 files
		Wstutor	TUTOR Tutor
		Dostutor	
USER	TRAVEL	Travel Travel2 Travel	

- DOMAIN: HEADQUARTER
- SERVER: ILRI-ETH-01
- VOLUME: SYS and USER

VOLUME	DIRECTORIES	SUB DIRECTORIES	FILES
SYS	APPS	Cdapps	Cial Spirs
		Ddv	11 files
		Sitelock	11 files
		Util	Netmon 2 files
		Xtnet	51 files
	BATCH	Yybat 64 files	6 files
	COURIER	Mailexe	123 files
	LEITCH	BUDGET	5 FILES
		INTRANET	Aciar Danida 164 files
		SOFTWARE	Win31 Win95
	LOGIN	HP_Print	13 files
		Xerox	1 file
		40 objects	
	MAIL	4003000e	
		4c010001	1 file
		A010001	1 file
	PUBLIC	Ar	1 file
		Castelle	Lpv330 21 files
		Dirctjet	HP_print 5 files
		Jetdirct	HP_Print 6 files
		Lanmanag	2 files
		Scanv	2 files
		Toolkit	39 files
		Utils	4 files
	TUTOR	123tutor	23 files
		Dbtutor	85 files
		Dostutor	30 files
		Novell	NWSS1 NWSS2
		Wstutor	TUTOR Tutor
USER	MAILDATA	33 Objects	

3.4.2 Network Users Group Information

The network users at ILRI are assigned four levels of access to the network. These include:

- Regular network users, those who work from the network. They can run applications and work with files according to the rights assigned to them.
- Operators (file server console operators, print queue operators, print server operators), are regular network users who have been assigned additional privileges. For example, print queue operator has a privilege to redirect printing.
- Managers (workgroup managers, user account managers), are users who have been given responsibility for creating and/or managing other users. Workgroup managers can create and manage users; user account managers can manage, but not create users. Managers function as supervisors over a particular group, but they do not have supervisor equivalence.
- Network supervisors, are responsible for the smooth operation of the whole network. Network supervisors maintain the system, restructuring and updating it as needed.

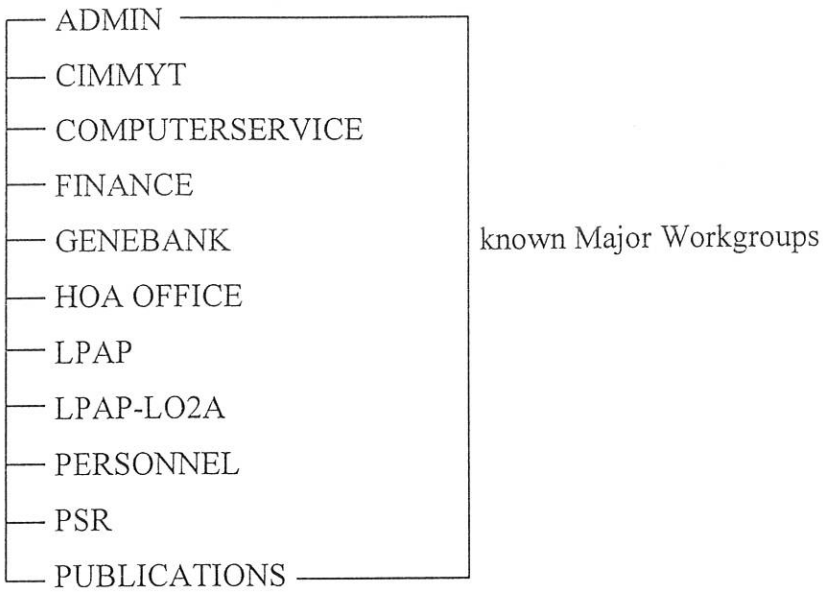
The numbers of regular users vary from application to application. Database and spreadsheet applications are widely used by staff at ILRI. The following table provides a cross-section of users of various applications.

Table 3-2, Group Information on ILRI-ETH-01 Server

	Group Information	
Group Names	**Full Name for the Service**	**Member List**
123 USERS	Lotus 123 V3.1	109
ACCPAC	ACCPAC Plus Users	23
CHECKAVTK	Anti-Virus Toolkit Check Users	1 (NETMANA)
CLIPUSERS	Clipper Users	3
CSCALLS	Computer support call dispatchers	3
DBUSERS	DBASE IV Users	109
ECOREGIG	Eco-regional Initiatives Interest Group	13
FLUSERS	Freelance Plus Users	85
IBBS	ILRI's Local Bulletin Board	EVERYONE

ISISRES	CDS/ISIS Research	5
ISISRW	CDS/ISIS Read/Write Group	27
MAILUSERS	MS Mail User group	EVERYONE
MSEXCHANGEUSERS	WINDOWS 95 Users	19
PRE_PRINT	Pre print workgroup files pool	6
SASUSERS	Sas Users gropu	25
SPSSWIN	SPSS for Windows	21
TRG-COMP-LAB	Training Computer Lab	10
WCBBS	WildCat Bulletin Board System	8
WPUSERS	Wordperfect/Wordstar Users	124

Users on the network are grouped into smaller working groups based on areas of research and functions in the organization. The admin group, for example connects users working in the administration. The following diagram shows working groups that have been created to facilitate collaboration team and file sharing network users.



3.4.3 Security Features on the Network

All information on the network is stored in a central location, the file server's hard disk. However, all users are not authorized to access all information (such as payroll files). Adequate measures have been also taken to avoid the accident of over-writing of

files. The following features have been implemented at ILRI LAN to improve the security of the network.

- Login security, which includes creating usernames and passwords and imposing station, time, and account restrictions on users.
- Trustee rights (privileges), to control which directories and files a user can access and what the user is allowed to do with those directories and files, such as creating, reading, erasing, or writing to them.
- Attributes assigned to directories and files, this involves determining whether that directory or file can be deleted, copied, viewed, or written to. Among other things, they also mark a file as shareable or non-shareable.

3.4.4 Network Applications

3.4.4.1 Printing

One of the applications of the network is printing. Users send print requests from anywhere on the LAN, a print job leaves the workstation, stored temporarily in a print queue on the file server, and get printed as soon as the printer is ready for next queue.

There are two types of printers used on the network:

- Local printer - printer connected to client workstations
- Network printers - Printers that are directly connected to the file servers or connected to the network via the RJ45 wall-jacks using any network printer interface devices or printers connected to another workstation which is connected to the LAN.

3.4.4.2 User Applications

Users at ILRI run two types of applications: standalone applications and network application

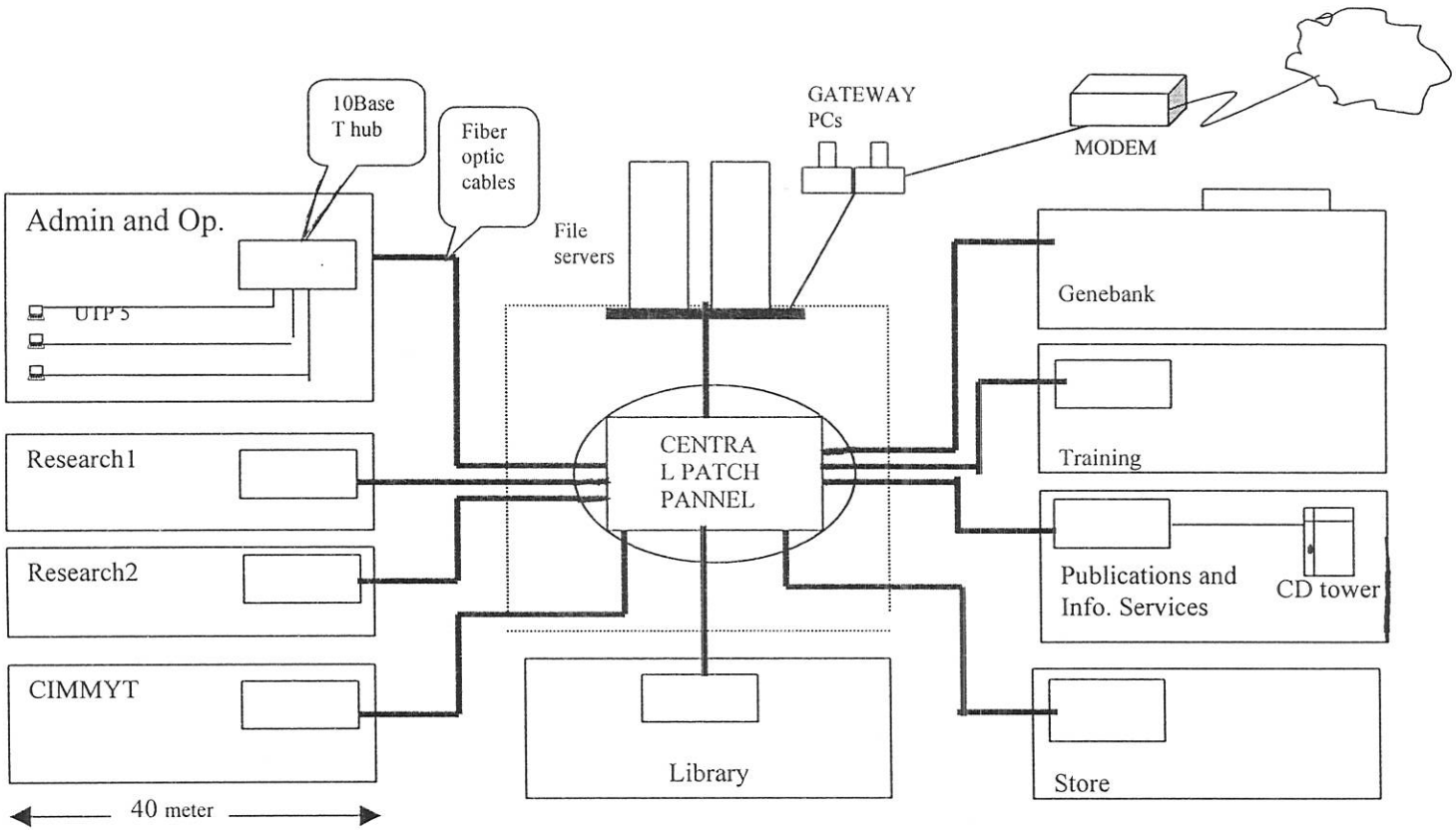
software. The standalone application software runs from the hard disk of a stand-alone personal computer. Network application software are those designed to run on networked computers and can be shared by a number of users. The following application software are installed on the network.

Word processing:	WordStar
Spreadsheet:	Lotus 1-2-3
Data management:	dBASE
Graphics:	Freelance
Statistics:	SAS
Utilities:	Xtree Net

3.4.5 A model of Existing Network Infrastructure

The physical layout of the **LAN** infrastructure is presented to support the review made above. Basic topological structures including the position of components, the file servers, hubs, premise wire distribution system, gateways, etc. are described in this graphical presentation

Figure 3-1, Topological structure of ILRI's LAN



3.5 Digitized Information Resources at ILRI

Information resources generated internally information that is meant for institution-wide use, operation and management could take two forms: unstructured and structured type of information. The unstructured type normally consists of flat file documents such as reports, manuals and proceedings. The structured type of information consists of databases and associated records, well organized and indexed so as to allow easy retrieval. This section provides an overview of structured and non-structured information available at ILRI.

Although a wide range of unstructured information exists at ILRI, this study confines to electronically available resources to be shared on the LAN. Complete lists of databases also possess difficulty. Each time a research project is launched, one or more database is often created to keep records of the particular project and to report the outcome. However, once the project is over, the status of the databases ends - then after it will only be kept for archival purposes. Therefore, it is difficult to list all databases in the research areas, not to mention a complete description.

3.5.1 Unstructured Electronic Information Resources

The central reference point for the review of non structured information is the ILRI BBS. The ILRI BBS is DOS batch file that is used to facilitate sharing information, downloading files, searching CD-ROM based agricultural databases, updating programs, etc. on the LAN. This service is meant for use by everyone and it is located in the SYS:BATCH directory of each file server. A program called 'LIST.EXE' is resident within the SYS:BATCH\UTILS directory to allow display of files on the screen. The main files that needs worthy of description are the following.

- Directory/Lists- Telephone Directory
- Travel Information
- Calendar of Events
- Training Quarterly Summary
- New Reprints added to the Library
- ILRI Contributions to Peer-reviewed Journals
- ILRI Contributions to Proceedings
- Accession List
- Forthcoming Conferences, Workshops, and Seminars
- ILRI Programs and Departments List
- Manuals - LAN Basics Manual, LAN Users' Guide Manual, Personnel Policy Manual, Staff Development Policy Manual, Tutorials and Course Notes
- Newsletters
- Reports - Report of the Director General, Medium Term Plan
- Minutes: ILRI-ETH Senior Staff Meeting Minute, Minutes of Program Management Committee Meeting
- Forms And Sheets - staff Performance Appraisal Form, Mailing Database Input/Update Sheet
- Statues -

In addition to the above list of digitised resources that are readily available for institution-wide consumption (on browsing mode on the screen or for downloading and printing), there are other electronic files that are published by individual staff and organisation. These electronic files are under the process of conversion to PDF format to encourage exchange. Some of these files are

listed below.

Table 3-3, List of Electronic Files

DOCUMENT CATEGORY	HOLDINGS	LANGUAGE
Communication Instruction series	Audiotutorial module 1 – 4	EN and FR
ILCA Annual Program Report	ILCA APR 92	EN
ILCA Annual Report	ILCA AR 90 – 94	EN, FR
Feed Evaluation	ILCA manual 5	EN
ILCA Proceedings	4 different Volumes	EN
ILCA Research Report	1 Volume	EN
ILCA Systems Study	1 volume	EN
ILCA Training Manual	2 volumes	EN
ILRAD Annual Report	ILRAD 90 – 94	EN
ILRAD Proceedings	9 different volumes	EN
ILRI Annual Report	ILRI AR 95 – 96	EN, FR, SP
ILRI Manual 1	1 Volume	EN
ILRI Proceedings	8 Volumes	EN
ILRI Training manual	ILRI TM 1 and 2	EN
Rural Dairy processing training series	Audiotutorial Module, 1 – 4	EN and FR

3.5.2 Databases

One of an institutional information resource is data or information maintained in a form of a database. A database is an organised collection of related records which give information about a particular entity using certain describable features. Since one of the concern of this study is to allow a single access point for pockets of institutional databases using the Web technology, it is important to review these resources. The following section is devoted to databases categorised by the unit, program or department responsible for creating and maintaining them.

3.5.2.1 Biosciences

Identification: PASSPORT.DBF

Location/Owner: FORAGE GENETIC RESOURCES

Description:

PASASSPORT.DBF is a database of tropical forage germplasm containing a descriptive

data relating to the identification and collection sites of the accessions stored in the ILRI genebank. It is created using dBASE III+ and exists in compressed form. This database is related to other four files on the accessions in the genebank through the accession number field. The four related databases are the following

- CROSSREF.DBF, which is a cross reference data to the other accession numbers in other genebanks of this accession.
- ILCANO.DBF, holds the information on previous ILCA accession numbers assigned to this accession
- ADDRES1.DBF, holds the code and the full names and addresses of the institutes in the fields COLL_INST and ORGANIZAT in the PASSPORT.DBF. Files are related through the code.
- COUNCODE.DBF, holds the codes of full country name of the country of collection data.

Identification: RHACC.XLS

Location/Owner: FORAGE GENETIC RESOURCES

Description:

RHACC.XLS is a Rhizobium strain database management system in a compressed form. The database is created using Microsoft Excel and available in Dbase III+ format. It contains the descriptive data relating to the identification (passport data), as well as to isolation of strains and collection sites of the strains stored in the ILRI genebank. The related files to RHACC.XLS include:

- RHSYNONYM.XLS, which holds the synonym data to the other strain numbers in other genebanks of this accession. Files are related through the CG accession identifier (ACCID)
- RHCOLSITE.XLS, holds the detailed description of site where the accessions were collected

in the field.

- RHCOLCOOP.XLS, which holds collector co-operator codes to allow for multiple collectors per accession.
- RHCOOP.XLS, holds details about all co-operators. Files are related through the co-operator code (CCODE)
- ACCREF.XLS, holds references to publications and/or other data sources.
- RHSAFETY.XLS, holds co-operator codes that indicate where an accession is safely duplicated.
- EFFECTIVE.XLS, holds records on the symbiotic effectiveness of strains.

Identification: DAGRI.MST

Location/Owner: ANIMAL GENETIC REOURCES

Description:

DAGRI.MST is a database system developed using Micro CDS/ISIS database management program. It is an integrated database system containing different types of records together. The different types of records associated in the database include the following

- Structure of breed characterisation information from literature
- Structure of breed population and performance data from NARS
- Structure of environment information record
- Data structure of contact persons from NARS (responding to questionnaires)
- Data structure of source document description (reference to the first record type)

3.5.2.2 Sustainable Production System Program

Identification: CBWHA88.DBF

Location/Owner: Highlands project

Description:

CBWHA88.DBF is a database of comparative bread wheat varieties study on drained veristols for high-altitude Ethiopian highlands. It is a numerical database that provides information on the amount of the grain yield tested on different treatments and seed moisture. The database is created and maintained using dBASE IV database management program.

Identification: **SOILMOST.DBF**

Location/Owner: Highlands

Description:

SOILMOST.DBF is a numerical database that provides information on the characteristics of a wet soil. The database is created using dBASE IV database management program.

In addition, the sustainable production systems program maintains quite a number of different types of databases in the Livestock Production Systems, mainly dealing on land tenure and dairy draft in the Arsi highlands and Holetta area.

3.5.2.3 Strengthening Partnership With NARS Program

Information Services

Identification: CONF.MST

Location/owner: Information Services

Description:

CONF.MST is a CDS/ISIS database that provides information on the list of forthcoming conferences on the area of ILRI domain and it is updated regularly to alert ILRI scientists. The database contains 595 records.

Identification: ILRIB

Location/Owner: Information Services

Description:

ILRIB is a bibliographic database of ILRI's library holdings as well as subsets of CAB international and AGRIS databases on animal agriculture. The database is created and maintained using CDS/ISIS 3.07. Currently the database has 109, 000 records

Database Structure:

Identification: ILRIP

Location/Owner: Information Services

Description:

ILRIP is a database of ILRI's publication as well as that of its scientists. It is created again using the CDS/ISIS software. The database contains 4, 600 records.

Identification: ILRIT

Location/Owner: Information Services

Description:

ILRIT is a time series data, starting from 1961 on production and trade in Livestock and their products for 193 countries and territories. The database holds more than 411, 000 records. It is created and maintained using the CDS/ISIS.

Identification: LIRS

Location/Owner: Information Services

Description:

LIRS is a directory of information resources on animal agriculture throughout the world. The database is created using CDS/ISIS and currently it contains 265 records

Identification: MAIL

Location/Owner: Information Services

Description:

MAIL is again a CDS/ISIS database containing records on address list of recipients of ILRI publications as well as the type(s) of publications.

Identification: SRLS

Location/Owner: Information Services

Description:

SRLS is CDS/ISIS database containing records of subscription information of serials. It contains data on currently subscribed or whose subscription has stopped and a record of completed holdings and bound serials. The database contains 1,242 records.

In addition to the above active databases created and maintained by the information services, there are other databases that are currently inactive. The list of these databases include HERBS, LEGSCR, SEEDS, VEGBOR, GROUP, INDIV, STAFDE, TRAINE, NARS, OUTRCH, MAILIN, AND MAILOU.

Publications

Identification: **ELECTRONIC FILES**

Location/Owner: Publication

Description:

Electronic Files is a database of electronic files containing records for the publishing activities of the unit. The files of the electronic version of the printed document are kept in a form of a database to allow easy communication within the publication staff about the status of a given document being processed. The database is created using Microsoft Excel and currently there are about 50 electronic files organized in a form of a database.

Identification: SLIDES*.IPG

Location/Owner: Publication Unit

Description:

This is an image database developed using Quick Imagebase software. The sources of the image base are slides of different types, mainly showing the different types of livestock breeds. The imagebase contains 890 records. Each record is described by image title, primary subject, date, location and territory where the image is captured.

Database Structure:

Identification: CGIAR SSA Training Database.mdb

Location/Owner: Training

Description:

This database contains a profile of individual and group trainees who have been offered training courses at different times on different subject areas. the records in the database contain information on the trainees detail, the type of training, funding requirement and name of the Consultative Group center.

3.5.2.4 Admin and Operation

The two main areas in the Admin and Operation that create and manage databases are the Personnel and the Finance department. Apart from various types of repackaged and consolidated management and activity reports generated from these two departments, there are several databases created and maintained many of which are sensitive to security. The finance department maintain personal account management, fixed and current asset management, cost center and project level budget management, property control management, and payroll system. The finance department uses mainly 'ACCPAC' software and in some instances records can be exported to Excel for further consolidation of data.

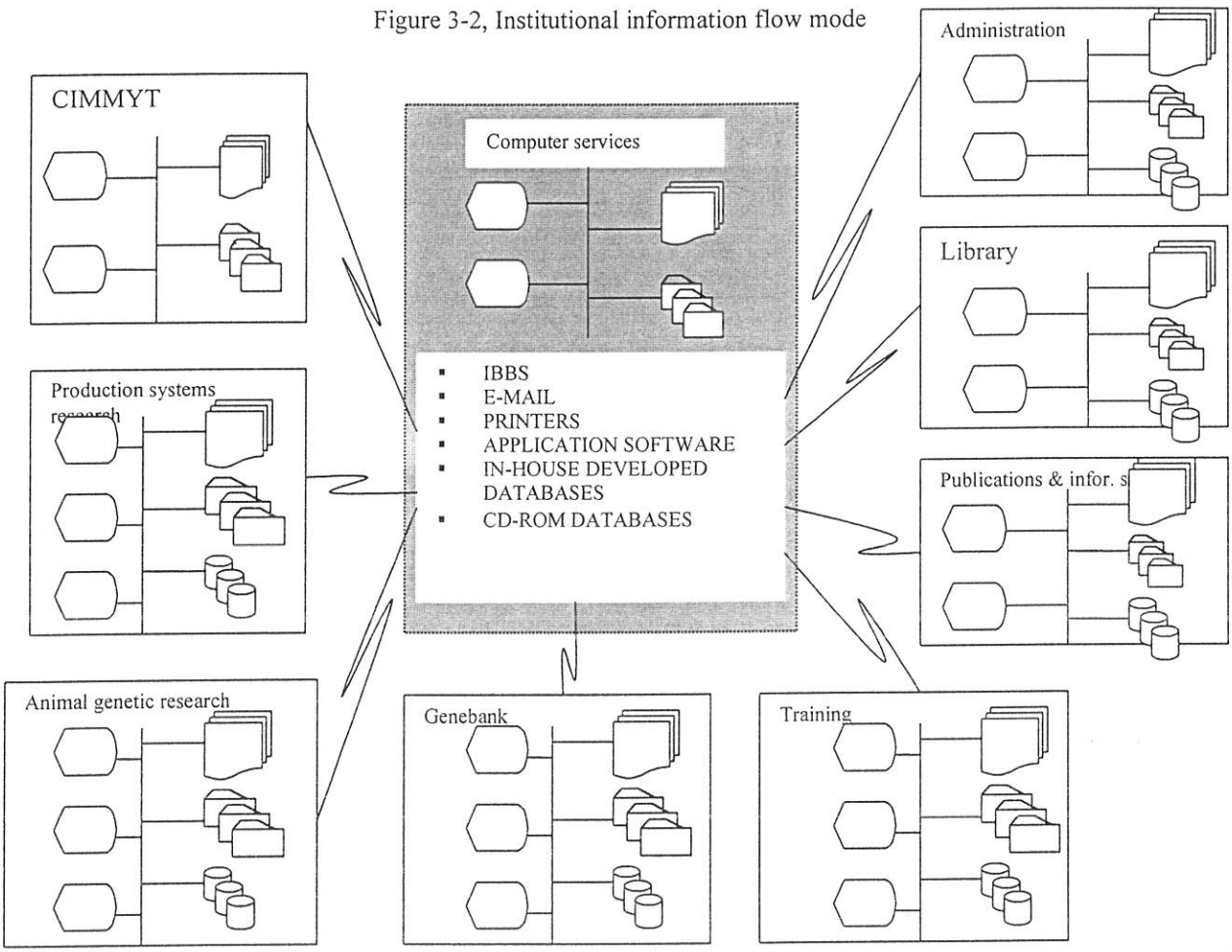
The personnel department is chiefly concerned with three database management systems. Personnel Information System (PIS), Insurance Management System (such as Medical Insurance System - MIS), and Leave Record System. The personnel information system organizes nationally recruited staff as well as internationally recruited staff detail and employment history. The medical insurance system controls and manages medical care benefit related expenses of the staff by keeping track of records for internal use and for claim information to the Insurer. The Leave records management system is maintained to manage leave balance details of the staff.

3.5.3 Institutional Information Flow

After reviewing the digitized information resources available at ILRI, attempt is made to model existing institutional communication flow. For the digitized information resources

The network infrastructure combined with the paper based delivery serve as the chief means of communication. The model shows how each workgroup shares multiple documents, databases, shared folders within its workgroup and through the LAN with other entities.

Figure 3-2, Institutional information flow mode



3.6 COCNCLUSION

This chapter has reviewed the infrastructural facilities available at ILRI. Based on the three main components of Intranet deployment: organizational framework, technical infrastructure and content, detail review and description of the existing system is reported. In terms of the organizational process, efficiency and accountability are the guiding principles of the institute. Various components of the network infrastructure such as the cabling, the backbone, the LAN type, file servers, and the file and print services are all reviewed.

In reviewing the overall infrastructure emphasis was placed on the content, about the volume, type, storage and access mechanism currently used. This is felt very essential because it is the content when structured very well that adds value to the user. In this regard, basic description of some 23 major electronic resources found on the ILRI Bulletin Board Service (IBBS), 15 electronic files and 35 databases were covered in some degree of depth. These resources can be potentially valuable for ILRI's Intranet site deployment. A review of experiences in many of the developed world shows many of the Intranet sites are now offering internal users mainly with human resource information such as policy manuals, procedure statements, personal accounts, purchase order forms, shopping carts, forms for address changes, etc.

CHAPTER IV

NEED ASSESSMENT FOR INTRANET SOLUTION

4.1 Introduction

The survey research method was used to investigate ILRI's information resource sharing system. In the course of the investigation, relevant facts were collected some of which are presented in the preceding chapter. This chapter provides information on the survey results specifically obtained from the end-users in an attempt to gain their needs, nature of collaboration, plans for upgrade, etc. The questionnaire method was used as survey instrument to gather the end-users opinion of the existing information resource sharing system.

The questionnaire (appendix -3) contains three major sections each of which presented related and interdependent questions. These three sections are: network utilization (which relates to Infrastructure), content, and organizational interaction (relates to organizational process). The sections were formed deliberately because they address the three key components of an Intranet deployment as suggested by Telleen. There are also two minor sections included in the questionnaire, one intended for bio-data and the other for general impression by way of conclusion.

In this chapter, the analysis of the respondent's reaction is summarized with a brief discussion of the survey results obtained. At the end, problems and requirements of the existing resource sharing system are stated.

4.2 Users Profile

All the staff with a network account were considered as the population for this study. This decision is made with a belief that these categories of the staff can have a need for upgrade of the network to more advanced information delivery system. Table 4-1 shows the user population covered in this study.

Table 4-1, Network account Users

Program/Sub Program	No. of Staff with Network Account
Biosciences	11
Production systems	29
SPAN	30
Research Support	19
Administration & Operation	40
Directorate & SPS	6
CIMMYT	5
ICRISAT	1
Total	141

This study has chosen a purposive sampling method. This kind of sampling method belongs to non-probabilistic sampling method and the sample size was defined by taking about 40% of the population of ILRI. Table 4-2 shows the actual unit of analysis that received the questionnaire

Table 4-2, Unit of Analysis

Program/Sub Program	Selected Respondents	%
Biosciences	6	10.9
Production Systems	12	21.8
SPAN	12	21.8
Research support	6	10.9
Administration & operation	14	25.5
Directorate & SPS	2	3.6
CIMMYT	2	3.6
ICRISAT	1	1.8
TOTAL	55	99.9

From the distributed questionnaires, 30 were returned which accounts 55% of return rate. The

following section gives a summarized profile of these respondents by their bio-data.

Table 4-3, Respondents by their Program/Sub Program

Program/Sub Program	No. of Respondents	%
Biosceinces	3	10
Production Systems	6	20
SPAN	7	23.4
Research Support	3	10
Administration & Operations	5	16.7
Directorate & SPS	1	3.3
CIMMYT	2	6.7
ICRISAT	2	6.7
Unspecified	1	3.3
TOTAL	30	100

Table 4-4, Respondents by their educational background

Educational Background	No. of Respondents	%
PH.D & above (Scientists)	7	23.3
MA/MSc	6	20
BA/BSc	9	30
Diploma and below	6	20
Unspecified	2	6.7
TOTAL	30	100

Table 4-5, Respondents by the number of year of experience in the Institute

No. of Year of Experience	No. of Respondents	%
Between 1 - 5	4	14.2
6 - 10	8	28.6
11 - 15	8	28.6
16 - 20	3	10.7
Above 20	5	17.8
Unspecified	2	
Total	28	100

4.3 Survey Results and Discussion

4.3.1 Extent of Network Utilization

Questions were asked to identify how the 'end-users' are using their computers to do their day-to-day activity, how frequently they are utilizing the network resource and for what purpose they are

using it. The following section summarizes respondents use of the network.

Table 4-6, Nature of Computer Use

Computer is Used	No. of Respondents	%
As a stand alone	3	10
By logging into the network server	10	33.3
Both ways	17	56.7
Total	30	100

Table 4-7, Frequency of Network Use

Frequency of Use	No. of Respondents	%
Several times a day	25	86.2
Once in two days	2	6.9
Once in three days	0	0
Once in a week	2	6.9
Unspecified	1	-
Total	29	100

Table 4-6 and table 4-7 above demonstrate the fact that there is high percentage of network use in the organization.

Users were again asked to indicate the reason(s) to log into the network. The respondents have checked one and more reasons from the possible alternatives provided. Table 4-8 summarizes their reason for logging into the network.

Table 4-8, Purpose of Network Use

Purpose of Network Use	No. of Respondents	%
For communication (such as e-mail)	9	31
To use the IBBS	1	3.4
For e-mail and to run application software	4	3.8
To send file to the printer	6	20.6
To access shared folders	2	6.8
For all of the above purposes	7	24.2
Unspecified	1	
Total	29	100

4.3.2 Content Creation and Communication

Questions were also asked to obtain the users reaction regarding whether they keep activity related information electronically, the type of information they maintain and the mechanism they use to distribute this information if it is meant for use by their colleagues.

The respondents were first asked whether they maintain their program or project related information. 58.6% of the respondents say 'yes' that they maintain electronic information and 41.4% said that they do not maintain electronic information. Respondents were also asked the type of information they maintain. The result is provided in table 4-9.

Table 4-9, Type of Information

Type of Information Maintained	No. of Respondents	%
Text only	10	34.4
Text & numeric	94	31
Image & Photo	4	13.8
Text, Image, Photo	3	10.3
Text, Image & Numeric	3	10.3
Unspecified	1	
Total	29	100

When asked whether they distribute the information they produce to colleagues, 60% said 'Yes" and 40% said 'No' and those who said Yes were again asked what mechanism they use to make available their information product for others use. The majority used paper-based delivery system to disseminate information to their colleagues (table 4-10).

Table 4-10, Mechanism Used

Mechanism Used	No. of Respondents	%
Posting on the IBBS	3	10.7
Sending e-mail	5	17.8
Distributing Printed Copy	8	28.6
Soft copy or printed copy when requested	4	14.2
IBBS and e-mail	4	14.2
IBBS and print copy	4	14.2
Unspecified	2	
Total	28	100

Finally, respondents were asked whether they are faced with too much paper volume piled up in

their office file cabinets and shelves, 36.7% said 'Yes' and 63.3% said 'No'.

4.4 Organizational Communication Pattern

What event causes the initiation of any communicating mission and how this task is effected are central to the understanding and design of a new communication model. After reviewing common organizational communication styles and formats and their corresponding medium which deliver the communication content, survey respondents were asked different questions to get details of the types of information they communicate and how they communicate. In these blocks of questions, users were asked about common institutional communication elements and the medium they use. The following grid shows a summarized result of these details. Only the highest and the lowest rated options are indicated for each communication elements.

Table 4-11, Organizational communication pattern

	Medium Used					
Communication Elements	Tel.	Email	IBBS	Doc./ forms	Meeting	Informal comm.
Messaging & notification	15.3	31%	-	36%	-	7.6%
Organizational issue	-	21.7%	21.7%	56.5%	-	-
Workflow processing	10.4%	5%	-	84.6%	-	-
Reports, newsletters	-	21.2%	15.2	52.8%	-	10.7%
Internal inquiries	6.8%	16.8%	-	65%	-	10.3%
Personnel issues	5.8%	14.6%	15.4%	64%	-	-
Departmental routines	10.3%	41%	-	41.5%	-	6.8%
Team work progress	25%	19.1%	4.1%	51.7%	-	-
Research collaboration	16	34%	-	50%	-	-
External contact	23.2%	40.8%	-	35.8%	-	-
Financial information	18.5%	-	-	59.2%		22.2%
Cross-functional projects, committee works		37.9%		54.3%		7.6%

In addition to the above cases that can typically signify an organization's communication process, other questions were also included to judge the on-line culture of ILRI staff. The first question relates to how each individual keeps informed of himself/herself about the activities going on and

changes taking place in other entities. The majority of the respondents (36.7%) said that they use E-mail, 30% used both e-mail and printed document and few respondents (10%) said they use IBBS or the printed document (table 4-12).

Table 4-12, Means of updating self

MECHANISM USED	No. OF RESPONDENTS	%
IBBS	3	10
Printed document	3	10
E-mail	11	36.7
Formal meetings	4	13.3
E-mail and printed document	9	30
Total	30	100

Respondents were also asked how they update their colleagues about the activities going on and changes taking place within their functional area. The majority (50%) said that they use the IBBS and the least was to informal communication (3.3%) (table 4-13).

Table 4-13, Means of updating others

MECHANISM USED	No. OF RESPONDENTS	%
IBBS	15	50
Printed document	8	26.7
E-mail	4	13.3
Formal meetings	2	6.7
Informal meetings	1	3.3
Total	30	100

4.5 General Description

As a concluding remark, general questions were asked to get respondent's overall impression of how they execute their day-to-day activities, whether in team or by their own, individually. The results show that group collaboration in ILRI are significant (table 4-14).

Table 4-14, Nature of collaboration

STYLE OF JOB EXECUTION	No. OF RESPONDENTS	%
Individually by my own	5	16.6
In group, Team, Committee, Task Force	10	34
In collaboration with immediate supervisor	6	20
Individually and in group	5	16.6
Individually and with immediate supervisor	4	13.3
Total	30	100

Respondents were also asked if there is anything they consider as a problem that hinders information access. They rated lack of adequate facility as the major problem and information overload as a minor issue (table 4-15)

Table 4-15, Problems of information access

LIKELY SUGGESTED PROBLEMS	No. OF RESPONDENTS	%
Information overload (too much information)	4	13.7
Information identification (not knowing where it is located)	4	13.7
Lack of adequate facility	8	27.5
No problem	6	20.6
Information identification and lack of facility	7	24.1
Unspecified	1	
Total	29	100

They were asked if they have any identified plan and need in regard to improving electronic information communication infrastructure available at their disposal, 59.3% of the respondents said 'Yes" and they recommend the following:

- Convert the existing IBBS into a usable form
- Give Internet training to staff
- Establish Web page design
- Connect ILRI to the Internet
- Mount databases on an Intranet in both Addis and Nairobi campuses and ultimately on the WWW

Finally, respondents were asked to give their opinion about the overall idea of the 'Intranet

Solution'. They were required to base their reaction on the briefings given during the introductory seminar arranged for the entire ILRI staff, before the study was launched. The following reaction pertains to this fact.

Table 4-16, Overall opinion

MEASUREMENT INDICES	No. OF RESPONDENTS	%
Strongly Agree	14	48.3
Agree	7	24.1
Indifferent / Neutral	6	20.7
Disagree	1	3.4
Do not have any idea	2	6.9
Total	30	100

4.6 Summary of Survey Results

4.6.1 Users Profile:

As shown in table 4-3 survey respondents were fairly represented in all the programs and research support units. This has helped the study to obtain a cross-sectioned view of the whole spectrum of the Institute. When the composition of the respondent's were seen by different variables, it can be judged that their reaction can be taken for granted to draw a logical conclusion. In respect of their educational background, 9 out of 28 valid respondent's are first degree holders (BA/BSc) which is 30% and the next highly rated respondents were the scientists who have PhD and above and they account for 25% of the respondents (table 4-4). The majority of the respondents, 57%, have 6 - 15 years of experience in the Institute. The number of respondent's whose experience is above 20 years are the second highly rated and account for 17.8%.

4.6.2 Extent of Network Utilization

In this category of questions, respondents were first asked 'how they are using their computer - as a stand alone or as network client or both ways.' Majority of the respondent's 56.7% said both ways and only 3 out of 30 or 10% said as a stand alone (table 4-6). This shows that the network

utilization is very high. Average daily use of the network or the frequency of use was asked and according to the result obtained 86.2% or 25 out of 29 total said several times a day and only 2 respondents or 6.9% said once in a week. The answers to the above questions and the result obtained is a good indication that there is more chance for the client machines to be used as Netware clients and this has happened several times a day (table 4-7).

The above result reveals heavy utilization of the network regardless of the purpose for which it is used. Purpose of use of the network was, thus, the next question asked. According to the respondent's reaction, E-mail was rated the highest accounting for 41% and the least was to visit the IBBS.

4.6.3 Content

Asked whether respondents maintain electronic information, 58.6% said yes and 41.4% said no. This indicates that majority of the users have their information in electronic format. When asked what type of information they maintain, majority of the respondents, 34.4% said they maintain textual information followed by textual and numeric information which accounts for 31%. The least rated type of information is image and photo which is 10.3%. This gives a clue that in many of the cases the data transported over the network is mainly ASCII files and there seems to be less bandwidth problem, with the existing 10 Mbps bandwidth.

Users were also asked about the mechanism they use to make available their information product for others use. Printed copy is rated the highest accounting for 28.6% followed by e-mail, 17.8%, and the least was the IBBS which is 10.7% (table 4-10).

4.6.4 Organisational Communication Pattern

A summary of all communication elements presented in the questionnaire was reported in table 4-11. These questions were mainly intended to measure the users pattern of institutional communication. The result obtained was summarised in one matrix and it shows that the paper based communication is the dominant pattern discovered. In 10 of the 12 listed common organisational communication elements, the paper based medium was rated the highest. E-mail was rated the second highest medium for institutional communication purpose. The IBBS which was established as the main platform for the institute wide information sharing was rated the least.

4.7 Organisational Set Up

Based on their institutional role, responsibility and the type of information they require the ILRI-Ethiopia staffs are identified to constitute the following categories.

- Board of Trustees - a group of high level officials who cater at the strategic management of the Institute. They usually convene once in a year and pass key decisions and approve annual work plans and budgets. The type of information these group require is, in most cases, key executive summary reports of ILRI-wide activities, current agendas and future plans.
- Directorate General - the Directorate General (DG), the external relations officer, deputy DG, Director of administration and the internal auditors form these category. These category of users are concerned with the Institution management and basically their information need ranges from a synthesised report of institution-wide activities to key management decisions taken regarding current activities and future plans. Mission critical reports, fund request protocol documents, medium and long range plan documents, Summarised statements of budget use are also required by the DG group.
- Program Directors - Program Directors are leading research scientists, who along with project

co-ordinators and leaders are responsible for the execution of research activities. The information needs of these groups of user community include scientific and technical information on current development and state-of-the-art of their research work, information on seminar, conference and proceeding papers, information on how to prepare funding request protocols and documents, information on their budget usage, etc.

- Research Supporters - these group of information users are those who are involved with playing a facilitation role to the research undertakings of the Institute. These are the research technologists, data analysts, database managers, data collectors, field assistants, laboratory attendants, the knowledge worker in the information services, the computer engineers and others in similar line of activity. Their institutional information need includes operational and procedural type of information which will assist them in executing their day-to-day activities.
- Operation Managers / Middle Level Managers - these groups are heads of departments, sections and units mainly found on the administrative, technical and operational areas. These include head of publications, head of finance, head of personnel, head of technical documentation, head of computer services, project supervisors, etc. Their information need varies depending on the specific units or sections they are running and heavily focus on activity reports and problems as reported to them by their subordinates. These categories of users interface the activities between the front-line operations and the senior management by communicating activity reports and problems.
- Front Line Operators - these category of users are those employees of the Institute who are directly involved with the actual operation of the institute activities. The knowledge worker answering questions to the scientist, the purchaser who is buying requested items, the pressman who is editing published documents or the typesetters who actually design the page layout of published documents, the office services area who are behind the paper work of the

management are some examples of information users in this category. These groups of users heavily use procedural, policy and manual oriented information.

In addition to the above classification of the internal workforce by way of characterising their institutional information need, there are also a wide variety of external entities that have a bearing on the internal information communication process. These are identified as follows:

- National Agricultural Research Systems (NARS) - including Universities, Research Institutes, and Veterinary departments
- International Agricultural Research Centres (IARCs) and Scientific community
- Consultative Group centres, about 16 research centres
- Donors and
- Outsourcing

4.8 Pattern Of Information Flow

According to the result obtained from the survey research, ILRI's institutional communication can be classified at the following levels:

- General Communication: this level of communication involves communication throughout the institute either for formal work activity or message exchange between colleagues. One instance of this kind of communication includes institution wide announcement which is made for the general staff by the head of administration office.
- Inter-program level communication: this is a communication need between program directors and the DG or the head of administration.
- Intra-program level communication: this is a communication need between the program director and project co-ordinator /supervisor/leader, or between program director and department or section heads within the same program

- Intra-project or department level communication: this kind of communication takes place between teams of researchers within a project or between researchers and their assistants, or between heads of departments or units and the operational staff within a department, unit, section, or sub-program.
- Inter-project or department level: this is communication between one project and another project either within the same program or a different program and on the operation side between one department and another department within the same program or a different program. For example, communication between publication unit and training (same program) and communication between publication and finance (different program).

4.9 Limitations of the Existing Information Sharing System

As shown in table 4-11, organisational communication is heavily dependent on paper based delivery. The LAN infrastructure is not optimally used. The ILRI Bulletin Board Service which is designed to serve as the institutional information resource sharing medium is used only when reference to personnel policies and manuals is needed. There are several pockets of databases disparately located throughout the institution. However, each of these independent creations are not transparent, known to others. There is no common access point provided through the LAN for users to navigate across the institute. Currently, database access through the LAN is the same as the traditional file copying service provided by Novell Netware.

In general the problems identified in regard to the information resource sharing and exchange set up can be summarised as:

- The user interface provided in the IBBS is not user friendly.
- Despite the LAN's existence, the paper based information delivery is the dominant pattern
- Several disparate databases exist, but are not known outside the group maintaining them

- A common institutional index to the rich content available does not exist which hinders access
- In many of the cases, content creation is uncontrolled and uniform standards are not adopted
- Database access through the LAN is the same as the file copying service provided by Netware and it is not possible to search for a particular record without copying the entire file of the database
- Several people working on the same database can only update the database record by providing print form updates to the database administrator
- Contributions to the bulletin board service are forwarded by respective units and departments through floppy diskettes and updating occurs quite rarely.

4.10 Identified Requirements

From the opinion gathered through the survey work, both the end users and the top level management have expressed their support towards a reengineered information resource sharing system. They want a system that facilitates easy information sharing both vertically and horizontally in the institute structure. They want a system that promotes not only quick access to institutional information but also a system that presents information in a form desired without requiring further manipulation.

Most particularly, the institutional requirement revolves around the following needs:

- An easy to use electronic information sharing system
- An internal Web site for ILRI
- Web based document publishing and distribution
- An opportunity to tie existing databases to the LAN for record based search
- Quick and easy access to institutional information resources stored in different places.
- A multimedia application over the network infrastructure

- To have a help desk system through the network
- To create multimedia training manuals for use through the LAN
- To set up an electronic discussion forum on various topics.

▪ CHAPTER V

INTRANET DESIGN FOR ILRI

5.1 Overview

In this chapter attempt is made to report **how** the design feature can be framed for ILRI. This chapter is aimed at providing specific details that will facilitate the development of Intranet solution at ILRI. Two sets of details of information are used in this design chapter. First, the background review of the current state of the art of the Intranet solution dealt in the literature review chapter of this report. Second, the review of existing infrastructure, requirements and needs of ILRI, reported in chapter three and four. Both general design features that are intended for overall implementation and the sample design features that will be attempted in this thesis report are included.

5.2 Intranet Design Considerations

In designing the Intranet solution for ILRI, five general design considerations were investigated in this study: performance, cost, usability, manageability, and security. Attempt is made to relate these considerations with ILRI's institutional tradition towards IT acquisition. Any design activity needs to cater for the needs and requirements of the system for which it is intended. To this end, a discussion was made with the head of computer services and the LAN administrator to set priorities for the above considerations.

The LAN administrator[2] was responsible for selection, procurement, installation, maintenance and supervision of all IT technologies for ILRI's network infrastructure. The experience of the LAN administrator together with the survey result was used as a basis for the design process. The

reaction made by the head of the computer services was summarised as: "ILRI has always opted a system that is easy to use by the end user and a system that supports both the scientific and administrative computing need."

The institution policy stated above also conforms to the users need identified through the survey conducted. Therefore, this design chapter will consider identified needs and requirements to re-engineer existing information resource sharing system with alternative solutions.

□

5.3 Design Components

5.3.1 Network Design

ILRI has a LAN in place. The attempt in this section is not to design a new network. The aim of the network design is to restructure the existing network infrastructure to support the Intranet solution. The focus is to establish where changes are required and how these changes can take place in cost effective manner, and of course without disrupting the regular operation. First additional resources are identified. Second, how these additions can be introduced into the existing system will be described.

5.3.1.1 Basic Resources Required

keeping in mind the requirement lists identified in relation to the network infrastructure in chapter four , the additional network resources required are categorised under the following major headings. The specification stating the minimum requirement for each class of components is described in chapter six under deployment of Intranet solution.

[2] Ato Abraham Bekele, Head of Computer Services & LAN Administrator

1 **Hardware Components**

- Switches
- Routers
- Firewalls
- Pentium pro class computers to host the Web server
- 10/100 Mbps NIC

2 **Software Components**

- Web server platform software
- Web server software,
- Database server, FTP server, mail server, news server, proxy server software
- Document publishing authoring tools
- Database connectivity tools
- Plug-ins for multimedia applications
- Web administration tools, for the management of users, security, remote resources, client software, hardware (Web server, routers and connection monitoring), content, collaboration, etc.

5.3.1.2 Strategies for Migration

With needs and requirements known and additional resources identified, it is now time to shift focus on how to effect the change. ILRI's LAN infrastructure is segmented by buildings in which each building share similar physical structure. The only topological difference noticed is in research1 building, where the computer services is located. Therefore, in an attempt to show the migration process, the research1 building is taken as a case so that the other segments can also be re-engineered in similar lines.

Phase -1: Migration at the desktop

In this phase attempt will be made to start to acquire new desktops that are equipped with 10/100 Mbit/sec capable adapter cards. Since these are backwards compatible with the 10 Mbit/sec, use of these devices allows the overall network infrastructure (hubs, end stations, the backbone, etc) to be retained. The higher speed of the cards does, however, permit switching over to the higher transfer rate at any time. A simplified structure of this type of migration is shown below.

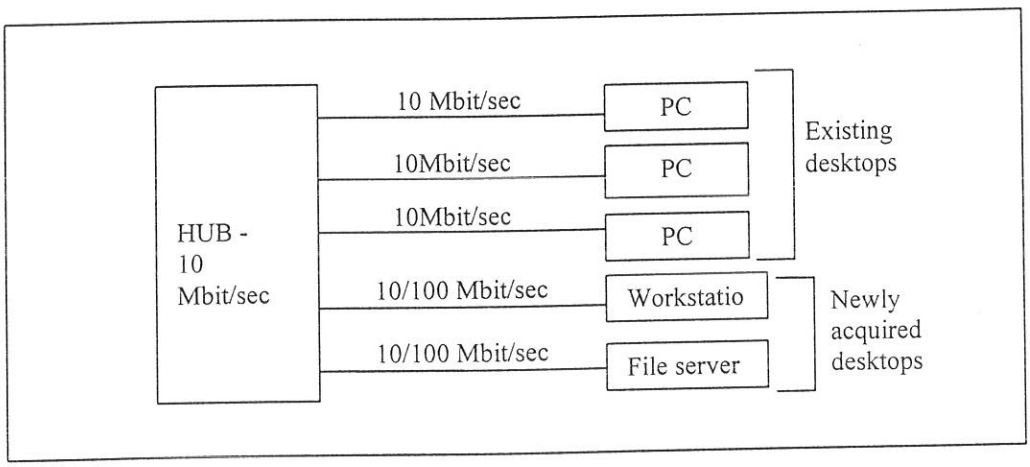


Figure 5-1, Changing desktops

Until this phase is initiated, the Intranet deployment can run with the existing system with a lower scale start. When new desktops are acquired, they can be deployed to places where high bandwidth is needed (such as training and information service).

Phase -2: Migration at the workgroup Hubs

When the Intranet site develops where the number of pages are growing and multimedia applications are appearing, the 10 Base T hub to which the end stations are connected can be replaced by a 10/100 Mbit/Sec switch at any time. The end stations that are already fitted with 100 Mbit/sec adapter cards operate in the Fast Ethernet mode and the throughput of the network automatically increases. Even if the older devices continue to communicate at a transfer rate of 10

Mbit/Sec, the workgroup switch automatically converts the different rates. The 100 Mbit/Sec end stations can utilise the higher bandwidth immediately. A graphical presentation of this shift is shown in Figure 5-2

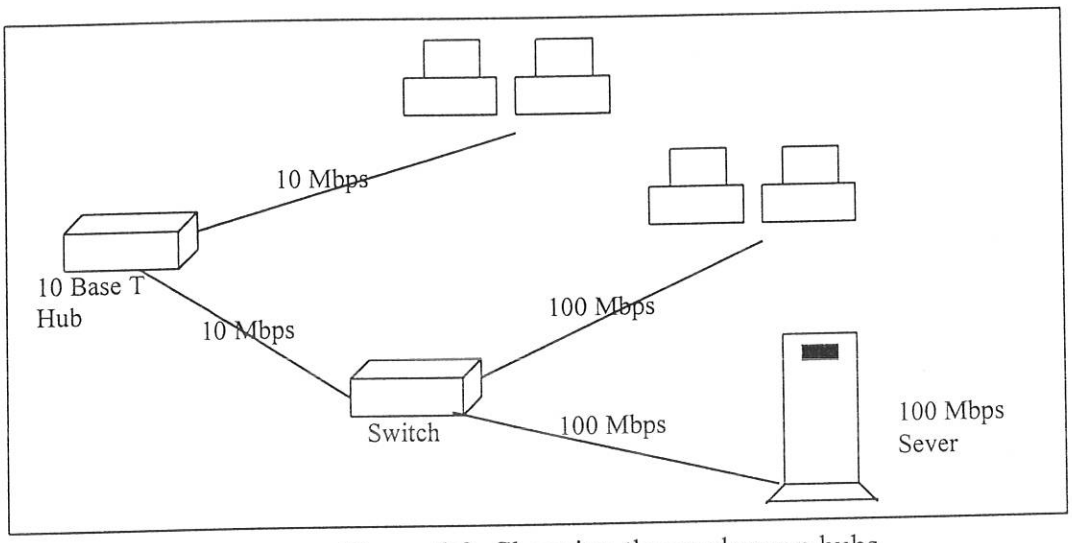


Figure 5-2, Changing the workgroup hubs

Phase -3: Total migration

In this phase, all the end stations connected to the workgroup switch are converted to 100 Mbit/sec technology. The central workgroup switch can utilise its full capacity in this phase and can interconnect all end stations in the cut-through mode. This full bandwidth will be made available to every end station. Figure 5-3 shows this structure

In the total migration phase, the backbone structure can also be changed. The use of switches in the above design will facilitate the migration process at the backbone. The first task to do is to replace the central hub by a switch, second replacing the workgroup hubs by switch and finally all hubs by switch. The collapsed backbone structures are now getting popularity (both cost wise and manageability).

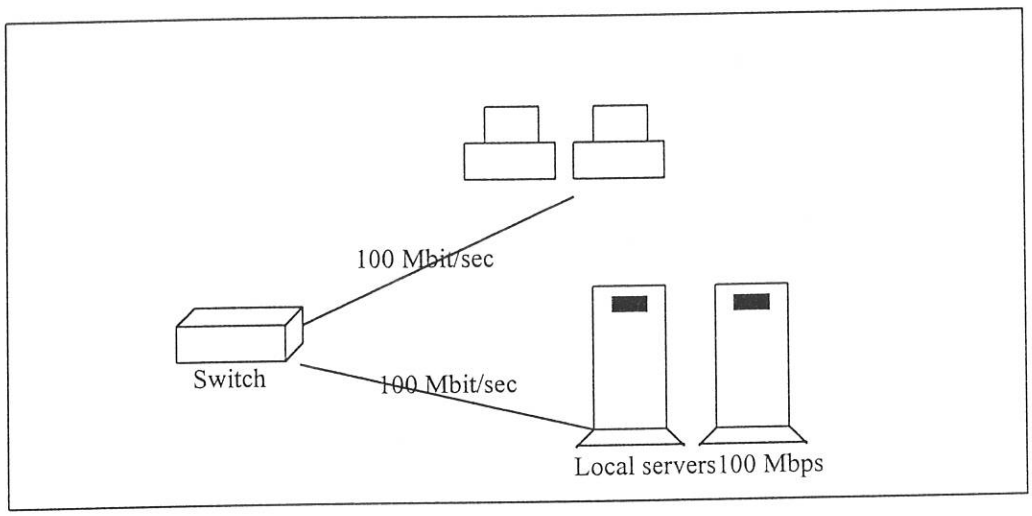


Figure 5-3, Total Migration

With the collapsed backbone structure in a building, ILRI's LAN floor distributors in the building distributor are connected directly over separate cables. All cables are then run to the respective sub distributors from this central distribution centre, creating a pure point-to-point connection on this segment. The collapsed backbone structure is shown in figure 5-4

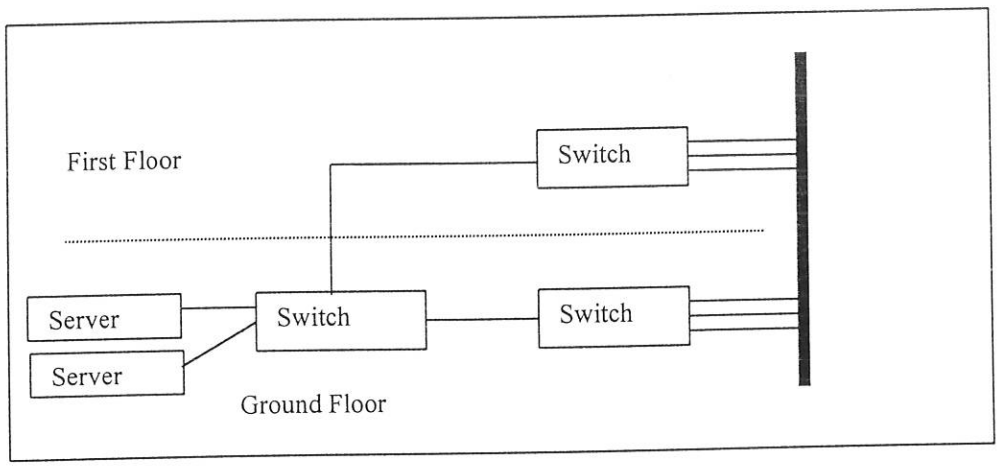


Figure 5-4, Migration at the Backbone

With these three phases of migration ILRI's LAN infrastructure can be reengineered to meet current requirements and future needs. How the entire network structure should look like is discussed in the proposed network system below.

5.3.2 Web Site Design

5.3.2.1 Overview

Intranet offers the same services and applications the Internet offers. The Web is now considered as the foundation service for many of the Internet services and applications. Lying on the higher level structure, the Web has enabled all other services and applications to be served on it. This section of the Intranet design is, therefore, aimed at facilitating access for institutional information resources over the network infrastructure. Attempt will be made to design the major services and applications which will help to solve the information resource sharing problem at ILRI. Selected services and applications are prioritised according to their significance to ILRI.

5.3.2.2 Web Site Structure Design

As indicated in chapter three, ILRI has a vast collection of information, generated internally or acquired from outside. The survey result has shown access to these data vault is very limited and so far the tradition is towards storage rather than access. The Web publishing is known for its capability not only to publish but also to easily access information. Therefore, this design considers first how a Web site structure can be designed for ILRI. The attempt is to design a balanced hierarchical tree that facilitate quick access to the institutional information resources. The actual list of contents that needs to appear in the ILRI Intranet site are annexed (appendix 4).

This site structure is designed to provide an easier-to-use interface that users can link to any page from anywhere in the Intranet site. By avoiding too-shallow or too-deep structure, attempt is made to create a balanced structure. Figure 5-5 illustrates the overall navigational activity in the Intranet site.

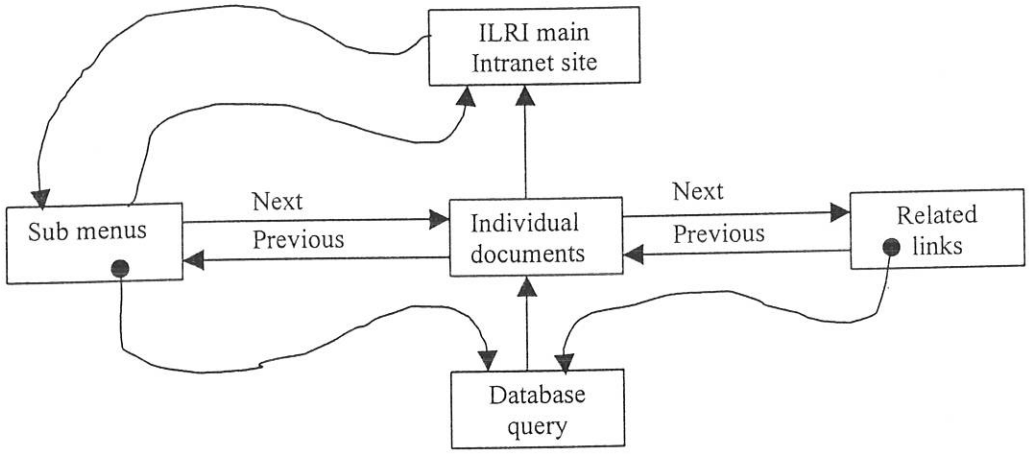


Figure 5-5, navigational flow model

Using figure 5-5 as a guiding principle, the ILRI's Intranet site structure design is presented in figure 5-6.

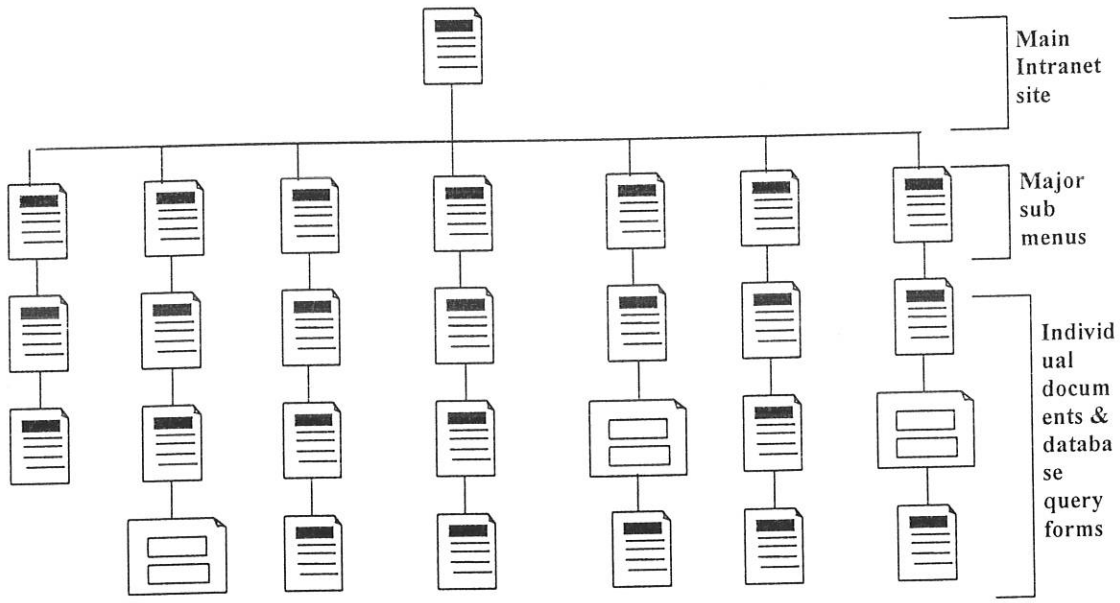


Figure 5-6, ILRI's Web site structure

Where:


Shows Web pages containing documents and links to different pages and services, such as links to newsgroups, FTP pages, etc


Shows database search forms that result from a hyperlink in the Web pages

An overview of the hierarchical tree structure in relation to identified user communities and information resources is illustrated in figure 5-7 below:

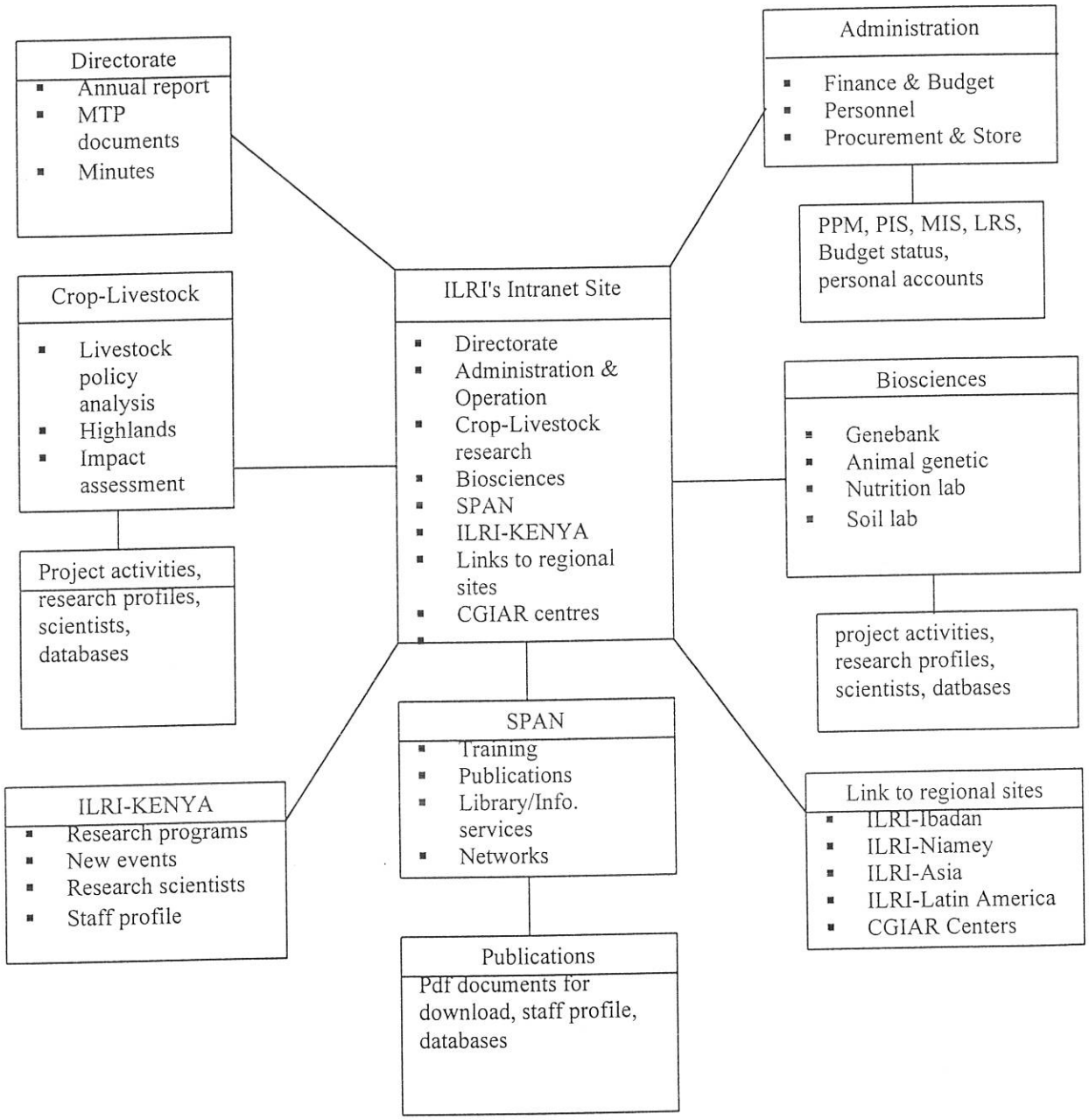


Figure 5-7, ILRI Intranet site map

5.3.2.3 Intranet-Based Document Management

The Intranet-based document management is given top priority in this design work. This is so because, document publishing and distribution is one of the major information related activity in

ILRI. As the survey result demonstrated, the paper based information delivery is still the preferred medium compared to the equivalent electronic version. In this regard, Intranet-based document management makes it easy to control and organise institutional documents and facilitate access.

5.3.2.3.1 Design Architecture

There are several vendor supported products which assist in the design of Intranet-based document management system. Intranet Solutions' Intra.doc!, the first document management system designed exclusively for the WWW is the highest rated from vendor supported products. Once this kind of document management server is acquired, the end user having a desktop, a browser and sometimes a generic document viewing software, can generate and publish information for distribution throughout the organisation.

A simplified design architecture of the Intranet-based document management is illustrated in figure 5-8 below.

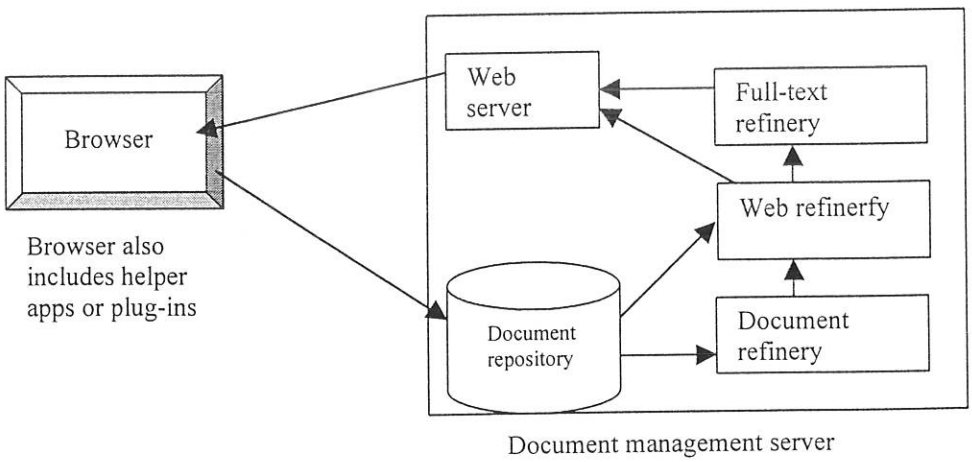


Figure 5-8, Intranet-based document management

As shown in the architecture, the steps taken to maintain an Intranet-based document management can be described as follows:

- users author a document and submit to a document repository together with metadata, such as title, subject, author and revision date of the document
- the three refinement layers that operate on the server convert each document to Web-readiness. Working together, they organise and control documents so they can be presented to users in a meaningful context.
- Users having access rights can then view the document directly in their browsers.

5.3.2.4 Database Integration

To tie the multitude of disparate databases found in ILRI for access through the Web, there are several design alternatives, some vendor supported and others developed in-house. The Intranet solution is based on open systems and vendor specific proprietary solutions are not normally recommended for database connectivity to the Web (for reasons of interoperability). Like the document management server mentioned above, a database server is required for hosting the database available at ILRI.

From the client side the desktop should be equipped with the Web browser and standard interface (a form) through which to submit queries. Like the refining layers in the document management system, there are also middleware programs/applications which pass query to and receive data from the Web server.

5.3.2.4.1 Design Architecture:

Before discussing how the application is created, a design architecture of the client/Web server database interaction is presented to show how the interaction works

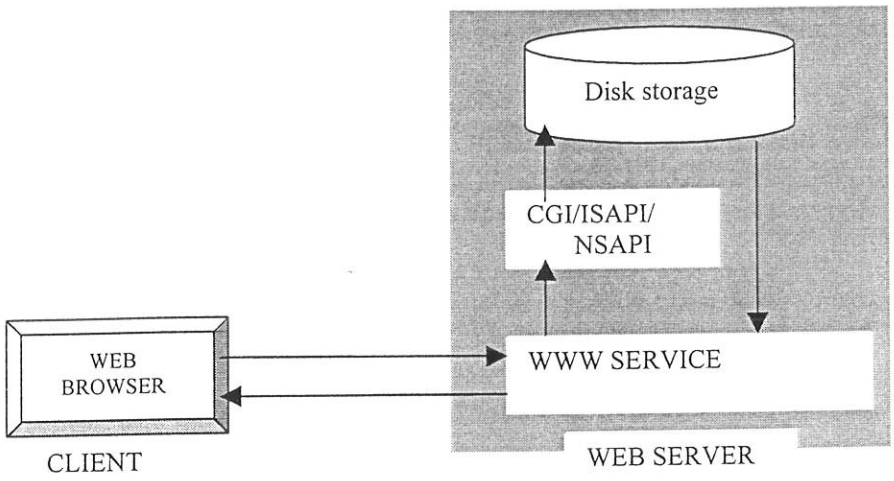


Figure 5-9, Database access model through the Web

The interactivity procedure between the client and the server is a three tier connectivity. A description of these procedures is presented below.

- Browser sends request to server, which can take one of the two methods, GET (where the client appends data to the URL it passes to the server) or POST method (where the client sends data by way of HTTP message data field. The client initiates the request by clicking any of the several options provided in his HTML pages. These options are: a hypertext link that runs the application directly, a 'submit' button in an HTML form, an inline object retrieved with the GET method, or a search object (that is, one that uses the HTML tag ISINDEX.
- Server receives request, if the data received is from form, the data is parsed into variables. The URL that the client browser sends contain the name of the application program to be invoked and run
- Query is generated by the gateway application
- Query is submitted to the database

- Database returns dataset
- Dataset is formatted into HTML by the gateway application
- Server sends gateway application output to client
- Client displays results page.

5.3.2.5 Databases Selected For Prototype

Two databases, one from the scientific application and the other from the administrative applications are selected for consideration in the Web database access design. These databases are:

- ILRIB.MST - A CDS/ISIS based bibliographic database maintained by the information service and open for search for all the scientific research. This database is selected because it is widely used by the scientific research community.
- EMPFILE.DBF - an employee record database maintained by the personnel which is not queried by the ILRI staff. The reason for selecting this database is that the general staff and the head of administration has shown interest to query these database from their desktop for various data, such as employment data, job classification, salary data, personal account data, leave balance data, medical insurance data.

The list of databases that can be made available at ILRI's Intranet site are annexed (appendix 5)

5.3.2.5.1 Database Structure of ILRIB.MST

This database contains 109,000 bibliographic records on animal agriculture and related fields. The source of the database records are the bibliographic holdings of ILRI library, CABI and AGRIS databases.

Field Definition Table (FDT) Data Base:ILRIB

?	Tag	Name	Len	Typ	Rep	Delimiters/Pattern	
-	10	Date of Entry	10	x			
-	20	Security Code	1	A			
-	30	Source	5	A			
-	40	ILCA Publication category	5	X			
-	50	Indexer code	2	N			
-	100	Doc. Id. Codes	60	X	R	salp	
-	110	Literary Indicator(s)	1	A	R		
-	120	Bibliographic Level	4	A			
-	130	Country code MF obtained	2	A			
-	140	Mode of Acquisition	5		P	AA-99	
-	200	Personal Author(s)	40	X	R		
-	210	Address of first Author	200	X			
-	220	Corporate Author(s)	200	X	R		
-	230	Title	400	X			
-	240	Parallel Title	400	X			
-	250	Title translated into English	400	X			
-	300	Author(s) of source document	40	X	R		
-	310	Corporate Author(s) source	200	X	R		
-	320	Title of source document	400	X			
-	400	Main serial title	200	X			
-	410	Parallel serial title	200	X			
-	420	Volume & part Number	25	X			
-	430	ISSN	25	X	R		
-	440	Language(s) of Text	30	X	R		
-	450	Language(s) of summary	25	X	R		
-	500	Publisher (Name & place)	200	X			np
-	510	Year of publication	4	X			
-	520	Pagination	30	X			
-	530	Collation Notes	100	X			
-	540	Document/Report No.	50	X	R		
-	550	ISBN	25	X	R		
-	560	Edition	25	X			
-	570	Map specifications	100	X			
-	600	Conf. (Name, place, date)	500	X			npd
-	610	Thesis	100	X			
-	620	Patent/Stand.No. & country	100	X			
-	630	Development project name	200	X	R		
-	700	Subject Codes	10	X	R		
-	710	UDC Number	30	X	R		
-	720	UDC of Source document	30	X			
-	730	AGRIS identification code	30	X			
-	740	Form of Document	40	X			
-	750	Controlled Descriptors	500	X			
-	760	Uncontrolled Descriptors	500	X			
-	770	Abstract	1650	X			
-	780	Notes	200	X			
-	800	AGRIS Input Code	7	X			

5.3.2.5.2 Database Structure of EMPFILE.DBF

This database is created using DBASE III+ database management software. It contains 580 records. The record provides information on the detail history of an employee, personal information, job title, rank, salary and other details. The database structure in its existing form is shown below

Field	Field Name	Type	Width	Dec
1	Location	Character	2	
2	Contr_Type	Character	2	
3	Empnum	Character	4	
4	Emp_Status	Character	1	
5	Surname	Character	20	
6	Forename1	Character	15	
7	Forename2	Character	15	
8	Nation	Character	15	
9	Sex	Character	1	
10	Discipline	Character	20	
11	Sub_Discipline	Character	20	
12	Public_No	Numeric	3	
13	Educ_Level	Character	20	
14	Birth_Date	Date	8	
15	Mar_Status	Numeric	1	
16	Dep_Childr	Numeric	2	
17	Level	Character	2	
18	Step	Character	2	
19	Personal	Numeric	9	2
20	JOB_Title	Character	20	
21	Program	Character	10	
22	Subprogram	Character	10	
23	Costcenter	Character	6	
24	Family	Character	6	
25	Duty_Statn	Character	6	
26	App_Date1	Date	8	
27	Leavedate1	Date	8	
28	App_Date2	Date	8	
29	Leavedate2	Date	8	
30	Last_Renew	Date	8	
31	Renew_Due	Date	8	
32	Prob_End	Date	8	
33	Address1	Character	40	
34	Address2	Character	40	
35	Address3	Character	40	
36	Address4	Character	40	
37	Address5	Character	40	
38	Home_Phone	Character	15	
39	Of_Dir_Pho	Character	15	
40	Office_Alt	Character	15	
41	Of_Ext_Pho	Character	3	
** Total **			525	

In the prototype application development for these selected databases, the existing database schema as shown above is restructured to consider selected searchable fields. While designing the user interface, the existing query process is reviewed in consultation with the respective database managers. From the end-users point of view, appropriate properties of the database files and provided outputs in print form are considered.

5.3.2.6 User Interface Design

Unlike the static Web publishing, a database access on the Web requires a front-end design through which users interact. The type of interface to design depends much on what information the users want to extract from the databases under consideration. This again requires to understand two sets of information: the users information requirement and the database structure. In this design section, the database schema is investigated for its database structure and searchable entities. Information provided from these databases in the form of paper print were reviewed for their content and structure by discussing with the end users.

The screen design was thus based on selected relevant fields that satisfy the users query. The IBM's System Application Architecture - Common User Access (SAA-CUA) standard screen controls in the windows environment is used. Some of these screen controls include text boxes, radio buttons, combo boxes, check boxes, drop-down/pop-up list-boxes and command buttons. These screen presentations are child windows whose path is obtained by going through their respective main page. The ILRIB database search screen, for example, descends from the 'Library and Information Services main page' and similarly the EMFILE.DBF is a child screen resulting from the 'Personnel Administration' Web page. They can also be accessed from the home page by linking to the 'database search' hyperlink. The design of the search screen layout and the features

included are presented in appendix 6.

5.3.2.7 Designing Mail Service

5.3.2.7.1 Overview

Electronic mail (e-mail) is the most widely used service on the Internet. Individuals, organisations, companies and governments are using e-mail as their primary source of communication. According to the survey conducted in this study, e-mail is the second highly used resource for organisational communication. Including e-mail design in ILRI's Intranet site is, therefore, imperative. In e-mail, basically two things are performed: sending and receiving messages. In this section, both these activities will be shown how they can be designed for use at ILRI.

5.3.2.7.2 Sending Messages

At the foundation of any communication service on the Internet, there exists a protocol which helps communicating computers to understand each other. The protocol used to send messages is the Simple Mail Transfer Protocol (SMTP). A mail server with SMTP is, therefore, required to exchange messages back and forth between the client and the mail server.

How the message transfer process occurs between the client (sender) and server (receiver) is illustrated below:

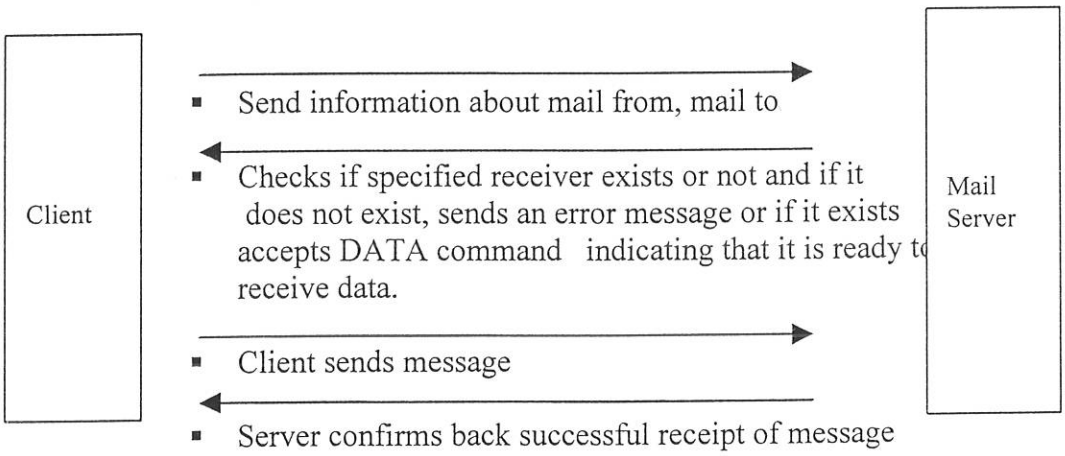


Figure 5-10, Mail service model

5.3.2.7.3 Receiving Messages

The protocol required to retrieve a message from mail server is Post Office Protocol 3 (POP3). Like the SMTP, the client sends commands to the server to which the server replies with coded responses. POP3 uses a series of simple four character commands such as RETR and LIST that perform the various tasks required to retrieve e-mail messages.

The POP3 client and server enter into three different states during a particular session. These are as follows:

1. Authorisation, where the client must identify itself to the POP3 server
2. Transaction, where the client requests actions on the part of the POP3 server
3. Update, where the POP3 server releases any resources acquired during the transaction state and closes the session by saying goodbye

5.3.2.8 Designing Usenet News

5.3.2.8.1 Overview

Usenet news is the most widely used service on the Internet (next to e-mail and WWW). Usenet helps scientists and researchers to keep themselves up to date on research and other projects. Usenet provides a way for news messages (called articles) to spread throughout the Intranet users. In order to set up a Usenet service, news servers are required. News servers accommodate messages of interest depending on the particular discussion groups formed. In these discussion groups (sometimes known as Newsgroups), messages are propagated to each individual members.

The survey work reported in this thesis has proved that ILRI has a strong scientific collaboration among research scientists. Therefore, the Usenet service can assist ILRI's scientists in project teams to share articles, questions, project progresses, etc. ILRI has about 45 distinct and related projects and depending on topics of interest in each project a discussion group can be established.

5.3.2.8.2 Setting Up Usenet Service

News Network Transport Protocol (NNTP) is the protocol which makes possible Usenet service. NNTP server is, therefore, required to post, inquire, retrieve, distribute news articles within the discussion group formed. NNTP is a text-based protocol used to send and receive Usenet news articles between a newsreader client and an NNTP server, and also between two NNTP servers

5.3.2.9 Designing FTP Service

File Transfer Protocol (FTP) is also another service that can be considered for ILRI. This service allows to copy files from one machine to another, download from or upload to a particular

machine. For ILRI's Intranet site, an "anonymous FTP servers" can be set up that allow users to log into this server and copy online documentation, software updates, driver files, help files and many more. The FTP service can be heavily used by the Computer services to distribute software, utilities, documentation, help desk systems, Frequently Asked Questions.

The staff can easily install software, fix bugs, copy files from the FTP server, get assistance from an online documentation. This will greatly reduces the workload of the computer service.

Password protected FTP server for internal use can also be set up.

5.4 Design Alternatives

5.4.1 Introduction

Based on the specific requirements and characteristics of ILRI discussed in chapter three and four, three design alternatives are considered here. These alternatives may not be the only one available. However, taking into consideration of the capabilities expected and design considerations discussed above, and of course considering ILRI's need, the following alternatives are presented as viable solutions. The advantages, disadvantages and technical requirements are compared in each alternative

5.4.2 Scenario One: Instant Intranet

ILRI has a LAN which means part of the Intranet is in place. According to the review of the technical infrastructure, desktop machines at ILRI are running windows 95 operating system and in many of these client machines , the network interface card supports TCP/IP. This means the necessary hardware are in place at least for client side. With today's technology, it is also possible to run TCP/IP alongside many LAN protocols on the same network. Therefore, as far as the

machines are connected by cables, even if they do not support TCP/IP, that is not a problem if the proper software driver is installed. The instant Intranet is, therefore, made possible in two variants: one by just adding TCP/IP and the other by running TCP/IP alongside with other LAN protocols (IPX/SPX, Netbeui).

The main essence of the instant Intranet is to provide Intranet and Internet TCP/IP services on an IPX only Local Area Network. In order to get this service, like any other network configuration two parts of this product must be used: on the server side and the other on the client side. The server Netware Loadable Modules must be loaded and configured to provide the IPX to IP gateway function and client NLMs for Novell's client 32 must be used to provide TCP transport via IPX, to form TCP/IPX.

In this kind of set up, the Netware workstations running Microsoft DOS/ Windows 3.1x and Windows 95 users will be provided additional client support. This allows to transport TCP and UDP network requests over IPX/SPX to the Web server running the IPX/SPX gateway where the request is converted to an IP network request and assigned a socket on the server's IP address for identification purposes.

Instant Intranet, an IPX-to-IP gateway product is available from performance technologies (http://www.perftech.com/ii3flyx.htm). This product allows to connect the public Internet if desired. An illustration of this kind of implementation is presented in figure 5-11.

Advantages

- Quick deployment - by purchasing the IPX-to-IP gateway product, ILRI can add on its IPX

LAN to get a TCP/IPX functionality quickly

- Highly secure system - because of the nature of the gateway functions, this kind of system can serve as a highly secure Internet access firewall. IP requests from outside can not pass to IPX network if IP is bound only to the outside network adapter.
- Internal users can access the Intranet services hosted on the server as well as the services on the public Internet

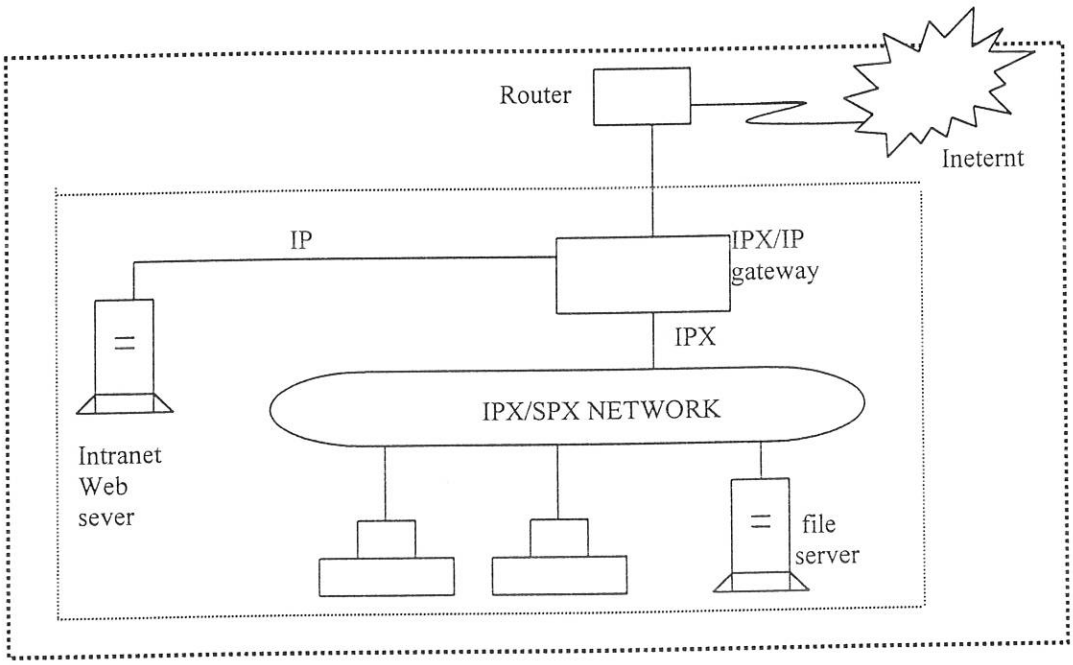


Figure 5-11, Instant Intranet model

Disadvantages

- IPX/IP gateway assigns the same IP address to all the nodes passing through it, Intranet or Internet solution that requires each node to have a unique IP address can not be implemented.
- The resources and services residing on the existing proprietary traditional LAN can not be served to Netware clients through the Web server. Only resources hosted by the Web server are accessible to the clients in an Internet-Web search and retrieval fashion.
- In this kind of set up, it is not possible to deploy a distributed client/server Web architecture

where a DNS server and other referenced Web servers exist.

5.4.3 Scenario Two: Upgrading Existing Infrastructure

In this alternative, the existing network infrastructure will be upgraded to a higher version in the same product line to the one existing. ILRI's LAN is based on Novell's network operating system, version 3.11 and by this alternative it is suggested to acquire Novell's 4.11 NOS product now shipped under the name of Intranetware, Novell's upgrade for the Netware 4 product line. IntranetWare product includes features that help to migrate an "ordinary" Netware network into an Intranet. Intranetware is Netware 4.11 plus a package of utilities that includes the following

- Netware
- Netware Web server
- Netscape navigator Web browser
- Novell IPX/IP gateway
- Novell (multiprotocol router) 3 with WAN extensions
- Netware Internet access server
- DHCP (Dynamic Host Configuration Protocol)
- DNS
- Unix print services for Netware
- Netbasic

With this kind of alternative, ILRI can upgrade its Novell Netware 3.11 operating system to Netware 4.11 (of course with additional money) and can turn existing network into an Intranet set up. On the client side, the majority of ILRI's workstations are running windows 95 OS and the clients can be configured for TCP/IP "stack" built into their OS. Alternately, the Novell's IPX/IP gateway configuration will allow user workstations on the LAN access to Intranetware TCP/IP based services. Along with hosting Web documents for both Intranet and Internet access, the

Netware Web server also has provisions to support CGI scripts, which enable to dynamically create Web pages. Other Web services include:

Image maps - besides standard text and graphics capabilities, the Netware Web server also supports full image map functions. Such functions enable to link to other documents or files based on the relative location within an image displayed on a Web page.

Server Side Includes - a method of including dynamic information in an HTML document.

FTP services - FTP enables to publish specific volumes and directories on Intranet or Internet so that it can be uploaded or downloaded without having to log into the Intranetware server directory as a Netware user, thus saving the need to provide a user license for that specific connection.

Thus, buying Netware 4.11 and after configuring TCP/IP, installing the Netware Web server, Novell IPX/IP gateway, Netscape navigator, ILRI can directly get its Intranet up and running. Figure 5-12 presents a full TCP/IP implementation of IntranetWare option.

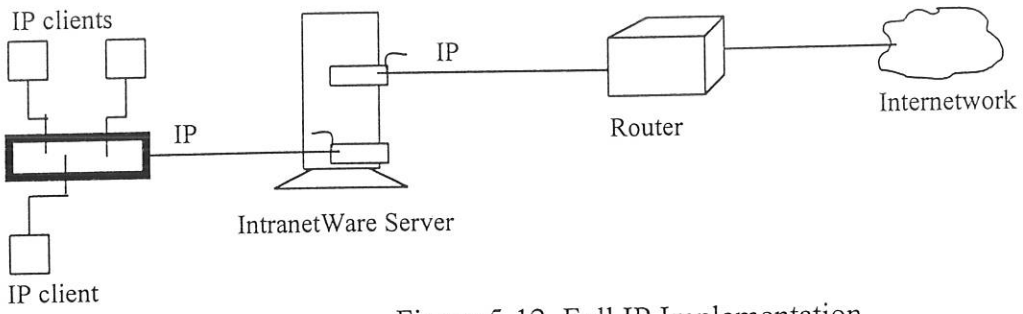


Figure 5-12, Full IP Implementation

Advantages

- Easy migration : ILRI users have a tradition in using Netware LAN and with little or no change on the users interface side, can continue to work with the IntranetWare solution
- Management: for the network administrator, the IntranetWare is no different the earlier

versions and thus can easily manage the LAN resources.

- Cost : Intranetware runs a function of Netware, and there is no need to learn new OS or get new hardware to provide information to users. The information sharing process can be performed on the existing file server with the capabilities to tie directly into existing databases.
- Smooth transition: the process of migrating into an Intranetware solution can be effected without disrupting the regular function of the network

Disadvantage:

- Lacks support: the e-mail service which is heavily used for ILRI's internal as well as external communication is not supported by IntranetWare.
- Poor user Interface: IntranetWare solution lacks many of the graphical user interface which ILRI's users are familiar to.
- No rigorous test: Novell has entered in to the Web server business recently and the IntranetWare performance is not very well tested.

5.4.4. Scenario Three: Migration to a New System

This option suggests the migration of the existing network infrastructure into a new network operating system, Windows NT. Windows NT is now viewed as robust, multithreaded environment found in Unix combined with the GUI of Windows 95. Windows NT is now slowly penetrating the market to beat its fierce rivalry, the UNIX based system. Now Windows NT is providing solutions to problems of how to connect users in disparate geographical locations - both around the corner in the neighborhood and around the world. Among the many new features and powerful tools provided by Windows NT, hardware independence, (portability or architecture

independence), support for multiprocessors (multitasking, multithreading), security, RAID support and file systems, built in MIE 3.0, integrated IIS are the most prominent.

It is also increasingly considered for Intranet deployment because it enables to set up and administer the major services and applications of the Internet-Web technology. These include WWW, FTP, Gopher service, Microsoft exchange (Internet mail and Microsoft mail) and telephony API (fax and Internet Explorer). Windows NT has, thus, become a strong choice for Web servers platform because it addresses the following needs:

- Stability - it handles different tasks in isolated memory segments. This means that if one program goes awry, it generally will not crash the whole server as happens on other Operating Systems. NT also has built in network monitoring capability.
- Ease of management - NT provides wizards that give step by step through administration tasks such as creating user accounts, managing folders, adding and removing programs, and administering network clients. It is also possible to remotely administer an NT server using a Web browser.
- Web and Intranet service - Microsoft has tried to build NT server as the complete Intranet platform, the latest version ships with a Web server (the Internet information system), FrontPage (a Web site creation and maintenance tool), Internet Explorer (Web browser), and NT domain name resolution server (DNS service). An NT index server that provides full text searches on HTML and MS office documents is available for free download from the Microsoft Web site.
- Gateway services - NT has TCP/IP, IPX (Novell's protocol), NetBeui (another protocol), Appletalk, PPP, and other protocols included in the OS. This means that the NT server can be a gateway between the old network and the new ones. It can be also be the network's connection point to the Internet (i.e., it is easy to get by without a router, though a router offer

added benefits).

- Security - NT provides higher levels of security than most organisations will need. Administrators can restrict access to files, folders, network devices like printers, and more.

5.4.4.1 Overall Architecture and Functionality

The increasing popularity of Windows NT rests not only on the varied features it offers as indicated above. Its ability to coexist with and run multiple protocols for backwards compatibility and interoperability is another major feature that gave Windows NT its high acceptance. Windows NT can run the following common protocol versions:

- Netware's IPX/SPX (gateway service, client service, file and print services and directory service manager for Netware)
- NetBEUI, NetBEUI Frame (NBF) is the windows NT version of the NetBEUI protocol stack included for backward compatibility with such NetBEUI based network Operating Systems as Microsoft LAN manager and OS/2 LAN server
- Appletalk - is included as a communication protocol to support NT's service for Macintosh (SFM).
- DLC, Data Link Control is a Windows NT communication protocol traditionally reserved for communication with IBM mainframe computers. Recently, this communication protocol has been used to communicate between Windows NT servers and printers that are attached directly to the network by NIC.
- TCP/IP and related protocols, services and utilities are also available in Windows NT. The range of protocols and services fall under the following categories: communication protocols (TCP, IP, UDP), special delivery protocols (ARP, ICMP), remote access protocols (PPP, SLIP), APIs (Windows Sockets 1.1 and 2.0), utilities (FTP, TFTP, Telnet, LPR, RCP,

REXEC), diagnostics (LPQ, PING, Tracert, Netstat, Nbstat), services (WINS, DHCP) and management protocols (SNMP).

Advantages:

- Ease of use: almost 100% of ILRI's client side desktops are supported by Windows 95 operating system. Windows NT also shares the GUI feature of windows 95 and thus ease of use by the end users can be maintained.
- Support: both the scientific and office computing activities utilise (95% , according to the data from the computing services) Microsoft office products. These products: Word 97 for text processing, Access for database management, Excel for Spreadsheet applications, Microsoft Exchange for E-mail, are all easily integrated into the Web through Windows NT
- Windows NT can easily coexist with the current ILRI's Novell LAN
- Many products in one: the Windows NT product starting from version 4.0 bundles with it important software for Intranet applications. The Internet Information Server (for Web, FTP, Gopher, etc), Microsoft Internet Explorer 3.0 for Web browser, FrontPage for Web page development, Internet Server API (ISAPI) for CGI applications, are all integrated with windows NT.
- Popularity: Windows NT is gaining increasing popularity and it is now estimated it is slowly taking over the Unix hegemony.
- New version: current version available for Windows NT is version 4.0 and recently Microsoft has announced it is preparing to launch version 5.0, thus a possibility to take advantage of added features.
- Trend: now desktops have started to come with Windows NT as their operating system as was the case with windows 95.

Disadvantages:

- Windows NT has a relatively poor security feature compared to, say, Unix
- Windows NT is not suitable for large high-end industry standard application.
-

In this section, the Windows NT and Novell's IPX/SPX coexistence model is shown

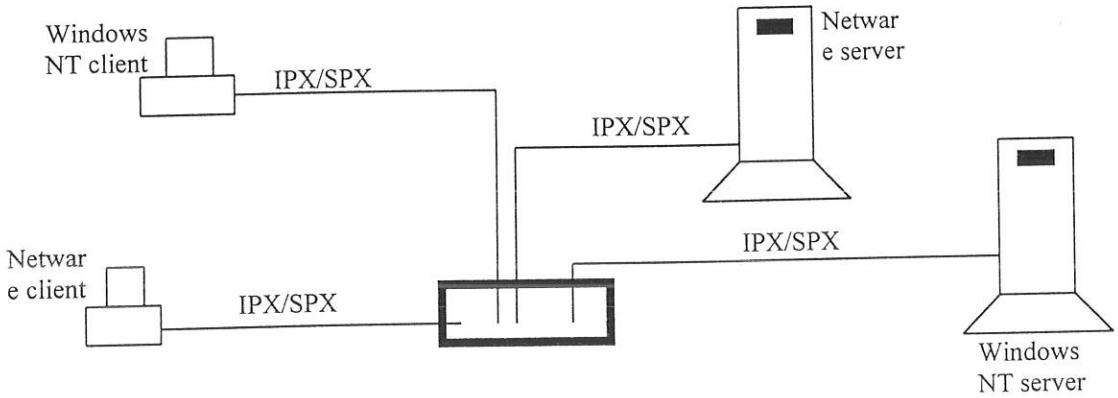


Figure 5-13, Windows NT co-existence with Novell

5.5 Proposed Intranet Solution

5.5.1 Overview

Intranet offers the same services and applications the Internet provides. One of the major services of the Internet/Intranet is the WWW. The WWW is considered as a hypermedia information system or as another multimedia. The Web makes access and content creation easy for the end user. Gradually, this can lead to a fattened Web site and can create chaos unless properly managed and controlled. The network at the backbone should, therefore, be designed to accommodate present and future volume of information. ILRI's LAN, in its present existence can adequately support an initial Intranet takeoff, with minimal Web publishing and multimedia application.

However, if all the digitised resources (as reviewed in this thesis) are to be made available at the Intranet site (under consideration), the LAN infrastructure needs an upgrade. Ultimately, the LAN has to support a full Intranet service which necessitates an upgrade. Considering the above migration phases, the proposed system shown in figure 5-14 combines all features the network infrastructure is required to meet identified needs.

The essential features of the proposed system and additional resources introduced are described below:

- TCP/IP client nodes
- 10/100 Mbps Network Interface Card at client side and servers
- Pentium II class Web server hardware
- UTP category 5 cables between clients and building switch/concentrators
- Fibre optic cables between buildings and the central switch/concentrator
- 10/100 Mbps switches
- Routers for Internet connection
- Firewalls and gateways to protect information from external intruders
- Web servers, Database servers, FTP servers, mail servers, proxy servers
- FDDI Ethernet Switching as backbone

Major resources deployed in the proposed network infrastructure are described below in table 5-1. The number on the top right and left side of the boxes in the proposed diagram correspond to the buildings described in this table.

Table 5-1, Server and other resource deployment

bld No	Building	Servers							Deployed Resources				
		1	2	3	4	5	6	7	Switch	Router	Firewall	Gatewa y	
1	Research 1 & Computer Services	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
2	Administration	Y		Y					Y		Y		
3	Publication & Information serv.	Y					Y		Y				
4	Training	Y		Y					Y				
5	Research 2	Y		Y		Y			Y				
6	CIMMYT					Y			Y				
7	Store								Y				
8	Genebank	Y		Y		Y			Y				
9	Library	Y		Y	Y	Y			Y				

Key: 1 -Web server

2:- document management server

3 -database server

4. -mail server

5 -NNTP server

6 - FTP server

7 - Proxy server

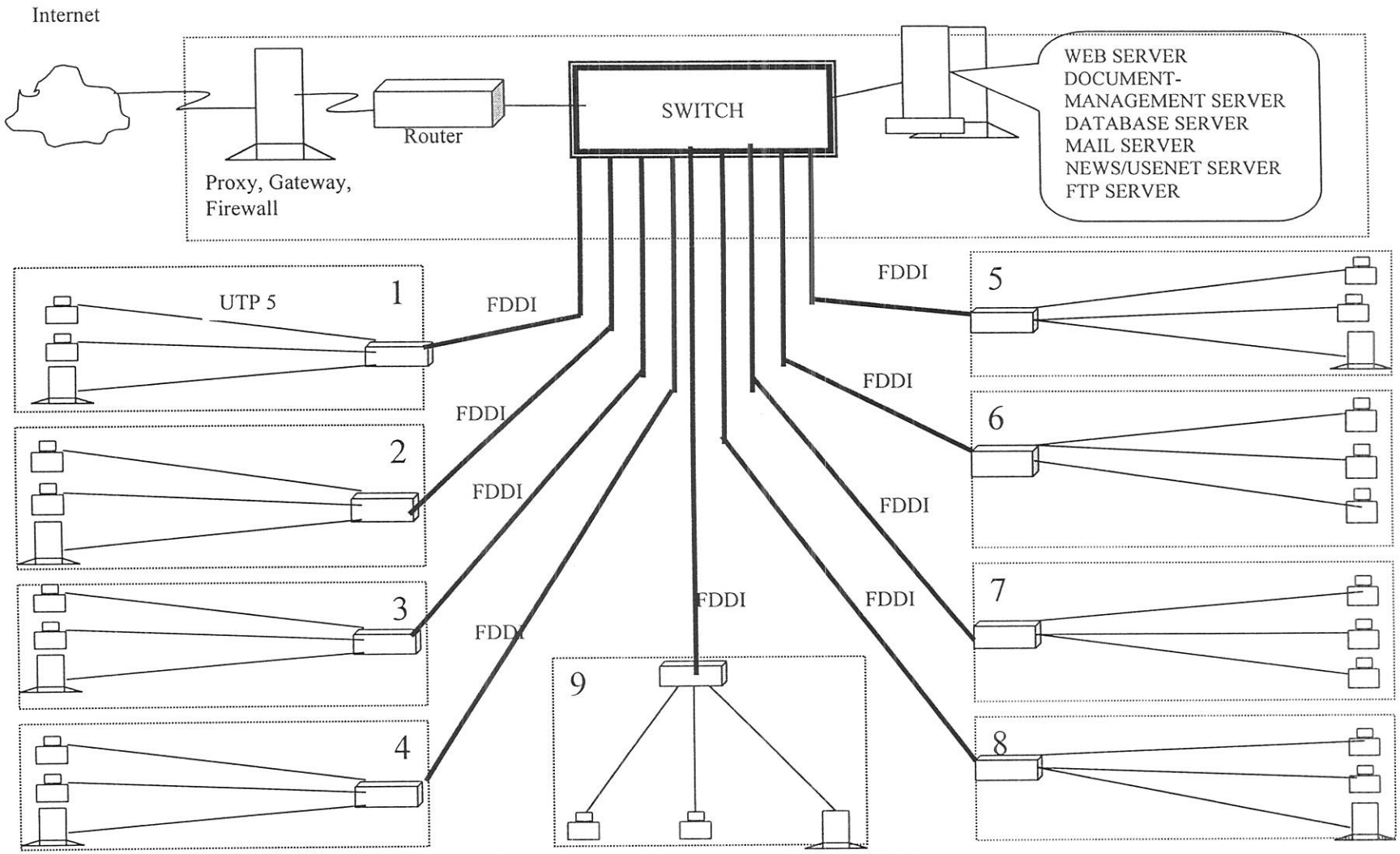


Figure 5-14, Proposed Intranet solution for ILRI

The proposed solution shown above presents the architecture of the network infrastructure which forms the basis for the Intranet solution. This does not mean, however, that the Intranet solution is only the network. The proposed system also takes into consideration the Web site design discussed before it (section 5.3.2).

CHAPTER VI

DEVELOPMENT AND IMPLEMENTATION OF INTRANET SOLUTION

6.1 Overview

The deployment of an Intranet design requires planning. Depending on the scale and extent of the Intranet deployment, the workforce, processes and existing system will be affected. The planning task is required to implement the Intranet solutions in efficient and cost-effective manner. The planning task ranges from internal reorganisation of processes and systems to procuring additional resources recommended in this report. Launching the Intranet deployment all at once may not be feasible because of budget and organisational constraints. The implementation process should be broken down into a series of logical and manageable steps. Planning, therefore, becomes important in respect of these points

General planning issues that could be considered in the deployment of ILRI's Intranet can fall under the following categories:

- Project plan, including the establishment of a project team with scope, phased schedules, tasks, budget, staffing, deliverables, and so on.
- System installation plan, including procurement, installation, configuration, and management that increases the performance of the existing system
- User support plan, including documentation, training, and help desk support
- Promotion plan, to sell the Intranet deployment to ILRI management and users.

The entire implementation process can be considered as a project. In project management, forming team members having the necessary skills and experience is critical to the success of the Intranet deployment. ILRI as a sponsoring agent should take the lead in the planning process and

establishing project team. This chapter is aimed at discussing ILRI specific issues as to how to proceed with the important project. At this stage, as a result of the work done so far, it is considered that the need for Intranet implementation at ILRI is established. It is also considered that basic requirements in terms of technical infrastructure and application services required are determined.

6.2 Work Plan

In line with the above general planning issues, a work plan needs to be developed to provide a checklist of activities and deliverables. In this section, attempt is made to develop a work plan for ILRI that can be used as a guideline for the Intranet project management. This work plan emphasises on providing details on functions and component tasks along the following lines.

6.2.1 Building a Project Team

Two types of change are brought about by the Intranet implementation: changes in restructuring the existing network infrastructure and changes in the way the workforce do their jobs and/or respond to the new systems. The success of the implementation will be measured if it helps the end user communicate in new and useful ways. This in turn demands full participation by the general staff. The ILRI management should sponsor and support the project by providing resources. The project team should work as an agent to develop and execute implementation plans. Finally the end-users make the changes happen by changing the way they work and communicate.

ILRI-ETH can build the project team by using the skills and expertise of the computer services and the Information services unit. All required skills and expertise may not be found inside the Institutional workforce. In order to meet the expectation of the Intranet deployment by avoiding

risks, the project team should be (to the minimum) composed of the following skills and expertise:

1. Project manager/Supervisor, whose role could be to:
   - Interface senior management on the issue of Intranet deployment
   - Lead a cross-functional team of internal and external specialists
   - Promote the project throughout the institution
2. Network administrator to install, test, configure and monitor performance of the network system
3. Web content developers/Webmasters, a range of experts from HTML authors to information architects. Their role is to:
   - Liaison with Web content providers
   - Develop site structure and page design
   - Create HTML pages using authoring tools, templates, and site mangers
   - Incorporate text, graphics, audio, video, scripts, applets, or applications as needed
   - Create and test hyperlinks to connect pages of related information
   - Manage site content, including updates, version control, retired links
4. Application developers/programmers, whose task is to:
   - Write programs using open standards (Java/JavaScript, c/c++, HTML, HTTP, VRML)
   - Write HTML forms
   - Write CGI scripts
   - Interact with backend databases via Structured Query Language (SQL), Open Data Base Connectivity (ODBC), and middleware tools
   - Debug and test the application
   - Manage version control, source checkin/checkout

6.2.2 Procurement for Basic Additions

The basic components of the required resources are outlined in the preceding chapter. In this section, attempt is made to suggest specific details that need to be considered. While procuring resources. in the suggested list provided, all shaded items are recommended for ILRI.

6.2.2.1 Web Server Components

1. The computer hardware

Table 6-1, recommended hardware

General purpose servers – platforms	CPU/max CPUs	RAM max RAM	Hard drive max internal storage	Operating system	Web server software	comments
Dell Poweredge 2220	2 PII 266/ 2 PII300s	128/512	6/27	WINNT advanced server 4.0	Microsoft IIS 3.0	Very powerful server expanadable to two PII 300 processors
Micron Vetix Lx1	PPRO 200/ 2PPRO 200s	64/1000	4/24	WINNT advanced server 4.0	Microsoft IIS 3.0	Strong performance expandable to 1 GB of RAM

2. Operating System

The three viable platforms that should be considered for operating system selection are:

- Unix
- Microsoft Windows NT
- Novell Netware

In this thesis report, based on the discussion made in the design alternatives and taking into consideration the advantages and disadvantages, Windows NT advanced server version 4.0 is taken as a development platform.

3. Web Server Software

The range of choices for Web server software is also vast. Considering ease of use, performance, interoperability, security and conformity with the Windows NT platform, Microsoft Internet Information Server 3.0 is considered as an appropriate choice for Web server software. Leading Web server software are presented below in table 6-2

Table 6-2, Web server features

Packages	Ease of use	Performance	OSs supported	Security	Applications supported
Apache 2.01	Poor	Very good	Unix, OS/2	None	CGI
MIIS 3.0	Good	Very good	WNNT advanced server	SSL2, SSL3, S-HTTP	CGI ISAPI
MPWS 1.0a	Very good	Poor	Win 95, WINNT	None	None
Netscape enterprise server 3.0	Good	Very good	WNNT advanced server	SSL2, SSL3	CGI NSAPI
Novell Web server 3.1	Good	Very good	Novell netware	SSL2, SSL3	Proprietary
O'Reilly & associates Website professional 2.0	Good	Good	Win 95 WINNT advanced server	SSL2, SSL3, S-HTTP	Proprietary

Apache Web server software is provided free. MIIS and Novell Netware server are also free with WINNT advanced server and Novell Intranetware are purchased respectively.

6.2.2.2 Switching Hub

As shown in the proposed system, existing 10BaseT hubs are required to be replaced by switches. Several vendors supply a wide variety of switches. 3COM is well reputed in providing LAN/WAN products. This report also suggests a switching hub to be procured from 3COM PRODUCTS. When acquiring the switching hub, the following features should be checked to maintain integrity with the existing LAN.

- Configuration: expandable chassis
- Network compatibility: Ethernet; FDDI
- Network capacity: 16-48 Ethernet; 2 FDDI ports
- IEEE standard: IEEE 802.3 10 Base2; 10Base5; 10BaseT;
- LAN speed: 10; 100 Mbps

- LAN interface: BNC; AUI, MIC, SMA, ST, DB-9, RJ-45
- Protocols supported: NWLINK IPX/SPX, TCP/IP, Netbeui, Apletalk
- Network management: SNMP
- Virtual LAN support

6.2.2.3 Router

A router is required to route TCP/IP traffic across multiple LAN adapters or between LAN and WAN adapters in the server. This is made possible by enabling the IP packet forwarding in the server or by setting up a dedicated router. As indicated in the introduction, ILRI is an international research institution with offices distributed throughout the developing world. Though not addressed in this thesis, the final goal of the Intranet solution at ILRI should be one that serves the information sharing need of the distributed offices. At present ILRI participates with the CGNET network and acquiring the router will assist better than the existing PC gateway.

Features required of the router include:

- Internetworking for Ethernet, FDDI and Token ring LANs and WANs using translation bridging and multiprotocol routing
- Local or remote: remote
- Configuration: modular
- Network compatibility: Ethernet, IBM Token Ring, FDDI, Fast Ethernet
- IEEE standard: IEEE 802.5, IEEE 802.3, 10Base2, 10Base5, 10BaseT, 100BaseFX, 100BaseTX
- Media type: fiber, thick coax, thin coax, UTP
- LAN SPEED: 4, 16, 10, 100 Mbps
- Number of WAN interfaces: 5-10
- WAN services supported: x.25, T1, E1, Frame Relay
- Network management standards: SNMP, Telnet
- Additional functions: hot swapping

6.2.2.4 Mail and News Severs

The Internet e-mail is in transition from the widely used Post Office Protocol (POP3) to the more sophisticated Internet mail access protocol (IMAP4), which includes features such as adding shared folders and remote access. There are variety of mail servers for Windows NT server, each of which supports POP3 and SMTP for sending and receiving messages to and from other mail servers. However, Altavista Mail 2.0 is widely known for its support of IMAP4 (PC Magazine, May 1997). News servers (more appropriately called discussion servers) are also important to host internal institutional discussions, in a from of Usenet newsgroup feeds. Two notable Windows NT news servers that use standard Network News Transfer Protocol (NNTP) are: MetaInfo's NewsChannel 1.0 and Frontier Technologies' NewsServer.

In general, the basic building blocks for ILRI's Intranet messaging should include the following:

- IMAP4 – a protocol that allows a client to access and manipulate e-mail messages on a server. This protocol is designed for disconnected e-mail use and lets users to perform such tasks as managing folders remotely, viewing just message subject lines and attachments based on various criteria. It also allows for shared mail folders
- MIME (Multipurpose Internet Mail Extensions) – a standard for transmitting non-text e-mail message attachments via SMTP. Most proprietary mail systems must translate any received MIME attachments through SMTP gateway.
- NNTP (Network News Transfer Protocol) – the protocol used by clients to post and retrieve messages to and from news servers that host discussions. NNTP is also used by news servers to replicate newsgroup discussions
- POP3 – an established protocol that lets users send and retrieve e-mail to and from mail servers. POP3 provides simple store-and-forward e-mail functionality.
- SMTP (Simple Mail Transfer Protocol) – a standard protocol that defines how e-mail messages are transferred between servers. SMTP defines only ASCII text content,

necessitating the MIME standard for non-text attachments

- UUENCODE/UUDECODE – along with MIME, another common method of sending binary e-mail attachments as plain ASCII text

6.2.2.5 Web Publishing Authoring Tools

The HTML development tools that are currently available make easy to create a Web page for an Intranet site. There are several products available, from the simple Notepad editor to the advanced WYSIWYG products. These tools are also very helpful to convert word or legacy documents into HTML format. Windows NT provides the Microsoft FrontPage authoring tool. Word 97, Microsoft Internet Assistant (free) are also useful tools to convert documents into HTML. Other products to consider include: HoTMetaL PRO, HotDog, COREL.WEBDESIGNER, etc.

6.2.2.6 Database Connectivity Tools

One type of Web based information to be served in the Intranet site are databases. Regardless of the native format in which the databases exist, integrating databases into the Web involves developing an application. The application resides in the database server to interpret requests to the DBMS and reply data set back to the requesting client. These applications are known as CGI and they can be developed using c/c++, PERL, Visual basic, Activex Control, JavaScript, Java or any other high level programming language.

Another option to connect the Web and application server is by accessing the Web server APIs. In Windows NT, for example, the Microsoft Internet Server API (ISAPI) can be used with the IIS to provide required connectivity.

As indicated in the design chapter, Windows NT is considered as an appropriate choice for server platform for ILRI. Therefore, in this thesis, the Microsoft Internet Server Application Program Interface was used to connect prototype databases into the Intranet Web site. Many of the databases in ILRI are constructed using Dbase III+ and CDS/ISIS database management software. In order to make these databases ODBC compliant, it is required to convert them into one of the drivers that ODBC can connect. These include the SQL server driver, Microsoft Access drive, Microsoft dBASE driver, etc.

ILRI should also consider acquiring vendor supplied Rapid Application Development (RAD) products for application development that assist to integrate databases into the Web. This kind tools help developers in building dynamic Web applications. There are several vendor supplied products of these kind. The tools to be acquired for ILRI should be checked for their compatibility with Win 95 and Windows NT and network support for Novell and TCP/IP. This thesis suggests the following RAD environments, listed according to their importance:

- Visual Interdev from Microsoft
- Intrabuilder from Borland International Inc.
- Sapphire/Web from Bluestone software Inc.
- Allaire cold fusion
- NeXT WebObjects

6.2.3 Training the End User

the Intranet implementation is required to enable as many people in the institution as possible to be full participants in the communication process. This can only be achieved through institution-wide training. The Intranet technology brings a change in the way the staff communicates and shares information. Therefore, training is required to enable users access and use the Intranet

resources (applications, documents, and data). Intranet as an institution wide platform for information sharing will help the user not only to access information but also to contribute. The training program should, therefore, help users to become consumers as well as publishers of information.

The training program can be designed at different levels for different categories of users. Based on their institutional role and in relation to information use and control, the training program should be organised accordingly. The different categories of users include: end users (to familiarise them with the browser to locate and retrieve information), the database administrators, application developers, Web masters, research scientists (to retrieve and post articles or news items to their discussion groups, for example), etc. For conducting the training, ILRI can use its own staff from the computing, information services and training section.

6.3 Prototype Development

6.3.1 Overview

According to Gunegerich (1997, 205-8), there are four types of prototypes in Intranet implementation. These are:

- The overview - intended primarily to show the range of functionality that can be included in the Intranet
- The Glitz - intended to show the capability of an Intranet including, for example, animated images in gif format, a short audio or movie clip, or possibly a pdf file displayed in Adobe Acrobat reader
- The trojan horse - used to demonstrate how a specific application can benefit from Intranet technology
- The straw man - useful in a collaborative environment where support for the Intranet project is not an issue

In this study, a combination of an overview and the trojan horse prototypes are used. with the

overview type, a framework will be provided to present ILRI in its entirety including the range of applications and services. This does not mean, however, all what is shown in the overview will be implemented in this prototype. By the trojan horse specific applications, such as database integration, Web publishing will be selected to demonstrate how these applications can be served on the Intranet site.

6.3.2 Prototype Web Publishing

For the purpose of the prototype, the Intranet Web page is formatted in HTML and JavaScript. The Web page presents a general overview of ILRI's programs, activities, links to regional centres, CGIAR centres, NARS and background information about ILRI. ILRI's logo also appears on right and left top corners of the main page. This page is published on the publishing directory of the Internet Information Server (IIS), (InetPub\Wwwroot). The list of HTML files published on the prototype development appear in appendix 7

6.3.2.1 The Web Publishing Process

Basic features of the Web publishing include:

- HoTMetaL PRO is used to author the HTML files
- MIME type configuration on the Web server is made to access non-HTML files, such as word documents
- A client server model is adopted where for this particular prototype, server includes Windows NT operating system and IIS Web Server.
- The network configuration on the server side is integrated into TCP/IP network. Dynamic Host Configuration Protocol (DHCP) and Windows Naming Service (WINS) are enabled on the server
- The client is configured for Microsoft TCP/IP and uses the Web server's computer name to connect with the server. The client is equipped with Netscape navigator and Microsoft

Internet Explorer

- The client and the server communicate with each other using the HTTP protocol.

6.3.3 Prototype Database Publishing

For the purpose of demonstrating database access through the Web, two databases were selected. These are:

- ILRIB.MST
- EMPFILE.DBF

6.3.3.1 Prototype Application development for ILRIB.MST

ILRIB.MST is owned by the information services and it contains bibliographic records of the ILRI library holdings and data sources from CABI and ARIS. This database is maintained using MS-DOS CDS/ISIS version 3.07 database management software. Currently the database is accessible through the LAN. External users visiting the ILRI library also search this database to find items of interest to their need. Search results from the ILRIB database is provided to users either in print or on floppy.

In this prototype application development, attempt was made to construct a client/server model where the client (equipped with Web browser and form interface) interacts with ILRIB.MST through the IIS Web service.

6.3.3.2 The Application development Process

ILRIB.MST exists in CDS/ISIS for MSDOS version which means it is not compliant to the 32-bit ODBC. To develop the application, first a sample of 20 records were exported to the WinISIS (the windows version of CDS/ISIS software). The sample record is then stored in the Microsoft SQL server version 6.5 on Windows NT IIS Web server. Other application development tools

and software include the following:

- Visual Basic Programming language version 5.0
- Visual Basic Scripting edition
- JavaScript
- ActiveX Control
- HTML

The search screen for the ILRIB database starts from a hyperlink in the 'SPAN-Information services' Web page. The Microsoft Internet server API is used to interface the application developed. When the hyperlink is clicked ('click here to run search'), a Uniform Resource Locator is sent to the server. The Internet Database connector file (IDC file) is referenced with the URL. The entire process can be illustrated as follows:

- The URL is received by IIS (the URL is sent by the Web browser)
- IIS loads Httpodbc.dll and provides it with the remaining information in the URL, which means the .IDC files are mapped to Httpodbc.dll. Httpodbc.dll loads and obtains the name of the IDC file (and other user specified items) from the URL passed to IIS.
- Httpodbc.dll reads the IDC file
- The IDC connects to the ODBC data source, and executes the SQL statement contained within the IDC file
- The IDC fetches the data from the database, and merges it into the HTML extension file
- The IDC sends the merged document back to IIS, which returns it to the client

The various codes written to develop this application (the script programming, the application (the Active Sever Page , ASP files, the Internet Database Connector, the IDC files, the HTML extension, the HTX file) appear in appendix 8

6.3.3.3 Prototype Application Development for EMPFILE.DBF

EMFILE.DBF is an employee database containing records of the ILRI national and international

staff, about their employment history, salary, position, and other related information. EMPFILE is created and maintained using dBASE III+ database management software. EMPFILE.DBF is linked to Personnel information system, Medical insurance system, and Leave record system. Together with related database files, information is generated mainly for the head of administration, finance and accounting, chief of personnel, and for the general staff.

The head of administration may want to get, say a list of all Nationally Recruited Staff and Internationally Recruited Staff including their job classification. The finance want to know any information that might affect the salary of an employee. The personnel officer may want to update employee telephone directory. The general staff has interest to verify its leave balance or the amount of money transacted against their name for various reasons (such as telephone bill, car hiring, etc).

The aim of this prototype development is to provide Web access for the EMPFILE.DBF by illustrating with few query examples. Attempt was made to show how employees can check their leave balance, notify their address changes by updating their personal address record.

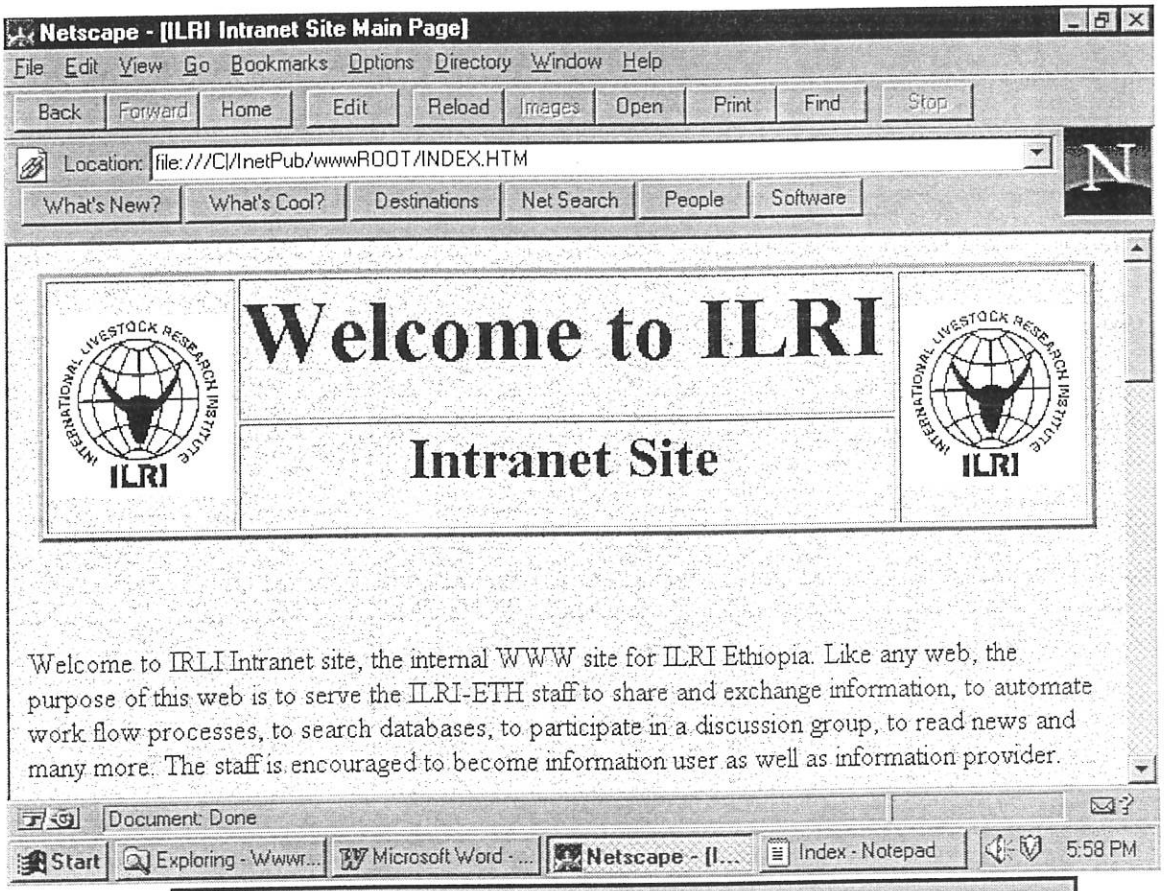
6.3.3.4 The Application Development Process

A sample of 20 records from EMFILE.DBF were exported to Microsoft Access database (.mdb format). This is made because ODBC supports the Microsoft Access driver. Though the .DBF drivers are also supported by ODBC, the Dbase III+ can not work in the Windows NT IIS Web server. The development tools used to create the application for ILRIB.MST are also used here. Instead of the SQL server driver which is used for the ILRIB.MST, here the Microsoft Access driver is used to connect to request through the ODBC. The screen form for the EMPFILE.DBF

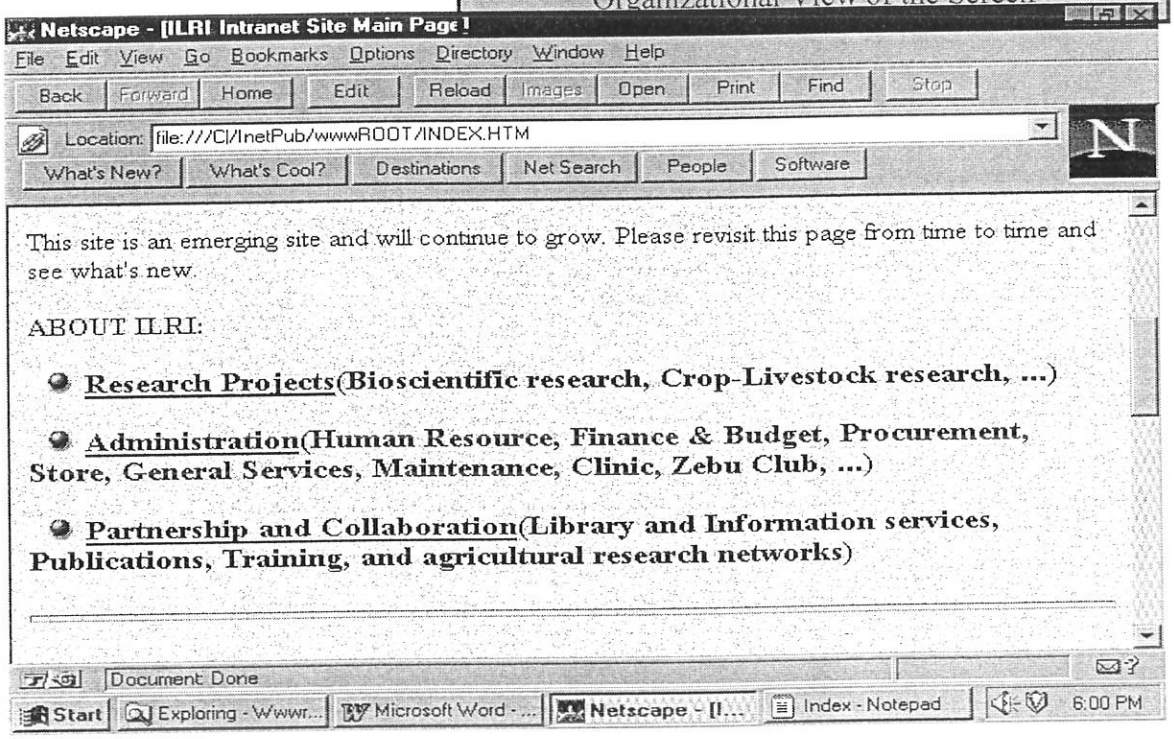
query is provided by clicking a hyperlink in the 'Administrative -Personnel Web page.

6.3.4 User Interface Design

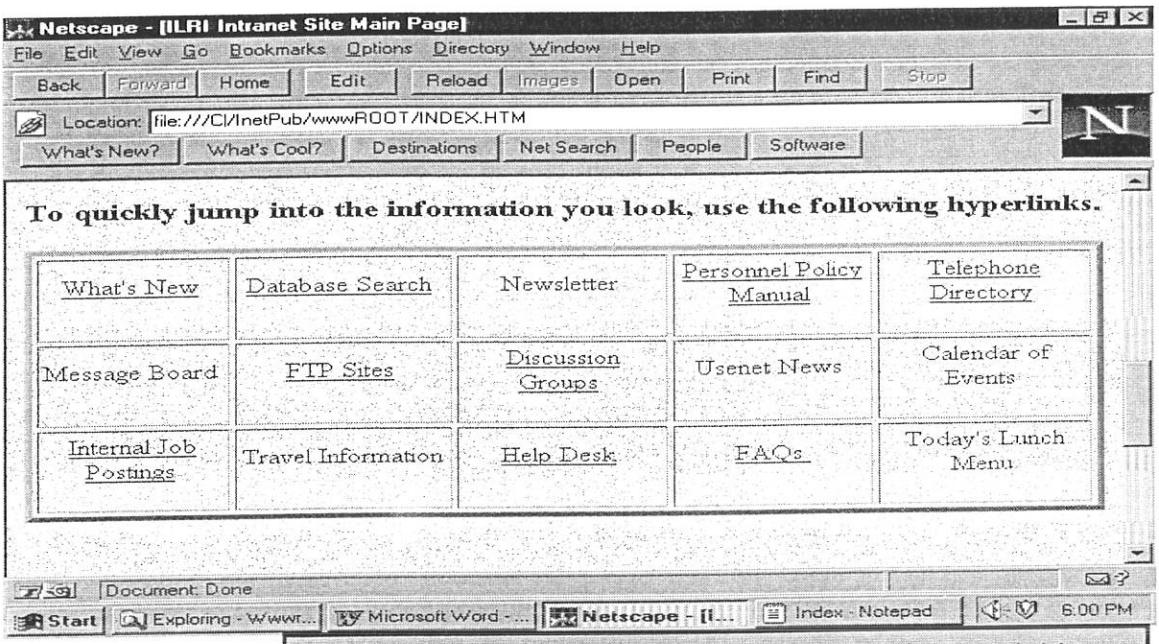
The structure of the overall framework of ILRI's Intranet Web page developed in this prototype and the relationship with several hyperlinks to individual pages, documents and database search forms are shown below. Attempt is made to show only those features that are attempted in the prototype development. As indicated in the Intranet design methodology section of this thesis (section 1.7), the following screen is presented here to show the three major views of ILRI's Intranet site. Detailed screen layouts and features for sub menus is attached in appendix 9.



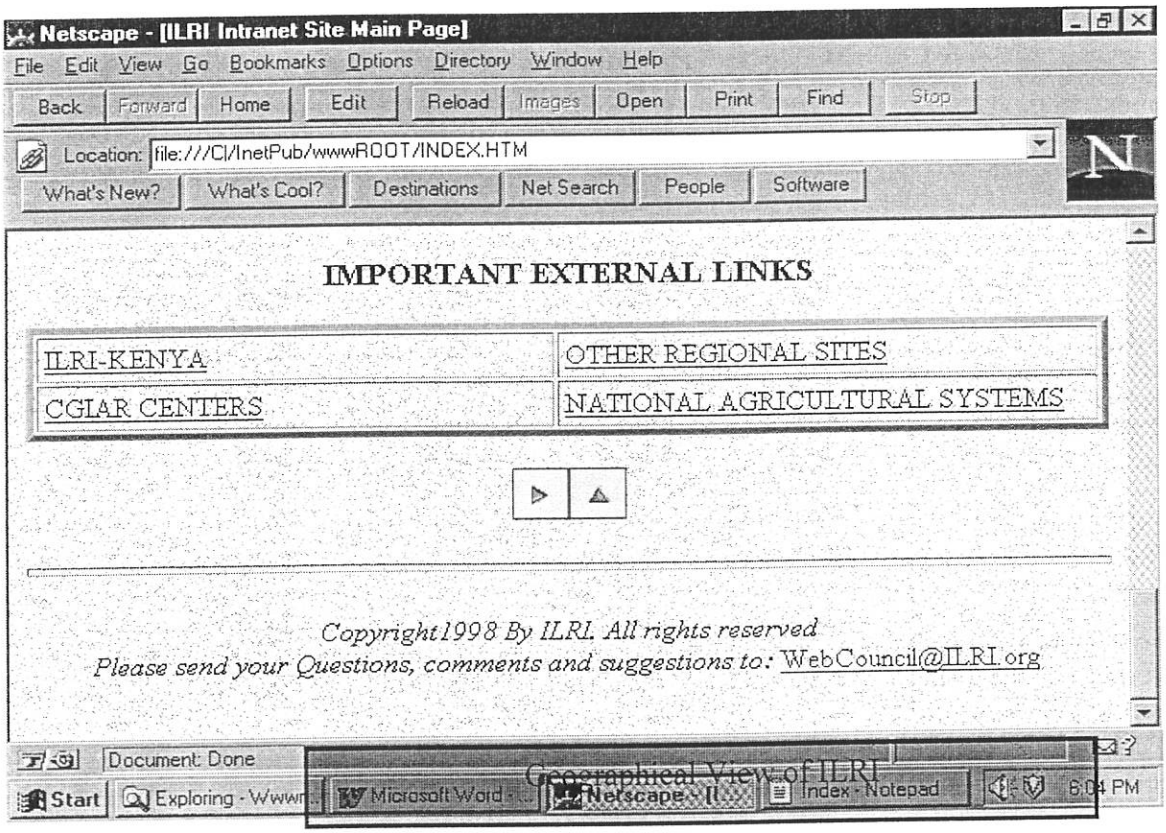
Welcome and Introductory Screen



Organizational View of the Screen



Multiple Views of Information related to specific activities



Geographical View of ILRI

CHAPTER VII
CONCLUSION AND RECOMMENDATION

7.1 Conclusion

Organizations are a place where people are working together for a common objective. In the process of executing the activities of the organization, member of the organization interact with each other to coordinate activities. For the organization work to be coordinated and headed to one direction, each individual acts from the same knowledge base. The organizations' knowledge base is the accumulated intelligence that has been built since its establishment. This accumulated intelligence is best reflected in the information captured, generated, stored, and communicated throughout the lifetime of the organization. It is this intelligence that the organizations' workforce refers to carry out its responsibilities. This is the essence of information resource sharing in organizations.

When organizations began to acknowledge that information plays a key role in achieving their goals, quick and timely access to the data vault of the organization becomes critical. This in turn has caused for the evolution of different mechanisms for information storage, retrieval and sharing. Today the electronic information delivery mechanism is preferred to the traditional paper based delivery. Within the digitized communication of information itself several changes have taken place. The punched cards, the mainframe era, local area networks, online searches, the Internet are all instances of such change. As recently as in 1994, organizations began to apply the Internet Web technology on top of their organizational LAN or WAN to leverage intelligence.

It is this aspect of leveraging organizational intelligence through the application of Internet Web

technology that this thesis has been concerned. Taking ILRI-ETH as a case, the whole exercise of this thesis was to explore the potential use of Internet Web technology for the purpose of information resource sharing. ILRI-ETH is the International Livestock Research Institute based in Ethiopia. ILRI-ETH has a local area network that was established in 1992. When the Internet Web technology is applied on top of organization's local area network or wide area network, it is referred to as 'Intranet', hence Intranet solution.

Trying to adopt Intranet solution for organizational information sharing require to investigate three important components viz. information infrastructure (or content), network infrastructure, and organizational process. Accordingly, attempt was made to collect data about these three core components in relation to ILRI-ETH. The interview method, survey questionnaire, institutional document review and observation were the main instruments used in this study.

In regard to content, the investigation revealed that ILRI has a vast store of information accumulated since its establishment in 1974. Concentrating on the digitized information resources, attempt was made to review the institutional information resources by dividing them into two main categories. The first category constitutes the non-structured information resources, such as manuals, reports, conference proceedings, minutes, etc. which are held electronically. And the second category involves the structured information resources that are maintained in a form of a database.

According to the survey result obtained, ILRI's institutional information resource is so rich that it needs an efficient mechanism of storing and accessing it. Much information is being stored than is accessed. Lack of quick and timely access to institutional information resource has resulted in

delay of activities. The survey result has shown that the institutional information resource sharing is heavily dependent on the paper-based delivery than the electronic delivery using the network infrastructure. Even if there are attempts made to share information using the network infrastructure, the utilization rate was very minimal. This under utilization was attributed to the poor user interface and less frequent update of the information.

In regard to the network infrastructure, the survey work conducted ILRI has a 10BaseT Ethernet local area network connecting 150 nodes in nine LAN segments throughout the premise of the institution. Each LAN segments are identified by a separate building and within the building Unshielded twisted pair category 5 cables connect nodes to the building wire concentrator. From each building hubs, a fiber optics cable run to the central patch panel which is located in the computer services. The building hubs and client nodes have all 10 Mbps bandwidth. According to the survey result, the network is heavily used for print sharing and file sharing purpose followed by e-mail.

The adequacy of the existing network infrastructure, whether it needs an upgrade and reengineering was also considered. According to the survey result and similar experiences elsewhere ILRI's existing network infrastructure requires restructuring. The reengineering mainly concerns the backbone, the bandwidth and the presence of Web and other servers. Even if ILRI can start the Intranet deployment with minimum publishing work, for a full deployment ILRI needs to consider acquiring the resources suggested in this report. The move from the traditional Ethernet to the fast Ethernet and from the 10 Mbps hubs to 100 Mbps Switch technologies is required.

Concerning the organizational framework and processes, ILRI is an International organization the

offices of which are distributed throughout the developing world. In addition ILRI's existence is largely dependent on partnership, collaboration and outsourcing of knowledge products to national governments and similar research institutions. Above all majority of the research projects are conducted in teams members of which can be located in different stations within ILRI. Due to this fact, ILRI's institutional activities, processes and the scope of the management spans the whole of the world.

As a result of such survey outcomes, the first thing ascertained in this study was the establishment of the need for Intranet solution. Regarding the content access and interface problems, Intranet solution makes it easier for quick information access and appealing user interface. Because the Intranet solution combines the Web and the Internet technology, both locating and retrieving activities are much facilitated. The Web browser through which Intranet resources are accessed is now considered as the single ubiquitous user interface. The Web is now considered as another multimedia and hence the ease of use. Because of the distributed network feature governing the Internet communication, the Intranet network also works in the Internet fashion where resources can be fetched from anywhere and from any direction.

Considering the institutional characteristics of ILRI, it was also found out that Intranet can be taken as one of the viable solution for quick and easy information exchange and sharing. Because Intranet uses the same protocols and services as the Internet, geographical disparity is not a problem to Intranet solution. If ILRI establishes a wide area network connecting all offices distributed in different geographical locations, the Intranet solution can be easily deployed on top of the WAN to connect all regional sites. The different sites can; therefore, work and collaborate as belonging to one network.

The next issue addressed in this thesis work was to identify required resources and services and how to integrate them to the existing ILRI environment. This aspect was dealt in the design chapter of this report. To introduce the Intranet solution into ILRI, the information resources and users were identified. The Web site structure was designed including applications and services. Basic additional resources required to re-engineer the network infrastructure was also determined along with the salient features to be incorporated. Based on the review of institutional characteristics, design alternatives were evaluated and how the new system should look like and what features to possess were proposed.

Finally, in the development and implementation chapter, a kind of proposition was made to start the Intranet solution by forming a project team. The project team is proposed to involve the institution management, agents, and users. The roles of each member forming the team were explained. Then, the team is proposed to start work by outlining a work plan involving procurement and user training. A prototype was also attempted to show how static as well as dynamic Web publishing can be implemented using a client Web server architecture.

7.2 Recommendation

According to ILRI's plan to restructure its information services as outlined in the document "Strategy and Programs for ILRI Information Resources: 1998-2010," ILRI has shown interest to move into Internet publishing and distribution of information. This thesis has investigated a similar line of intent to some degree of depth and has shown the way how to. ILRI might, therefore, use the results reported, methodologies suggested and design alternatives recommended by this study as an input to the execution of its plan. The Intranet solution is primarily intended to leverage information resource sharing inside ILRI, regardless of the global

distribution of offices. This priority should be, therefore, considered primarily. In a phased approach, the Intranet solution can continue to address the information services to the extramural users.

To be specific, this study recommends the following points for consideration during the course of the implementation of the Intranet solution.

- ILRI should be able to sponsor and support the Intranet implementation by allocating necessary resources
- ILRI should consider setting up a project team which will act as an agent in the implementation of the Intranet solution
- The project team should start operation by working out an action plan involving all aspects of procurement, installation, testing, user training and evaluation. In some instances ILRI might need to contract with consultants who have enough experience in Intranet deployment.
- ILRI should also set up a Web council that approves content for publishing, follows revision, drafts policy statement concerning access to users and roles expected of them. Unless very well monitored and controlled, the Intranet technology makes publishing by the end user so easy that might eventually lead to chaos.
- The existing Local area network should be upgraded to Wide area network to extend the Intranet solution to connect all regional offices and field sites for the entire staff to become full participant in the Intranet implementation.
- Similar investigation to the one reported in this thesis should be repeated in the different regional sites (specially in the head office Nairobi, Kenya) to avoid duplication of resources
- The Intranet solution is a scalable technology, where it can be started small and fully developed later. Therefore, ILRI-ETH can start to implement the Intranet solution with the

existing infrastructure in a small scale

- Regarding the network migration, it is recommended to upgrade the existing system in the phased approach as outlined in the design chapter of this report.
- Intranet solution is a recent discovery and is an emerging technology and currently it is in its infancy stage. Technology also changes every time. What is regarded as the best fit today might be replaced by new and better solutions. What is proposed in this thesis might be nullified by developments and changes happening any time in the future. Therefore, ILRI should always keep track of technology changes and evaluate against the already existing system.
- When Web servers are gradually replacing the existing file servers, the outgoing file servers should not be thrown away. There are mechanisms to integrate the legacy system and continue to work with the Web servers.
- To easily integrate the CDS/ISIS based databases available at ILRI, it is recommended to migrate into a windows based database management software which is compliant to the ODBC drivers. Alternatively, application developers should write a new CGI or try to customize already developed applications that integrate CDS/ISIS databases into the Web.
- ILRI should recruit more expertise having such skills as application development, Web site design, Web server administration, graphic artists, information architects.
- Many of the programs that can be used for Intranet site are freely available on the Internet and ILRI should consider searching different Internet/Web/FTP archival sites before deciding to buy or to customize.
- Since ILRI's existence is dependent on external collaboration and networks, further research should be conducted in the area of Extranet technology and virtual networks.

7.3. Implication

ILRI is an international organization that enjoys substantial infrastructural facilities and financial support. ILRI has a long tradition of online culture. Due to these and other favoring conditions, the Intranet solution recommended in this thesis can be implemented with reasonable ease compared to other institutions in this country. In general, the implication of this study on other institutions can be viewed under two categories by dividing the rest of institutions in Ethiopia into two classes:

7.3.1 NGOs and PVOs

Many of the Non-Governmental Organizations and Private Business Organizations in Ethiopia are currently connected to the Internet or are using computer and related technologies to manage their information processing need. This culture added with the financial resources they can command, the Intranet solution designed for ILRI can boost the NGOs and PVOs to launch similar projects at least within the coming three to five years time. I know, for example, the chamber of commerce is on the verge of

Re-engineering its information management activities to Internet/Web technology both for internal and external communication need. This can prompt member business firms under the umbrella of the chamber to move to the same direction.

The non-governmental organizations have also close work relationship with ILRI and can imitate the same deployment technology for their information communication and sharing both within the country and with outside sponsors and donors.

7.3.2 Government Ministries and Public Institutions

Many of these institutions are operating a legacy system, which is not year 2000 compliant and their main concern today is to convert these legacy systems into Y2K compliant systems. In addition, the computer and related IT technologies were introduced into the public institutions just recently and the online experience by these institutions is very much lower compared to the NGOs and business establishments. The local area network or wide area network which is a precondition for Intranet solution is also absent in many of these public institutions and Intranet deployment can take time to materialize in these institutions. These delay may cause a gap between NGOs and public institutions which is also true in the present infrastructural and financial facilities.

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Appendix-1

NAME OF INTERVIEEWS

1. Mr. Abraham Bekele, head of computer services
2. W/o Azeb Abraham, Librarian
3. Mr. Belayhun Wondimu, Chief financial officer
4. Dr. Brigitte L. Mass, Visiting Scientist, Genebank
5. Mr. Dessalegn Mammo, chief personnel officer
6. Mr. Hambissa wakoya, project supervisor, computer services
7. Dr. Ibrahim El habib, Training materials specialist
8. Dr. Michael Smalley, Director, SPAN
9. Dr. Rege Edward, Scientist, Animal genetic resources
10. Mr. Saleem Mohammed, Project coordinator, Highlands
11. Dr. Shapiro B., project coordinator, Livestock research
12. Mr. Paul Neate, head of publications
13. Mr. Tall Aguibou, head of administration

Appendix-2

ADDIS ABABA UNIVERSITY
SCHOOL OF INFORMATION STUDIES FOR AFRICA
M.Sc.I.S. DEGREE PROGRAM

Interview Checklist:

Dear Sirs/Madam:

My name is **Shimelis Getu**, a graduate student at Addis Ababa University in the School of Information Studies for Africa (SISA). Currently, I am working on my thesis research in ILRI under the title, "Information Resource Sharing at ILRI: the Potential for Intranet Solution."

Intranet is defined as a mini-Internet within an Organization, Institution or Company. It is similar to the Internet because you are connected by wires and servers to access e-mail, more servers, databases, and software programs. It is different from the Internet because you can control the environment. The major reason to adopt Intranet on top of Organizational LAN or WAN is to increase internal effectiveness. This study is all about:

> "implementing an Internet-Web technology to extend the functionality's of the existing electronic information communication supported by the LAN."

You are chosen for this Interview in an impersonal way and merely because a cross-section of representatives' is needed. This study will attempt to come up with a small solution but with a far-reaching impact which definitely will have a bearing on your Program, Project or Unit.

I would like to come in and talk with you about the points attached

Very Sincerely Yours,

Shimelis Getu.

- Name of your Program
- Objectives & Activities
- Work relationship, scientific collaboration within ILRI
- Types of information generated & disseminated
- Databases created & maintained
- Network utilization
- Any identified need related to the management of electronic information
- Physical & logical organization for people, processes, & decisions
- Any comment you wish to make

Appendix-3

ADDIS ABABA UNIVERSITY
SCHOOL OF INFORMATION STUDIES FOR AFRICA
M.Sc.I.S. DEGREE PROGRAM

Survey Questionnaire

Research Topic: **Information Resource Sharing at ILRI: the potential for Intranet solution**

Candidate: **Shimelis Getu**
Institution: **Addis Ababa University**
School of Information Studies for Africa (SISA)
Contact Address: **P.O. Box 150237, Addis Ababa**
Tel # 55 39 80 (Office)
E-mail / Internet: Kennedy.aau@telecom.net.et
Ethiopia

Dear Respondent:

Intranet is defined as a mini-Internet within an Organization, Institution or Company. It is similar to the Internet because you are connected by wires and servers to access e-mail, more servers, databases, and software programs. It is different from the Internet because you can control the environment. The major reason to adopt Intranet on top of Organizational LAN or WAN is to increase internal effectiveness by extending the functionality's of many of the conventional electronic information infrastructure.

As it was hinted during the 'Intranet seminar', the main objective of this study is:

- To extend the functionality of ILRI LAN with a TCP/IP configured Internet standard computer network
- To re-engineer the information resource sharing activity at ILRI with Web based standard

In order to realize this objective, one of the major task involved is the 'information needs assessment of ILRI.' This questionnaire is, therefore, prepared to collect relevant facts and data pertinent to the objective addressed above. The candidate believes your cooperation and objective reaction really makes a difference. All your responses will be used in the analysis of the research work and will be kept confidential

Please do not write your name. If you need more clarification, please contact me at ILRI Library or in the Computer Department (Ext.172).

THANKING YOU IN ADVANCE FOR YOUR PRECIOUS TIME!!!

IDENTIFICATION

- Unit (Program / Sub Program): _____
- Responsibility or Position (Job Title): _____
- Educational Background: _____
- Year of Experience: _____

COMPUTER NETWORK

1. Do you have Computer(s) & related technologies in your Program/Project/Unit?

   [ ] Yes [ ] No (If No, skip to question 33)

2. Is /are your Computer (s) connected to ILRI's LAN?

   [ ] Yes [ ] No

3. If Yes to the above question, What rights are you granted from the network?

   File read only [ ]
   File write only [ ]
   File update or change [ ]
   Post Documents onto the IBBS [ ]
   Run applications [ ]
   Install or customize applications [ ]
   Download shared folders [ ]
   Other, please specify _____

4. How do you use your Computer(s)?

   By logging into the network File Server [ ]
   As a stand alone [ ]
   Both ways [ ]

5. Does your computer contain data/information or applications in addition to those you find through the network ?

   [ ] Yes [ ] No

6. What is the main reason for you to log into the network (check one or more depending on specific needs)

   For communication (such as e-mail) [ ]
   To use ILRI Bulletin Board Service (IBBS) [ ]
   To run application software from the server [ ]
   To send file to the printer [ ]
   To access shared folders [ ]
   Other, Please specify _____

7. On the average, how often do you log into the network?

   Several times a day [ ]
   Once in two days [ ]
   Once in three days [ ]
   Once in a week [ ]
   Other, Please specify _____

8. For which of the following functions, the LAN serves your need best?

   For communication [ ] For application sharing [ ]
   For resource sharing (such as printer) [ ] For information sharing [ ]
   Others, Please specify _____

9. How often are you successful to log into the network?

Always[ ] Sometimes[ ]
Rarely [ ] Not at all [ ]

10. Is your Program/Project/Unit connected to the Internet

[ ] Yes [ ] No

11. If yes, what is the main purpose you use for?

E-mail [ ]
WWW search [ ]
FTP (to download files) [ ]
Telnet (to log into remote machine) [ ]
Other, Please specify _____

12. Do you have any Program, Project or Institutional information published on the Web (posted on ETC Web server or through other Web sites elsewhere)?

[ ] Yes [ ] No

13. If Yes, are these Web pages accessible by other Programs or Projects within ILRI?

[ ] Yes [ ] No

CONTENT

14. Do you maintain your Program or Project related activity information electronically?

[ ] Yes [ ] No

15. Do you produce information which could be used by other Programs, Projects & units within ILRI?

[ ] Yes [ ] No (If No, skip to No. 19)

16. If your answer to the above question is Yes, how do you make available the information to other entities within ILRI?

By posting on the IBBS [ ]
By sending e-mail [ ]
By distributing printed copy [ ]
By distributing soft copy or printed copy only when requested [ ]
By publishing on the Internet [ ]
Other, Please specify _____

17. List all the major information outputs of your Program or project, including the frequency & media used (Example is given to guide)

	Type of Information Output	Frequency	Medium
1□	Newsletter	Quarterly	IBBS or print copy
2□			
3□			
4□			
5□			
6□			
7□			

18. What type of information do you normally maintain in your computer or access from the network?

Textual [ ] Numeric, Statistical [ ]
Image, Photo [ ] Sound, Video [ ]

19. Do you feel your Office file cabinet or file folder is overloaded with papers of all kinds?

[ ] Yes [ ] No

20. If Yes, does ILRI has any archival center or data repository where you can store inactive documents and files?

[ ] Yes [ ] No

21. In your Program or Project, if there is content creation activity (such as writing, editing, proof reading) of the information it produces, how does it get these information published electronically or on paper

By own Program staff [ ]
By the computer department [ ]
By the publishing unit [ ]
Other, Please specify _____

ORGANIZATIONAL INTERACTION

22. In your day-to-day activity, in a situation where you want to send or receive information to or from other Programs/Projects, how do you manage to do that? (Check applicable to own by marking an 'x' across the row)

Type of Information Required to Send or Recieve	Medium Used To Send or Recieve Information					
	Tel. call	E-mail	IBBS	Printed Forms/documents	Informal communication	Other
messaging & notification (such as memo)						
Organizational issue (such as policies, procedures)						
Workflow processing (such as purchase order						
Staff directory (such as address)						
Reports/Newsletters, training manuals						
Internal inquiries (such as maintenance)						
Personnel issues (such as job openings, benefits, leave application)						
Departmental routines (plans, meetings agenda & notes)						
Team works progress (project plans, status reporting, research reports)						
Research collaboration (profile, status)						
External contact (Correspondence)						
Financial information (periodic financial statements, budget tracking)						
cross-functional project (project-related documentation)						

23. List, all functional entities within ILRI Programs or Projects (in order of significance), which you think have frequent contact with your activity.

1□ _____
2□ _____
3□ _____
4□ _____
5□ _____
6□ _____
7□ _____

24. What is the mechanism you use to know the rules, procedures & current activities of other departments in ILRI?

The IBBS [ ]
Printed document [ ]
E-mail [ ]
Meeting (formal) [ ]
Informal meeting [ ]
Other, Please specify _____

25. How do you keep ILRI staff informed of changes and new plans in your Program or Project activities, policies, procedures & regulations?

The IBBS [ ]
Printed document [ ]

E-mail [ ]
Internet [ ]
Meeting [ ]
Informal meeting [ ]
Other, Please specify _____

26. How do you submit your Program or Project activity report to the management?

Send printed copy of report [ ]
Send soft copy on diskette [ ]
Other, Please specify _____

GENERAL

27. How do you Normally execute your day-to-day activity?

Individually by my own (self) [ ]
In group/Team/Committee/Task Force [ ]
In collaboration with immediate Supervisor [ ]
In consultation with some other Departments [ ]
Other, Please specify _____

28. What do you think is the main problem for your Program or Project to deliver or access information within ILRI?

Information overload (too much information) [ ]
Information identification (not knowing where it is located) [ ]
Lack of adequate facility (hardware, software, etc.) [ ]
No problem [ ]
Other, Please specify _____

29. Does your Unit has some plan in regard to improving the existing electronic communication infrastructure?

[ ] Yes [ ] No

30. If Yes to the above question, please describe in brief

_____

_____

_____

31. Is there any identified need(s) in your Unit that the computer department can be called to help?

[ ] Yes [ ] No

32. If Yes to the above question, please describe the need briefly

_____

_____

33. If you were present during the Intranet Seminar held on the 10th of February 1998 at ILRI Auditorium, do you think the 'INTRANET SOLUTION' helps to improve the existing electronic information resource sharing facility at ILRI?

Strongly Agree [ ]
Agree [ ]
Disagree [ ]
Strongly Disagree [ ]
Do not have any idea [ ]

DECLARATION

The thesis is my original work and has not been presented for a degree in any other university.

Shimelis Getu Assefa
June 1998

The thesis has been submitted for examination with my approval as University advisor

Dr. Lishan Adam