INTRANET and Development of Citizenship Database

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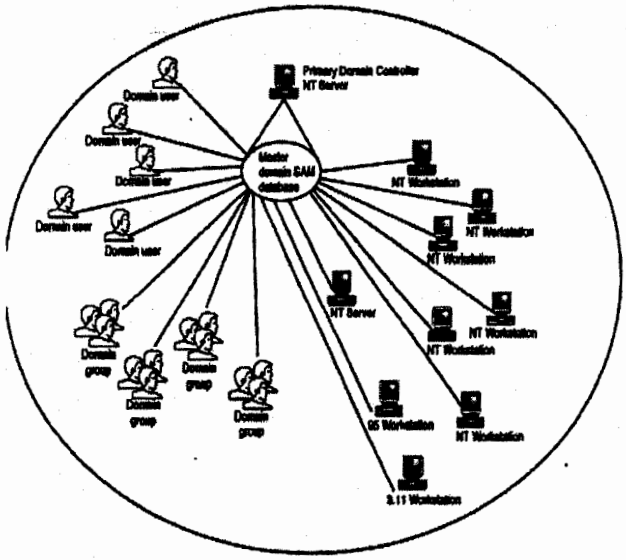

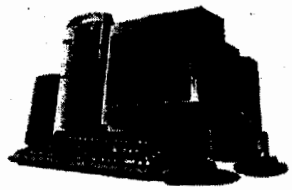

The Power of technology

"Ride the stallion of time"

Preface

Since the dawn of the twentieth century, time seems to pass by at whole lot more pace then before. No matter how sarcastic this statement seems to be, it is an absolute truth. Though historians and scientists might define time and its pace differently, but the events of twentieth century has proved them wrong in many aspects. The reason is the technological advancements and innovations of this century. Every thing now seems to be more dynamic and closer to perfection. Scientists are coming up with new and improved modes of living. Every now and then technological wizards wave their magic wands and we are introduced to a new amazing gadget, which takes another leap into the feature to make our life more comfortable and easier.

Industrial revolution achieved its glory in the middle of twentieth century. This era induced a sense of competition and valor in the minds of developers, The technology developers and shapers.

Among many technological wonders like airplanes, automotive and defense equipment some scientists came up with an advanced form of an old device called "Computer". Computing devices like John van Nueman's machine, Jacqard's loom etc were always there, but none were as powerful as the form computer took by the middle of the century.

From then on it was no turning back for computers, soon they were in accounting systems, databases and in our houses even in cars. Why it was so, the reason is these electronic devices are very small in fact like micro creatures, are efficient and never make mistake.

It is only a matter of times that when we see these computers or micro controllers at all sort of unimaginable places. Computers are productive and that is why they are being used every where. They are replacing manual workers with small devices, which makes it more cost effective, less time consuming and prone to errors.

Executive summary

Pakistan is considered an underdeveloped country and like all other such countries lacks a formal citizen database which is absolutely vital for its sustainability. Feeling this need Government of Pakistan started efforts towards citizen documentation. It took half a century for this documentation process to mature. But soon it was realized that all kinds of citizen databases are maintained under manual system and they need to be computerised or automated.

Immediately a task force was setup to computerize every kind of citizen database in the country. Exit controll list and visa information systems were on the priority list.

We (Basit Ali Khan and Syed SajjadAli) were assigned a project **by Ministry of Interior, Government of Pakistan,** to quickly convert the existing system into Computer based and design such an information structure that whole ECL (Exit Control List) become more productive and result oriented.

This project has been divided into two phases and each phase has further two portions. The hierarchy is as under:

Phase I: Urgent and speedy method .

A) Designing and implementation of Database in Access 98.
B) The other part is to connect it throughout all Pakistan's important points such as airports etc.

Phase II: Reliable, Efficient and the most secure network called The INTRANET.

A) Designing of database in Oracle as a backend and Developer 6 used as a data entry form.
B) Connect that database to HTML page.
C) To make a secure network using Routers.

This report is aimed to give the comprehensive view of system study design and implementation phases of the project, carried out at the Ministry of Interior, Government of Pakistan. First part is about the database development that includes EXIT CONTROL LIST and VISA MONITORING SYSTEM (Visa monitoring system) which is used for keeping the updated information about the visitors/foreigners who come in Pakistan for a short period of time. The second part describes the design, installation and

connectivity of the ECL and VISA SYSTEMS at all the normal exit points of the Pakistan.

Important: ***The project is highly secret and confidential, thus we are not allowed by the concerned authorities to explain the first part in detail. However, we are permitted to give some basic information about the database.***

Objectives

The objective of this project was to automate exit control list of Pakistan and Visa information system. It was also vital to design such a system that change and information flow should be as efficient as possible. ECL changes in the existing system takes about two to three days, this lead time should be reduced to as low as few minutes. The reason is huge loss to Government will occur if an unauthorized person moves in or out of Pakistan without government knowledge. Another objective of the study is to have comprehensive and ready on demand information of people currently living in Pakistan who are on a visit to this country. Government wants to be notified immediately about the people who 's VISA have expired and they are still in the country.
In the current system all the documents were paper based and updates took lot of time.
Thus criminal activities were hard to curb.

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Proposed solution and its objectives

Introduction

- Requirement Analysis
- Urgent Solution
- Secure Solution

Objectives

- Efficiency
- Correctness
- User Friendly
- System Security
- Flexibility
- Information retrieval
- Time saving

PART II

The Project

Introduction

1. Organization

The Ministry of Interior, Govt. of Pakistan was planning to use the computer for maintaining the complete record of the persons who are by any reason not allowed to leave the Pakistan with out the knowing of Govt. For this purpose they are maintaining the Exit Control List (ECL). This is highly secret document of the Ministry and they were In search of finding the people on them they can trust. We were lucky; they chose us for this National Level project.

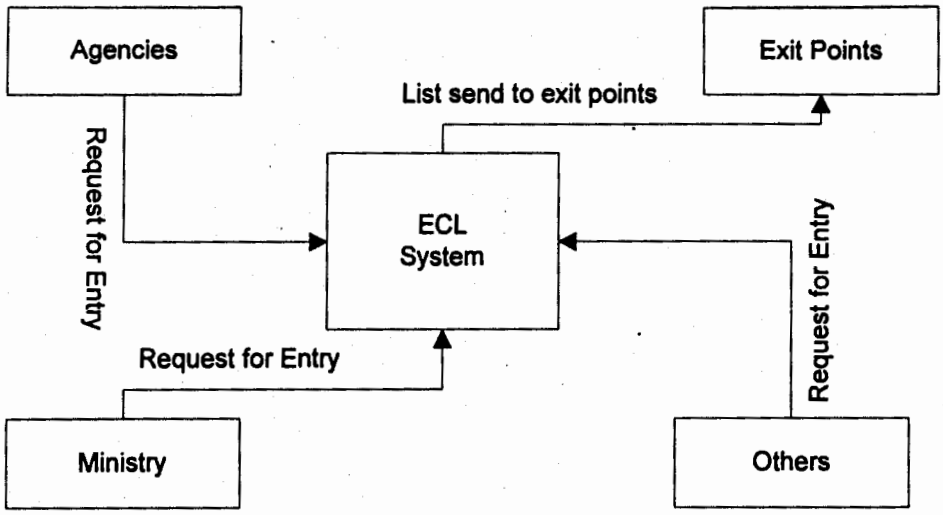
This project is to develop the database for Exit Control List and VISA system (We are not allowed to provide the further explanation due to the confidentiality of the data)

2. Overview of existing system

Manual

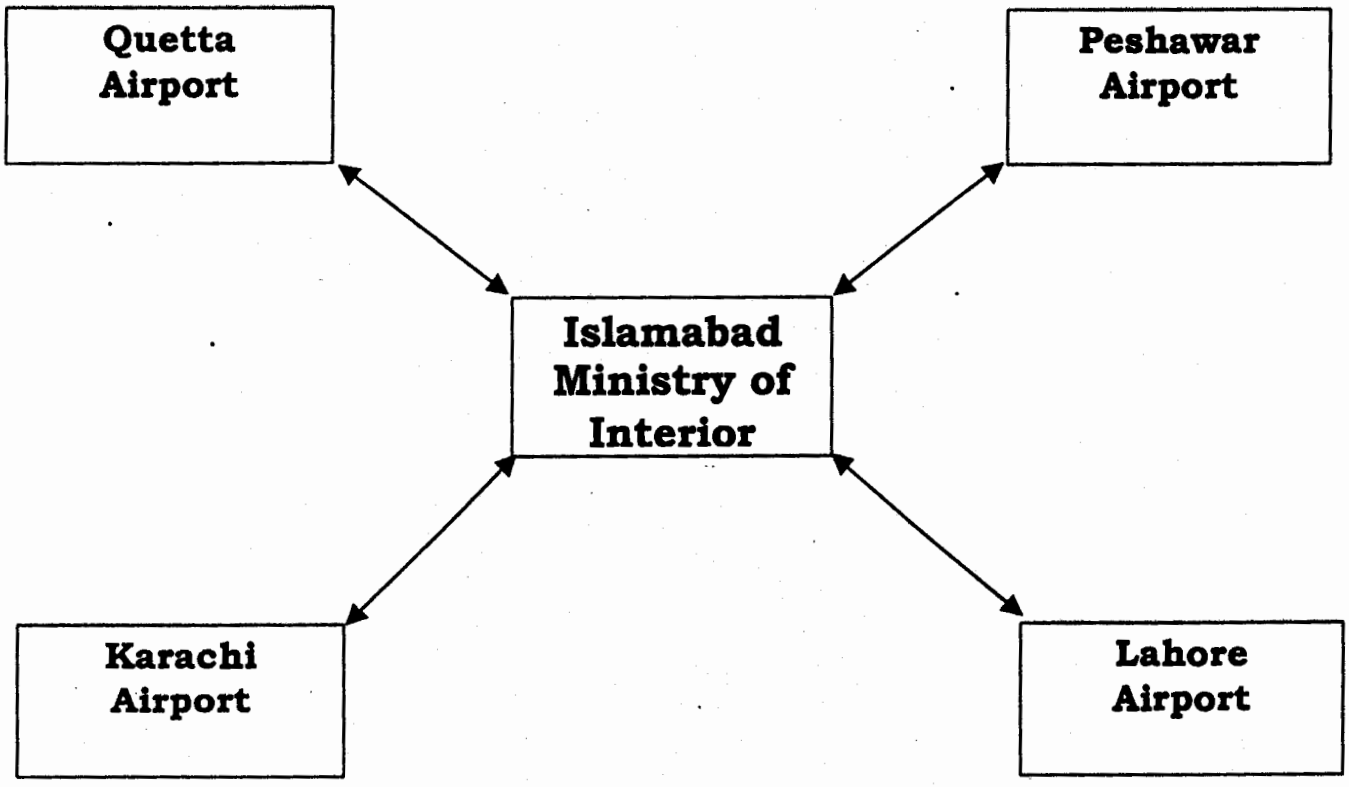
3. Problems associated with existing system

- Manual
- Inefficiency
- Data accuracy
- Laborers
- System Securlty
- Limited Flexibility
- Time consuming
- Wastage of resources
-



Context Diagram of ECL

Proposed system



Problem Statement

Before computerization of the ECL system the whole system was manual, this generally cause the followings:

1. Slow: ECL is required to be present at all the exit points of Pakistan very sharply when it is updated (deletion and addition of name) but due to the manual system, it was very difficult to provide the ECL to all the relevant personnel.

2. More Labor: The more people were involved in preparing and disbursing the List.

3. Accuracy: Due to manual preparation of list some times accuracy of the list was a doubtful factor.

Proposed System

The proposed ECL database system is such an efficient that has been reducing the worries of the concerned authorities.

Requirements:

Hardware Requirements

- A reliable communication link with the Intranet is required. The Ministry will need to have ROUTERS to make secure and efficient work.
- IBM Pentium II computers HUB, DTU, US Robotics Modems etc.
-

Software Requirements

- Windows NT Server4 with an appropriate number of clients accesses license.
- Service pack / Option pack 4 for NT
- Microsoft Access 98
- Oracle 7.3
- Developer 6
- Cold Fusion Studio
- Front Page 2000
- Internet Explorer 5

Project Phases

There are two phases to achieve the goal, under the direction of ministry's officials:

Phase I

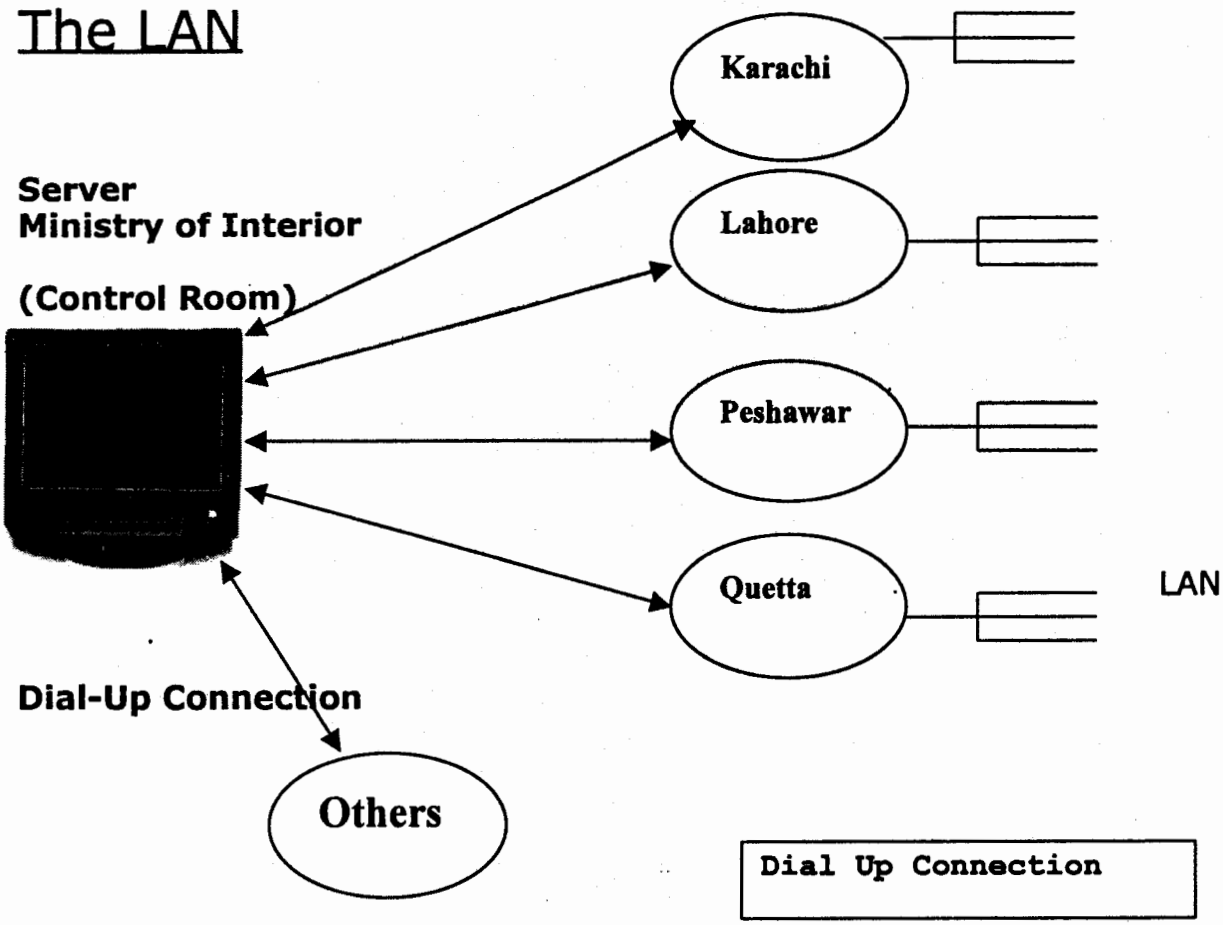
To establish very urgent and economical setup. The tools and procedure are as under:

1)
To develop the database of citizenship (ECL,VISA) in Microsoft Access and which is reside in the server, which is located probably in the ministry' control room.

2)
The clients (who are situated in different key points in Pakistan) are able to connect with dial-up to the server and download the regarding .MDB access file and update their database and then disconnect it immediately.

3)
most importantly develop a software for client end which facilitates the functions of:

- Database query
- Database updating
- Database Search
- Database Connectivity
- Dial Up Networking
- Database Management
- Database Security
- Network Security



Phase II

To develop and deploy the database management system in the WAN environment to run on the secure and reliable Intranet of the ministry. We have decided to make INTRANET setup to fulfill all above requirements. This setup is more costly than phase I but there is no cost value as for as national interest is concerned. The tools and procedures are as under:

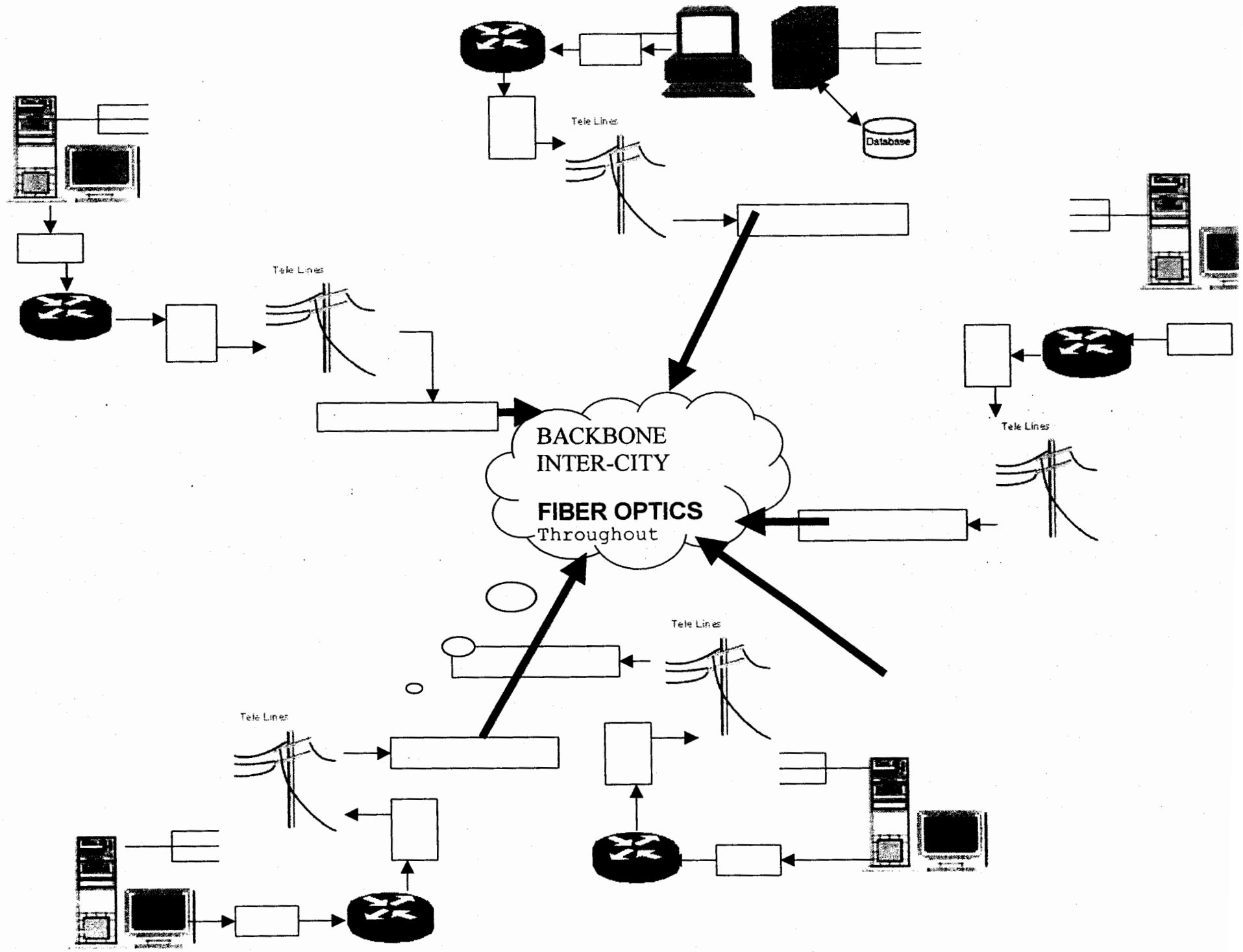
1. To create database in ORACLE and connect it with the HTML/CFML page and ASP, to make the access in easy way through just any web browser (Internet Explorer, Netscape, etc). In this case we need to have some tools which are given below.

   a) Install Windows NT 4 (licensed for 4-6 users) as operating system.

   b) Develop a database in ORACLE 7.3 using developer 6 for standalone data entry.

   c) With the help of cold fusion server 4 and cold fusion studio we make .CFM / .CFML format by which we can browse or generate required queries by using internet explorer at the client side but clients are not authorized to update, change or any modification, they are only allowed to just browse their required result.

2. To establish the INTRANET setup we need to have Routers (2500/760 series) as a best hardware tool along with the other common hardware (Computer P II, Hubs, Cables, etc) to keep our data at the most secure and more efficient. The backbone is Fiber Optic for fastest communication. In remote areas we may use Radios. (Please see Intranet diagram)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Database
Tele Lines
Tele Lines
BACKBONE
INTER-CITY
FIBER OPTICS
Throughout
Tele Lines
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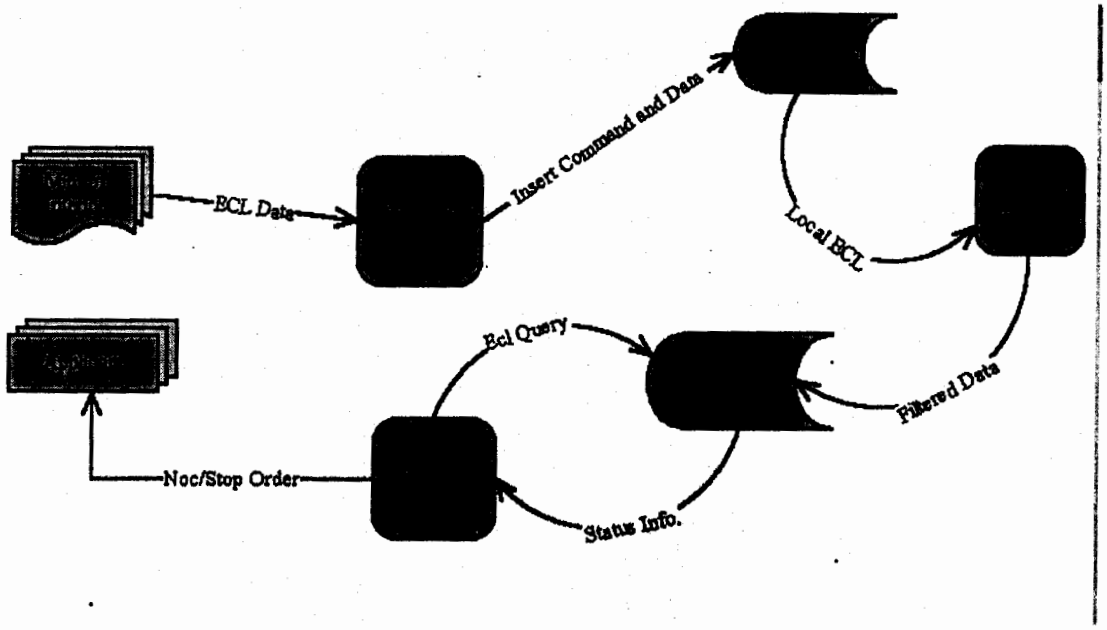
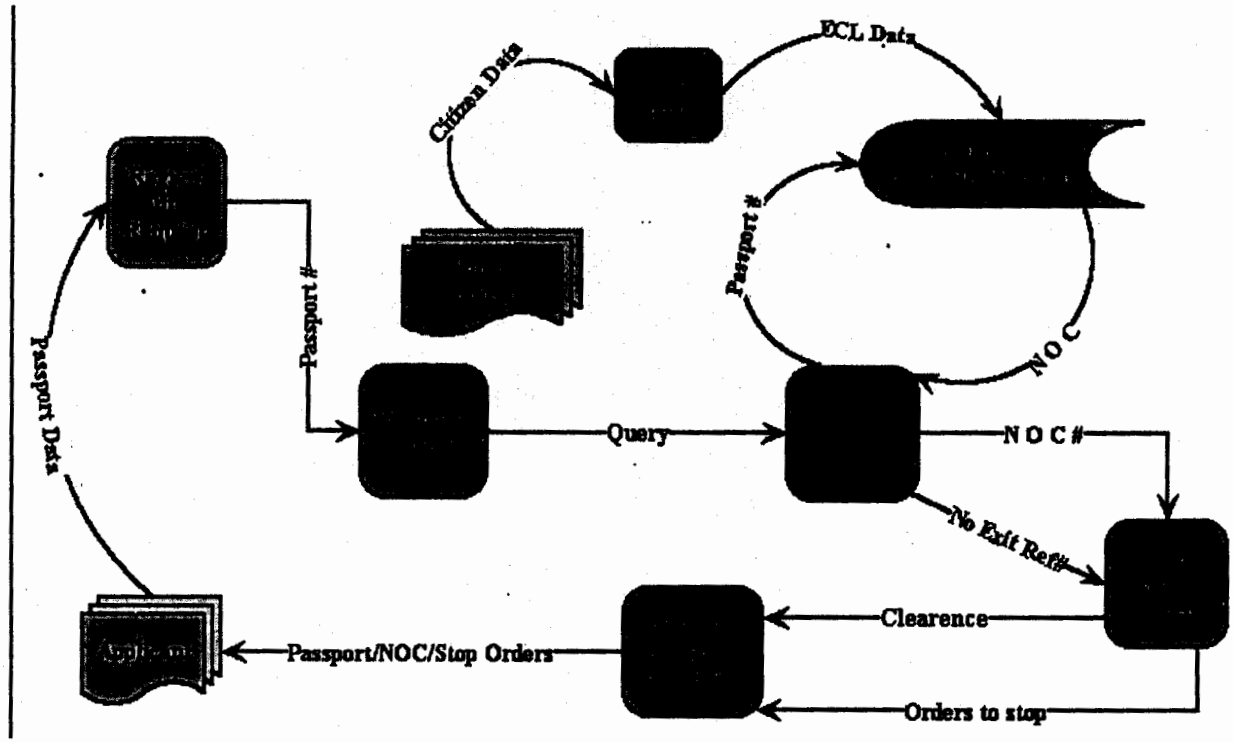


If we look at the detailed view of the DFD of the proposed system we would find that it is not at all a lengthy procedure and with computer technology involved in it, it is fast accurate, reliable, secure and flexible.



Methodology

The project done needed an extensive research regarding the study of the existing system of ministry of Interior Govt. of Pakistan. The study phase of the project was the most time consuming. It ought to be like that. Most of the software development project fail due to the inconsistent and faulty execution of this phase.

Various survey methods needed to be used in this study. But primarily three modes of data collection were used namely,

- ✓ Face to face interviews
- ✓ Internet browsing
- ✓ Published literature Survey

During the literature survey we studied the existing system and as mentioned earlier found various disparities and problems. It was not hard enough though to rectify those problems being and IT student. The problem they had was a classic example of lack of inter and intra-department communication. The history of I T and I S is full of such cases where they need a strong robust and most importantly a secure computer network. Although in this case we had a more serious situation.

In this case we not only needed a Local Area Network but we also needed a Hi-Definition Wide Area Network. Not only this but because it was a concern of National security we had to go one step further in and create a highly secure Wide Area Network.

As mentioned earlier we proposed a WAN utilising the technology of Internet called INTRANET. Intranets are the type of WAN which are the preferred choice of all level of I T professionals. Following are the reasons we chose INTRANET technology.

Concept of INTRANET, its Future and EXTRANET

Networks Compared			
	INTERNET	INTRANET	EXTRANET
Type of Access	OPEN	PRIVATE	CONTROLLED
Used by...	PUBLIC	ORGANIZATION MEMBERS	BUSINESS PARTNERS
Type of information	GENERAL	PROPRIETARY	SELECTIVE SHARING

A WAN provides other LAN users in distant locations with the same information and services that your local LAN users have. If you have offices across town or across the country that must share services, such as inter-office e-mail or database information, you need to link the LANs over a WAN. Many companies have found that e-mail is a great way to pool resources, share ideas and distribute information about the company's business. If you maintain a central database or other applications, like shared documents that all personnel must access, you will need to set up a WAN, especially if you intend to expand your offices into other cities.

Types of WANs

There are almost as many WAN types as there are LAN options. A very basic WAN is nothing more than two computers calling each other over a modem connection. A more complex WAN may involve connecting hundreds of offices together with high-capacity digital circuits. Usually a WAN takes the form of something between these extremes. The actual circuits and services used to build a WAN are determined by the type of applications being shared across the WAN link. The speed of the circuit used for wide area networking may be driven be the number of users sharing that line and/or the type of LAN traffic (that is, applications) sent over the line. The kind of circuit is usually based on the number of sites connected and the applications shared over the link.

The Project in Action

After detailed analysis and literature survey of the project. The hard core software development phase started. The development phase though is the core of our project but this phase needs strong backing and support form the SURVEY phase.

We completed the project in two phases as planned. The first phase demanded development of a database software in Visual Basic programming language. We used Ms Access database in this exercise. This solution was perfect for such situation. The reason was that Ms Visual Basic is specially designed for database projects and was perfect for our situation. Ms Access database on the other hand is one of the is one of the many competitors in the DBMS.

Ms Access was the successful competitors among others. We conducted a thorough analysis of all the available options.

Following were the available options.

- Ms Access
- Oracle RDBMS
- Ms SQL server

Any DBMS is judged on many grounds, but two of the following criteria are the most important.

- ✓ Amount of data DBMS can manage
- ✓ Number of concurrent connections DBMS can handle.

Ms Access clearly dominates the alternatives. Ms can handle upto 2 Giga byte data in its tables. Though Oracle has a far more data handling capacity but in our situation we cannot sacrifice performance on the bases of higher data handling capacity specially when we never need it.

Besides this aspect Ms Access can handle up to 16 concurrent connections. Surely Oracle and SQL server clearly out beat in this regard. Still we will Ms Access the reason is that higher concurrent connection is not needed here.

PHASE II

The phase II needed a much broader software development and deployment. For this area we developed an Intranet with database connectivity. The intranet spanned LAN as well as WAN. This software development needed comprehensive knowledge of

HTML
DHTML
Web Graphics
DATABASES
Web Databases
Connectivity
Server admin
Server side Includes
WAN networking

We had all the required knowledge. Thus we developed a software for INTRANET.

Please find a detailed description on benefits and future of INTRANETS. The FINDINGS on INTRANET are result of a comprehensive research and data hunting. Various data collection methods were used for this purpose. Among them the main sources were

- **Published and printed study guides on INTRANET**
- **Internet research**

Appendix

The Appendix contains following three important topic references.

- Cisco Router and it's security feature which is implemented in our project
- Advantages of using INTRANET
- Various WAN technologies to use for implementing INTRANET

The Future of Intranets

CONTENTS

INTRANETS

One thing is certain in the uncertain world of computers and information-serving systems: Both business trends and evolving technologies will play important roles in shaping the future of intranets. Intranets will enable their users to conduct business more efficiently, communicate in a more rapid and effective manner, and generally facilitate nearly all manner of business, personal, and governmental interaction on almost any scale.

Now that we have made our way through a lot of technical, practical, and theoretical information on intranet design, it is time to discuss the future of the intranet concept: where the technologies, analysts, information systems (IS) managers-and, most importantly, the users-are channeling intranet development and viability. These trends include acceleration of the pace of business, movement toward a global information economy, enhanced telecommuting, the rise of virtual corporations, and significant outsourcing of traditionally in-house tasks. The technology trends include open architecture in application development and integration; increased bandwidth to support live, full-motion video and digital audio; intelligent agents to facilitate searches and indexing; and increased functionality of stand-alone applications to provide greater flexibility and utility to users.

Business Trends

The development of intranet and Internet systems-really, anything having to do with the integration of IS technology in the workplace-is linked inexorably with general trends in the business world, from revenue considerations to the whims of both managers and users when contemplating intranet functionality.

Many corporations are just now becoming aware of a fairly new concept: data mining. Data mining is essentially the analysis of an extremely large body of often ignored or undervalued data that has been collected as a result of the normal progression of business issues, such as sales figures, mailing lists, and product complaint information. By crunching numbers, putting the data up against different tests, and searching for new and perhaps unexplored indicators of viability in a product cycle, producers can reap significant insight into previously nebulous regions of their costs, markets for their products, and their products themselves.

Similarly, embedded processing technology and its potential is a trend that greatly influences both the implementation of current intranet systems and the direction in which such communication platforms will evolve over the next decade. Computer chips are falling in price dramatically, and one of the new uses for this resource is embedding processors everywhere-microwaves, cellular phones, soda machines

The bottom line is this: New technology is creating more information on services and products that must be analyzed, distributed, stored, and manipulated, and without the common framework of an intranet to support such activities, corporations will find themselves lost in a never-ending sea of data. As computer chip prices fall, many uses of these chips for collecting or processing information are becoming economically viable for the first time. As the use of embedded chips proliferates, more information is gathered. Much of this new information will be stored and accessed via intranets.

The growth of intranets is directly related to the information explosion. As information and technology become more accessible, we will begin to see them infiltrate every sector of our lives. For example, a power company only has so many trucks, but it needs to be more responsive to customers. In the past, the company would have had to buy more trucks and hire more drivers. Now, using computer chips and an Intranet, the company can instead improve the management of its current fleet of service vehicles. Computer advances in general-and intranet technology specifically-have made it easier to track this data and provide it to the appropriate employees who can deal with it in an appropriate fashion.

Intranets offer a new and revolutionary way of communicating-both as a distribution channel and an information source. The most profound aspect of an intranet is that it can provide everyone in an organization equal access to information. It can also provide a soapbox from which disgruntled, enthusiastic, or otherwise motivated people can convey thoughts, ideas, and feelings. In order for organizations to take complete advantage of the new lines of communication made available by intranets, they must make a conscious effort to establish a corporate culture that is conducive or perhaps complementary to the atmosphere in which an intranet is designed to flourish. Although this is certainly not a simple task for any company, it is a necessity that must be undertaken if a corporation truly wants to maximize the possibilities of communication.

The important thing to remember is that a corporation's front line of employees are usually the best-positioned to efficiently manage its resources, resolve its problems, and advance its projects. By supporting employees with intranet-based information resources that are constantly available and consistently accurate, corporations will be able to service both corporate and client needs quickly, accurately, and successfully.

Reformatting the Workforce

With an intranet and various pieces of technology assembled in multiplatform, open architecture systems, some types of jobs will be eliminated, especially those that "repackage information," such as data entry, transcription, low-level oversight, filing, and basic research. Coupled with this decrease in one demographic of the corporate workforce, however,

is an increase in another sector of jobs that will mushroom for those who draw on the intranet's resources in their daily work, as well as for those who have the background to support current and future technology advances. As this new technology proliferates, systems administrators and integrators, content developers, trends and data analysts, and front-line workers from salespeople to maintenance personnel will need to be empowered by ready access to information via intranets. Remember, though, that computers don't make anything but the most basic and mundane decisions (nor will they do much advanced decision-making in the near future), so employers won't be looking to replace decision makers with intranets or other information systems.

In addition, on a much grander scale, intranets will increase productivity and thereby potentially benefit the global economy. This will happen through both a general stimulation of trade as well as specific instances of corporate success due to advanced market planning based on such things as computerized analysis of market trends. All this will be made possible by virtue of the statistical business and other data collected and made available by intranet systems.

Workplace Communications

The technology of an intranet makes geography less important in a global economy. It's just as simple to send an e-mail message or post an event on a calendar for someone in another country as it is for someone in the cubicle down the hall. This makes it considerably more practical for people to report to managers in different locations, negating traditional concerns for departments to be in the same physical location. A traditional floor plan is no longer relevant with intranet technology. Individuals and companies can be connected despite geographic, time zone, or political. This fits in with the trend toward the internationalization of commerce and the specialization of business as in the virtual company, which is explained in "Virtual Corporations."

The organization of an intranet and its resources has the potential to be as important as the actual floor plan of an office. An intranet can link those who are far away from one another and can also allow those who normally are close to go far away, perhaps to work from home, while on an airplane, or in that favorite motel in Topeka, Kansas. For example, a firm in New York City totally revamped its office strategy because of the way its communication systems facilitate new avenues of collaboration. It cut office space down to a third of its normal level, saving money and lots of space. Next, instead of everyone having a permanent office and space within the building, people now work from home or the road. They now use a system referred to as "hoteling," which means that their main office is administered somewhat akin to a hotel's management structure.

As more and more people work from home as telecommuters, intranets will provide the tools necessary to have a fully functional remote site offering access not only to the resources of the Internet but also corporate databases, documents, and workflow. An intranet offers a plausible solution to people who now do not need to physically be inside an office during the traditional 9-to-5 hours. Organizations save money on space rental, utilities, parking, and maintenance, and individuals save money on gas, clothing, and lunch. Individuals can also spend more time with their families, which often results in happier, more productive employees.

Information Economy

The most important thing that a company or an individual can possess in today's business world is information, in the form of either large sets of raw data or more refined, analyzed records. We will continue to experience the rise of the information economy as the prime motivator behind modern business transactions as the buying and selling of information grows in size to rival the trade in physical goods. Information is what distinguishes one company from another: It allows a company to understand its market, spot trends, and respond to crises or developing needs. In trying to position themselves for future growth and prosperity, corporations will strive to be one (preferably two) step ahead of the competition in gathering and analyzing information.

As more businesses have come to recognize the role that information plays in the workplace-and have begun to explore new, exciting, and powerful methods of collection, processing, and analysis-they are undergoing fundamental changes to the way that they conduct themselves in relation to not only their clients but the market as well. Although in the past such resources were only available to the largest and best-funded businesses and institutions, the many and varied technologies that intranets bring to bear on the system have the effect of leveling the playing field.

What's more, information can be purchased directly through news feeds-both conventional sources like Reuters and AP and those delivered primarily through the Internet such as Individual, Inc. (www.individual.com)or the PointCast Network (www.pointcast.com). For example, an organization could pay a service bureau $500 a month to stream targeted news feeds directly into its intranet, providing on-demand access to specialized information that is available to all employees. Each employee no longer has a subscription to newspapers and magazines, saving money, time, and frustration-and he or she will never again encounter articles missing from magazines, have to share subscriptions with coworkers, or deal with highlighted, dove-tailed, and tattered paper-based information sources.

Virtual Corporations

One business trend that intranet systems help make possible is the advent of virtual corporations. A virtual corporation is born when several corporations, most often with different specialties and located in different geographic areas, work in concert as a single entity to service the needs of particular clients specific to the virtual corporation, or perhaps to support joint research efforts. Intranet technology is enabling virtual corporations to work more closely with one another, be better coordinated, and compete more directly with a single corporation. Virtual corporations can be defined as companies with little or no physical infrastructure. For example, during my company's first year of existence, the only building we gathered in was the restaurant we held meetings at. Almost all of our communication and collaboration was done using the Internet and our intranet. Even today, with more than 25 employees building complex software, more than two-thirds of our development is done at home. Only hard-core collaboration is done at the office.

The Global Economy

As the international walls of business disappear and trade barriers are lessened, domestic companies are shifting their focus from a national agenda to an international strategy. Today, companies are looking at international clients and evaluating the products and services that they can offer those clients. To accomplish successful sales relationships on an international level, however, businesses first must begin to understand the trends that drive culture and business environments in particular countries. Intranets offer an ideal method to track issues world-wide because they can leverage companies' access to information.

Telecommuting and Hoteling

Telecommuting will continue to become more popular in the future, and hoteling, in some cases, will take the place of typical office arrangements. Recall that hoteling is the concept of employees reserving an office, cubicle, or conference room at a company's headquarters when they need space to work or to meet colleagues and clients, otherwise, conducting their work through the virtual floor plan of intranet technology. For the most part, an intranet eliminates the need for paper file storage in cumbersome file cabinets in an office. Electronic storage, therefore, eliminates the need to access files stored in a physical location, which in turn eliminates the need to conduct work near these files.

Similarly, telecommuting from home gives people access to all information stored on the intranet, leveling the playing field between employees working out of the office and employees working from home. Intranets will continue

to open doors for employee collaboration, allowing all employees to participate fully, regardless of where in the city or world they are.

Outsourcing

Whether it is corporate downsizing, the decentralization of government, or the increasing hold of the computer in the workplace, more businesses are turning to "outsourcing," the hiring of short- or long-term consultants or contractors to accomplish a specific job once handled by a full-time employee. Consultants and contractors may not come cheap, but because they are not employees of the business (meaning that the business is not required to pay benefits, such as health insurance and pension plans, and even certain taxes for these employees), they often translate into significant savings. Thus, a business often gets more bang for the buck through consultants and contractors than it would with a full-time employee. Intranets will continue to play a role in outsourcing by offering a one-stop resource center for background information on the company or project, saving many hours that an employee might spend discussing information with a consultant or contractor. An intranet lets the employee put his or her energies elsewhere, while the consultant gets him or herself up to speed through the company's intranet

Technology Trends

The technology trends that will both affect and be affected by intranets are many and varied, including open standards, bandwidth, wireless communication, single-client applications, increased integration of applications, voice mail and fax gateways, intelligent agents, and new applications. In the following sections we cover some of these topics, with the goal of empowering you with an excellent overview of the direction of intranet technology and the possibilities that loom on the horizon.

Open Standards

One of the most powerful technology trends in building intranets is open standards, also known as open protocols or open architecture. Open standards is an ideal that allows for the easiest and most fluid connection and communication between different corporations' applications. Intranets allow all software to be written using open standards; however, not all companies select this option, sometimes due to security concerns, although just as often due to a lack of useful information on the issue. The Open Standards Initiative allows applications to integrate with one another more easily and efficiently.

Open standards allow intranets to be built with standard protocols, which essentially means that all applications can speak in one language. The most important open standard is TCP/IP, which all intranets by definition use. This is opposed to a proprietary language only available with one application. Microsoft Word is a proprietary, or closed, standard, because Microsoft

documents can only be read and written by Word. Special bridges can be put in place so that MS Word documents can be read by other applications, but this is essentially a workaround for those who don't have the native environment.

Voice Mail and Fax Gateways

Just as the introduction of high-end computer systems has drastically changed the daily operation of most offices, from policy to corporate culture to employee satisfaction, so too will that trend continue, eventually encompassing some of the intermediate technologies that have been present for some time, including voice mail and facsimile machines. It's important to realize that this is more than an "upgrading" of technology; it's more properly characterized as a paradigm shift (If you'll pardon the overused phrase) in the office workplace. This, of course, will occur over a somewhat extended period, but until then you will see gradual but consistent improvements and changes in both the systems themselves and their role in the professional environment.

In the short term, you can expect to find-or to implement, depending on your role in the office-voice mail and fax gateways integrated into LANs and intranets to provide both simplified in-house access to faxes as well as remote access from hotels, employee homes, and the like. As this trend continues, some or possibly all of the functionality of these services will be absorbed by information-serving systems that will be native to your intranet. Some examples are Internet Phone-based digital recording of voice transmission and a "virtual fax" machine that in place of (or in addition to) scanned, phone-line transmitted documents will be more tuned toward accepting "Internet faxes" of documents. This function is more like a hybrid of FTP and e-mail, and users will eventually accept this as a standard, distancing themselves from the "fax" and "voice mail" references.

Intelligent Agents

One of the things that will happen in the future of the intranet is the development of actual working intelligent agents, applications that can be given basic parameters for a search, CGI creation, or scheduling, and then complete at least an initial product for a manager to review or accept. The Internet is a huge resource, the biggest library in the world; unfortunately, a very large animal apparently ate the card catalog. An individual couldn't possibly find everything in the library in one sitting, but creating an intelligent agent makes it possible. In the future, advances in Natural Language Query processing and other complementary technologies, plus possibly some type of standardized Dewey Decimal-esque system for the Net, should result in faster, more powerful, and more effective search techniques, as well as other systems.

For example, a company that manages a mutual fund investing in a Turkish industry could have an intelligent agent that monitors news feeds and surfs the Net looking for Turkish financial news. The agent automatically stores relevant news items in the appropriate areas of its intranet. News items pertaining to stocks in the mutual fund's portfolio are immediately splashed across the fund managers' screens.

This allows users to have immediate access to the latest information all the time. Another new technology is software applications that can be programmed to check out your favorite sites in the middle of the night and download them to your computer so you can check them quickly and without having to wait while they are downloaded. These programs, including Freeloader and WebWhacker, help people who have bandwidth problems because they go out and download your favorite sites without you having to wait for the results; the next day they are there. Whether one of these programs or a more sophisticated intelligent agent is used, retrieved information can be displayed on an intranet for all its users to refer to and so that it will be searchable.

Intelligent agents can visit the sites that the people on your intranet surf often and turn them into something useful like summaries of latest information. Intelligent agents are buffers between you and the sea of information that is the Internet.

The Future of Intranet Applications

The key to the success of intranets in the future is to integrate intranet functionality with systems that are currently installed on corporate networks, especially the icky legacy applications that are running on VAX, AS400, and other platforms. This can be accomplished most successfully through the use of gateways from intranets to desktop or server applications, thus allowing an organization or corporation full use of the most comprehensive set of internal resources available. Most organizations are PC based, meaning most applications are performed on the desktop; so the key is integrating this particular demographic.

Users are familiar with their desktop applications, and the organization has already invested in them, so it would seem obvious that a good medium-term solution is to keep using the desktop applications while enhancing them with the options available to intranet-based systems. The two players most likely to lead the way in this arena are Microsoft and Netscape, with a multitude of third-party software coming from random companies to support various applications and platforms.

For example, say an organization uses XYZ's legacy contact database system, and it is integrated into an intranet. Then if all the users upload their personal databases on XYZ, it will merge them into one large contact database for the organization as a whole. Ideally, each employee would have the choice of using a Web browser or continuing to use XYZ as their client

application for interacting with the client database. The important thing is that the organization has all the information together and that all employees can access the full range of functions, including updating the database, from their computers.

Individual companies will most likely not build the gateways between their desktop applications and intranets, unless they use proprietary applications that have been developed or enhanced with in-house technology and programmers; they will most often look to the makers of the particular applications. The creators of these applications are working furiously to create gateway modules to make their applications compatible with TCP/IP protocols and aid in the exporting of data into more accessible formats. Gateway modules already constructed will allow companies to integrate intranets with the desktop applications with ease and speed. Getting information from desktop applications into an intranet is tough; it will require either excellent third-party software or a good bit of time, effort, and dedication by the company and its programming staff. It may be easier for large companies with involved applications to just start from scratch with a native intranet solution. Small, financially challenged companies will need to think long and hard about possible solutions so as to avoid huge IS debacles and wasted investment.

We're moving into a whole new arena with the advent of intranets. The applications are once again being performed on a server at a central location where computation processing and data storage is performed. The client or terminal used by the individual is just a window to the server. Today, far and away the most common window is the PC-but this could change with the commercial introduction of the network computer in fall 1996. The network computer will give people a stripped-down machine to serve as a window that allows entrance into an intranet; you may have heard the same product referred to as the "Internet Terminal." Some day this may be incorporated into a cellular phone or personal digital assistant that would serve as the window or gateway into an intranet, with the applications actually performed on the server and only output data being returned to the client.

Instead of having a PC with a traditional operating system on it (such as Windows 95, Linux, System7) you can have a machine that is tasked specifically to run network applications or TCP/IP services. The whole purpose of the machine is to access the server, get information, and somehow manipulate that information and send it back to the server. For example, such a network computer would have no hard drive. It would only be able to access the Internet, intranet, or network to which it was attached. It would download a Java applet to do any necessary client-side computations-for example, real-time graphic rendering of stock market transactions transmitted to it by a remote server. When the user was finished watching the stock market, the applet would be automatically flushed from the network computer's memory. That applet or any other would be reloaded as necessary to perform subsequent tasks.

The production of intranet software means an organization can buy integrated suites of software specifically designed for organizations to communicate internally. The suites have existing functions like asynchronous messaging, scheduling, and contact management.

Palm-Top Computers

A palm-top computer accesses your intranet's resources through a wireless modem and could also serve as a voice phone. Because you can pack all this technology together in one unit, your palm-top becomes your client; it doesn't need to sport particularly powerful features because all the resource-intensive work is done by the remote server. You just need a quick connection to the server to access your calendar, keep notes, browse your Rolodex, and so on.

Teleconferencing

Teleconferencing through intranets in the future will be free of long-distance telephone charges. Calls will be placed from intranets to the server, which in turn will dial a local phone exchange that completes the call or dial into software built into the recipient callers' software. In the latter exchange, the transmission becomes two computers "talking" to each other. This is an especially interesting case, because it raises several questions about who specifically would bear the cost of such systems-the phone company is in no way configured to monitor and bill for this system in an effective way. If the people who maintain the individual servers opt to charge for their services, the entire system would most likely be subject to numerous intrusive telecommunications regulations, which would seem to almost negate the efficacy of the system before it is even constructed. Of course, this second option is based on an extension of a nascent technology that is already circulating among Internet users, although not quite ready for the corporate world: Internet telephone software. Using this technology, user messages are recorded and converted into a particular format, say .WAV or .AU, and then piped to the receiving end where they are decoded and played. Currently, the sound quality is substandard, and it will be some time until an acceptable level is reached. However, when broadband transmission capabilities come into play, full-motion video and sound can be joined to provide powerful and affordable teleconferencing solutions.

As business becomes increasingly global, this intranet function aids in keeping the prices of global communication low. Software that can currently perform this task include IP Phone, Internet Phone, and WEB Phone.

Other evolving teleconferencing functions include recording call completion statistics in a central database that confirms that particular calls occurred and their duration, cost, and so on. There also could be a recording of the conference call saved and linked to a schedule so that someone could look back to that day, see what happened, and hear the contents of the call. As audio encoding becomes more advanced, you'll most likely see a rapid rush to store audio copies of all phone conversations and voice-mail messages on

a server somewhere within your intranet. This has many legal implications that will have to be evaluated as case law becomes available.

The next step as this technology advances is real-time voice recognition, which would allow a transcript of the conversation to appear in real time on the screens of all the participants, or the conversation or transcript could be broadcast immediately to others who want to watch or listen to what happens with the call. This can be stored in a database or file that can be searched later. Everything can be recorded and used later, making everything a resource in and of itself. The conversation would not need to be transcribed by someone. It could be edited for use later in reports or to share with others in the organization. This technology exists in varying degrees but is neither efficient enough nor affordable for a general release to the public. In the near future, however, both hardware and software developments should make this type of system at least a possibility for midsize companies.

High-End Applications

At the high end, customized server-side intranet software will integrate more of the user's daily tasks-work flow, expense reports, time slips-and make it accessible through a single client. The client for this integration will increasingly be an ordinary Web browser.

If an organization uses client codes or project codes for time sheets, the codes could be integrated in intranet software. Then, when employees fill out time sheets on an intranet, a menu of project codes pops up so they can assign their time accurately. Using a Web browser as the client, users enter their time into a database, which can be fed into payroll and recorded so the organization can track costs.

The pop-up menu of client codes is one example of applications that can be built into a high-end customized intranet so users can input information directly into a decision-critical database-not just discussion group information, but information that goes into a database that can cause checks to be cut from payroll, generate expense reports, and monitor work flow. All will be accessible through the Web browser, which will be customized to the specific needs of an organization.

Ordinary users could do it, and it's automated so that it is being fed to the end user automatically-whether it is cutting a check, approving a design and automatically sending it on to the next person for his or her approval, or manufacturing for the product to be designed.

Summary

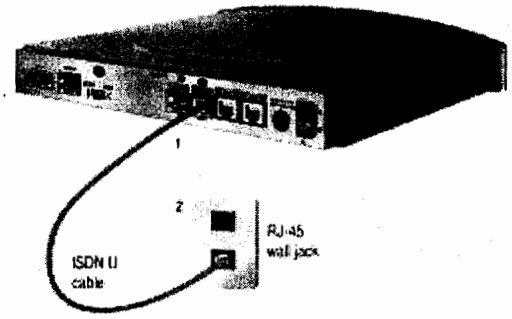
Just as technological and business trends will affect the future of intranets, so will intranets have a major impact on these trends. The immense synergy between business and technological trends and intranets will continue to

serve as a launching pad for new ideas and technological advances, all in the name of more productive businesses and workers. Intranets will allow businesses to change their concept of how business happens. Already, intranet audiences are accomplishing more just by using a Web browser, and the scales continue to tip toward smaller, cheaper, faster technology and technological devices. In the future, users may be walking around with their computers in their pockets. Whatever the size and shape of the next wave of computers, those workers who have unleashed the power of intranets will be ready to service their clients and step up to competition, no matter where in the world they are.

The Cisco Router

* Cisco Router => The Box
* Cisco Router => The Components
* Cisco Router => The IOS

Cisco Router



The Box

* Ethernet Port = e0, e1
* Serial Port = s0, s1
* Token Ring Port = t0, t1

* Console Port
* Auxiliary Port
* Token Ring Port

The Components

* **RAM/DRAM**

  - Stores routing tables, ARP Cache, packet buffering, packet hold queues

  - Temporarily storage for the router's configuration file

  - Content is lost when router is shut down.

* **NVRAM**

-Non-volatile RAM
-Stores the router's backup configuration file
-Content is retained when router is shut down

* **Flash**
-Erasable, reprogrammable ROM
-holds operating system image and microcode
-allows upgradation of IOS without any hardware change
-Flash content is retained after shutdown
-can hold multiple copies of IOS

* **ROM**
-Contains power on diagnostics, a bootstrap program and operating system software

-What is bootstrap??

* **Interfaces**
- Network Connections
- Packets enter and exit through interfaces
- Located on Motherboard or on separate modules

* Cisco Internetwork Operating System
* Can be configured using console port or remotely
* Command line interpreter is called EXEC
* EXEC interprets the command and carries out the corresponding operation.
* **What is a mode**
- used for configuration of the router
- allows configuration of specific nature
- multiple modes are available for configuring of different options

* **User EXEC mode**
-A "look only" mode
-user can only view information
-no configuration changes are possible

* **Privileged EXEC mode**

- Allows change of configuration
- Supports debugging and testing commands
- detailed examination of router
- manipulation of configuration files
- access to configuration modes

* **Setup Mode**
  - interactive prompted dialogue
  - creation of first time basic configuration

* **Global Configuration Mode**
  - Implements one-line commands
    - Perform simple configuration tasks
    -

* Other Configuration Modes

* **RXBOOT mode**
  - maintenance mode
  - can be used to recover lost passwards

The IOS: Logging On

* Press "Enter" to get started
* User Access Verification enabled
* Enter Password
* User mode
* Router> <---------User mode Prompt

* In User Mode, type "Enable"
* Password Verification will take place
* Privileged Mode
* Router# <----------Privileged Mode Prompt

Context Sensitive Help

* Use "?" to get help
* Type Command and then?
* Example1
  - Clock?
  - All subcommands of "Clock" command will be shown

- clock set

* Example2
  - CL?
  - Will show all commands beginning with CL
  - Clear and Clock

System Startup

* Startup Routines
  - Make sure that the router comes with the tested hardware
  - Find and load the Cisco IOS Software
  - Find the Configuration Statements
  - Apply the Configuration Statements

System Startup

* Bootstrap
  - Loader executes from ROM on the CPU card
  - Simple, pre-set operation to load instructions that in turn cause other instructions to be loaded in memory

* Operating System
  - source is determined from boot field of configuration register
  - determines flash or network load
  - image is loaded from exact location

* Configuration File
  - loaded from NVRAM into main memory
  - executed one line at a time
  - start routing processes
  - supply addresses for interface
  - set media characteristics

* Setup Dialogue
  - If no configuration file is available in NVRAM
  - question driven initial configuration routine is executed

- Configuration is stored as an image

Command Line Editing

* CTRL - L
  - go to the beginning of the line

* CTRL - E
  - go to the end of the line

* ESC - B
  - Go back to the beginning of previous word

* ESC - F
  - Go forward to the beginning of next word

* CTRL - B
  - Go back one character

* CTRL - F
  - Go forward one character

* CTRL - P (or Up arrow)
  - Last Command Line

* CTRL - N (or Down arrow)
  - More recent command recall

* TAB
  - Entry Completion

* CTRL - Z
  - Backs you out of configuration mode

Router Status Commands

* **RAM**
  - Internetwork Operating System
    . show version
  - Programs
    . Show Processes CPU
  - Active Configuration Files
    . Show running-config
    . Write term
  - Tables and Buffers
  - Show memory
  - Show stacks
  - Show buffers

NVRAM
- Backup Configuration File
- Show Startup-config
- Show config

Flash
- Operating Systems (Show Flash)
- Interfaces (Show interfaces)
- Console Privileged EXEC mode (enable)
- Auxiliary virtual terminal port (Telnet)

Cisco Discovery Protocol (CDP)

1 Provides single proprietary command
2 Enables network administrators to access summary of multiple protocols and addresses configured on other DIRECTLY connected routers
   - cdp enable
   - show cdp interface
   - show entry {device name}
   - show cdp neighbors
   - show cdp neighbors details
   - Hold time
   - Indicates how long the CDP frame with this information can be valid

- Frequency between cdp entries = 60 sec
- For aging cdp entries = 180 sec

Configuration Files

- Management from Privileged EXEC mode
- Configure terminal (Configure terminal manually from console
- Configure memory (Load configuration information from NVRAM)
- Copy TFTP running-config (Load configuration information from a network TFTP server)
- Show running-config (Display the current config in RAM)
- Copy running-config startup-config (Store the current configuration in RAM into NVRAM
- Copy running-config TFTP (Store the current config in RAM on a network TFTP server)
- Show startup-config (Display the saved config in NVRAM)
- Erase startup-config (Erase the contents of NVRAM)

Passwords

- Console Password (line console 0)
- Virtual Terminal Password (line vty 0 4)
- Enable Password (enable-password)
- Perform Password Encryption (service password-encryption)

Identification

- Router name (hostname)
- Login banner (# banner motd)
- Interface Description (Interface e0 , description Isb end)

Network Segmentation with ROUTERS

1 ***Manageability***
   - routing protocols
   - give network administrator greater control over path selection
   - network routing behavior is more predictable

2 ***Functionality***
   - flow control
   - error and congestion control

- fragmentation and assembly service
- explicit packet lifetime control

3 ***Multiple Active Paths***

- network topology having more than one path between stations
- before making forwarding or filtering decision, routers can examine
- (Destination service access point (DSAP), source service access point (SSAP), path metric information)

Separate Multiprotocol Routing

- configured protocols operate like "ships in the night"
- each protocol is not aware of other protocols running on the same router
- RIP
- OSPF

Integrated Multiprotocol Routing

- configured routing protocols share the results of the integrated routing algorithm
- supports packet switching for more than one protocol
- carries routing updates that are usable by several routed protocols
- replaces the naïve routing algorithm
- creates separate routing tables for each routed protocols
- saves network and router resources
- simplifies administrator's operational tasks

Enhanced IGRP

- Cisco Proprietary
- Integrated supports for IP Apple Talk and Novell IPX
- uses a distance vector algorithm

Distance Vector Concept

- Also known as Bellman-Ford algorithms
- Pass periodic copies of a routing table from router to router
- Regular updates between routers communicate topology changes
- Router A passes its routing information to Router B
- Router B adds a distance vector number (number of hops), thus increasing the distance vector

- Router B passes its routing information to router C
- Process occurs in all directions between directly connected neighbors
- Accumulates network distance so that a database of internet work topology information can be maintained

Topology Changes

- In case of internetwork topology change, routing table updates must occur
- step by step process
- each router sends its entire routing table to directly connected router
- Each router compares routing update from a neighboring router to its own routing table
- If a smaller metric exists for a specific network, it updates its routing table
- Adds cost to its own routing table

Problems

- Routing loops
  - due to slow convergence
  - causes inconsistent routing entries

- Counting to infinity
  - the destination network is down
  - packets are continuously looped around the network
  - a routing loop exists

Solutions

- Defining a Maximum
  - Specify maximum distance vector metric as infinity
  -
- Split Horizon
  - routers information is not sent back on the interface on which it is learnt

- Router Poisoning

  - entry for the network down state is kept by a router enabling other routers to recomputed topology changes

- Hold Down Timer

  - router ignores network update information for some period

Link State Concept

- Shortest Path First (SPF) algorithms
- maintains full knowledge of distant routers and how they interconnect
- RFC 1583
- Implemented as OSPF
- Link state routing uses

  - Link State Packets (LSPs)
  - a topological database
  - SPF algorithm
  - SPF tree
  - routing table of paths and ports to each network

Network Discovery

- Routers exchange LSPs
- Each router constructs toppological database consisting of all the LSPs of the internetwork
- SPF algorithm computes network reachability and SPF tree is created based on shortest path
- router lists best path and ports in routing table

Problems

- Processing and memory requirements

  - Network administrators must ensure that resources are available

- Bandwidth consumed for initial link state "flood"

  - All routers exchange LSPs during initial period
  - internetwork is flooded

- Unsynchronized updates
  - inconsistent path decisions

- Synchronizing large networks
  - which network topology is correct

- Router Startup

  - order of start alters the topology learned

- Partitioned regions

  - slow updating part separated from fast updating path

Solutions

Reduce need for resources

-Dampen update frequency
-Target link-state area hierarchy for topology
-Exchange route summaries at area borders

Co-ordinate link-state updates

-Use time stamps
-Update numbering and counters
-Manage partitionin using an area hierarchy

Distance Vector vs Link State Routing

- Views network topology from neighbors perspective
- Adds distance vectors from router to router
- Frequent, periodic updates: slow convergence
- Passes copies of routing table to neighbors router
- Gets common view of network topology
- Calculates the shortest path to other routers
- Event triggered updates: faster convergence
- Passes link-state routing updates to other routers

IP Standard Acess Lists
IP Extended Access Lists
IPX Standard Access Lists
IPX SAP Filters

Access Lists

- Used for Packet Filtering
- Control the flow of data across a network
- to restrict traffic across an interface
- to restrict traffic across virtual terminal lines
- to restrict routing updates

Access Lists

Protocol	***Range***
IP	1-99
Extended IP	100-199
Ethernet type code	200-299
DECnet	300-399
XNS	500-599
Apple Talk	600-699
Ethernet Address	700-799

IPX	800-899
Extended IPX	900-999
IPX SAP	1000-1099

IP Access Lists

- Collection of permit and deny rules applied to IP Addresses
- Sequentially processed
- Implicit DENY ANY
  - if at the end of the list no match is found, the packet is discarded
- Standard
  - use source addressing for applying rules
- Extended
  - use both source and destination addressing for filtering and can filter by a specific protocol also
- Dynamic Extended
  - grant access to a destination on per-user basis through and authentication process

Standard IP Access Lists

- access-list 1 permit 149.57.0.0 0.0.255.255
- {Implicit deny all - not visible in the list}
- access - list 1 deny 0.0.0.0 255.255.255.255
- ip access-group 1 out/in
- show ip interface
- show access-lists

Extended IP Access List

- Access-list-number {permit| deny} protocol source source-mast destination destination-mask [operator operand] [established]
- ip access-group access-list-number {in | out}
- protocol
  - IP, TCP. UDP, ICMP
- operator and operand
  - It, gt, eq, new and a port number
- access-list 101 permit tcp 149.57.0.0 0.0.255.255 any eq 25
- (implicit deny all)
- (access-list 101 deny ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
- ip access-group 101
- access-list 101 deny tcp 149.57.0.0 0.0.255.255 167.71.0.0.0.0.255.255 eq 23
- (implicit deny all)
- (access-list 101 deny ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
- ip access-group 101

Ipx Configuration

- ipx routing [node]
  - enables IPX routing
- ipx maximum-paths paths

- enables load sharing

- ipx network number [encapsulation encapsulation-type] [secondary]

- show ipx interface
- show ipx route
- show ipx servers
- show ipx traffic

- debug ipx routing activity
- debut ipx sap

Ipx Standard Access List

- access-list 801 permit 9f 6a
- (implicit deny all)

- ipx access-group 801

Ipx SAP filters

- Access Lists from 1000-1099
- uses Service Access Points

- 4 is for Netware file server
- 7 is for Print Server
- 24 is for Router
- access-list 1000 deny 5a 7
- access-list 1000 permit-1
- ipx access-group 1000

Frame Relay Configuration

- **DLCI**
  - Data-link Connection Identifier
  - identifies the PVC
- **LMI**
  - Local Management Interface
  - overhead processing that sets up and maintains the connection
- Router (config-if)#
  encapsulation frame-relay [ietf]
  - sets frame relay encapsulation
  - default=cisco
  - ietf=Internet Engineering Task Force

- Router (config-if)#
  frame-relay lmi-type {ansi|cisco|q933a}
  - specifies lmi type
  - ANSI=T1.617 Annex D
  - q933a=ITU-T (Q.933 Annex A)
  - cisco=Gang of Four (Cisco,DEC,Northern Telecom and STrataCom

- Router (config)#
  frame-relay map protocol protocol-address DLCI {broadcast|ietf|cisco}
  - to map destination network protocol address to a DLCI

Non Broadcast Multiple Access

- All routers connected by virtual circuits peer on the same IP network
- DLCI are used to identify connections

Split Horizon & Frame Relay

- Split Horizon
  - no routing update sent on an interface, this information

is not propagated on that interface

- With Frame Relay NBMA, this means that routing information can not be sent to the various nodes

- Solution=Us Full mesh
- Disadvantages
  - not one but many FR PVCs would be required
  - Configuration Complex and difficult to support

Use of Subinterfaces

- Use a number of virtual circuits on a single physical interface
- Subinterfaces are logically available
- Each Subinterface will use a different DLCI
- Router (config)#
  interface type. Subinterface-number point-to-point
  - defines logical subinterface for FR and enters the interface
  configuration mode

- Router (config-if)#
  frame-relay interface-dlci dlci broadcast
  - adds a DLCI to the FR subinterface on the router

Point to point protocol

- Authentication
  - PAP
  - CHAP
- Compression
  - increase of effective throughput
  - stacker
  - Predictor

- Error Detection
  - enable a process to identify fault conditions
  - Quality
  - Magic Number

- Multilink
  - Use of load balancing
  - Cisco Supports Multilink PPP

- Router (config-if)# encapsulation ppp
  - defines encapsulation type as ppp

- Router (config-if)# ppp authentication pap
  - sets authentication mode

ISDN Configuration

- Global Configuration
  - Select Switch Type
  - Specify Traffic to trigger DDR call

- Interface Configuration
  - Select Interface specifications
  - configure ISDN addressing

- Router (config)# isdn switch-type switch-type
  - specify the switch type with which the routers communicates

- spid
  - service profile identifier
  - the used by telephone company to identify your equipment

- dialer-goup group-number
  - adds the interface to the group listed dialer idle-timeout
  - time after which connection will be terminated

- Dialer hold-queue
  - number of packets that can be held by the router while making connection
- dialer load-threshold
  - configures the bandwidth maximum before another call is made

In the following section I discuss the most prominent WAN services in use today and describe the services in some detail.

56Kbps Digital Data Service (DDS)

The 56Kbps DDS has been the standard in WAN connections for many years. Many organizations have used this type of circuit to connect offices together. As the name implies, this type of circuit can transmit data bits (1s and 0s) at the rate of 56,000 bits per second. The 56K circuit is a point-to-point circuit; this means it connects one site to another or one LAN to another. It can be a permanent, or *nailed*, circuit between two sites, or it can be a switched circuit that is dialed up as needed to other compatible 56K services. This type of circuit is sufficient for passing files or e-mail and even for running applications on the server for a few users. However, if you have 80 users all accessing a database over this circuit and sending e-mail, the 56K circuit is too slow; users will experience long delays in sending and receiving data.

T-1 Services

A T-1 (also called DS-1 or Digital Signaling-1) is a grouping of 24 64Kbps channels that create a 1.5-megabit-per-second circuit. Like the 56K circuit, a T-1 is a point-to-point service. T-1 circuits are widely used and make up a large percentage of both data and voice and video WANs. A T-1 is ideal for linking offices together at near-LAN speeds. If you are running an ethernet LAN at 10Mbps, the T-1 service will provide better than one-tenth of your LAN transmission rate. This may seem slow, but considering an average ethernet LAN only runs at about 20 percent or 30 percent capacity, the T-1 is actually closer to one-third of your LAN transmission speed. A T-1 can be nailed or switched, as with a 56K line. In addition, the T-1's channels can be divided among multiple sites. For example, your Washington, DC office could have eight channels in the T-1 going to Chicago and the remaining channels going to New York. This WAN effectively would tie all three office networks together.

T-3 Services

A T-3 (also called DS-3 or Digital Signaling-3) is a grouping of 28 T-1s to create a 45Mbps circuit. This type of service is expensive and is employed primarily when a large-capacity data transmission path is required. In a typical WAN implementation, you will not need this service, but you may hear it discussed as part of a T-1 network implementation. T-1s are multiplexed, or *bundled*, together into a T-3 for easier routing through the phone company's network.

Frame Relay

Frame relay is a service designed to operate on a 56K or a T-1 type circuit. It provides many virtual channels inside the circuit. You could take a 56K circuit and use frame relay to create several channels to other sites so that instead of one 56K circuit going from Washington, DC to Chicago and

another going from Washington to New York, you would simply install one 56K frame relay in Washington with virtual channels to the other locations. This is one advantage to frame relay. Another advantage is that it is typically cheaper than standard point-to-point circuits.

The disadvantage is that the actual through-put in a 56K frame relay circuit is less then 56K. The phone companies will offer a committed information rate (CIR) to guarantee the minimum through-put. You may be able to send bursts of data above the CIR but not for sustained periods of time. You will always have the minimum transmission speed guaranteed by the CIR rate you purchase.

EVEN RECORDS INC

EVN Records has offices in three states on the East Coast. These offices currently share demographics and sales information over the phone and through the postal system. It recently has begun working with a firm in California to set up its artists' touring schedules. Meanwhile, upper management wants to reduce the long-distance phone expenses among the three East Coast offices; with their new West Coast associates, the long-distance costs will skyrocket. Upper management is interested in using the Internet to set up web pages for their artists. The network managers have convinced upper management that the information among the East Coast offices can be shared electronically by e-mail and that linking their Windows NT networks over a WAN will cost less than EVN's current long-distance telephone charges. The California office only needs to share e-mail with the East Coast offices; it doesn't need to be linked to the WAN. Because the three East Coast offices only have a few users on each LAN, it is decided to use 56K Frame Relay to link the three East Coast office LANs. These three offices each have a Windows NT workstation, and these networks will be bridged together into one LAN using the NT server at the main office. The main office also will have a fractional T-1 connected to a local Internet provider for e-mail and putting the Web pages online. The other East Coast offices will share the fractional T-1 connection out of the main office to the Internet. The California office is already connected to a local Internet provider, and the Internet will serve as the WAN for the transfer of e-mail between California and the East Coast offices (see Figure 1).

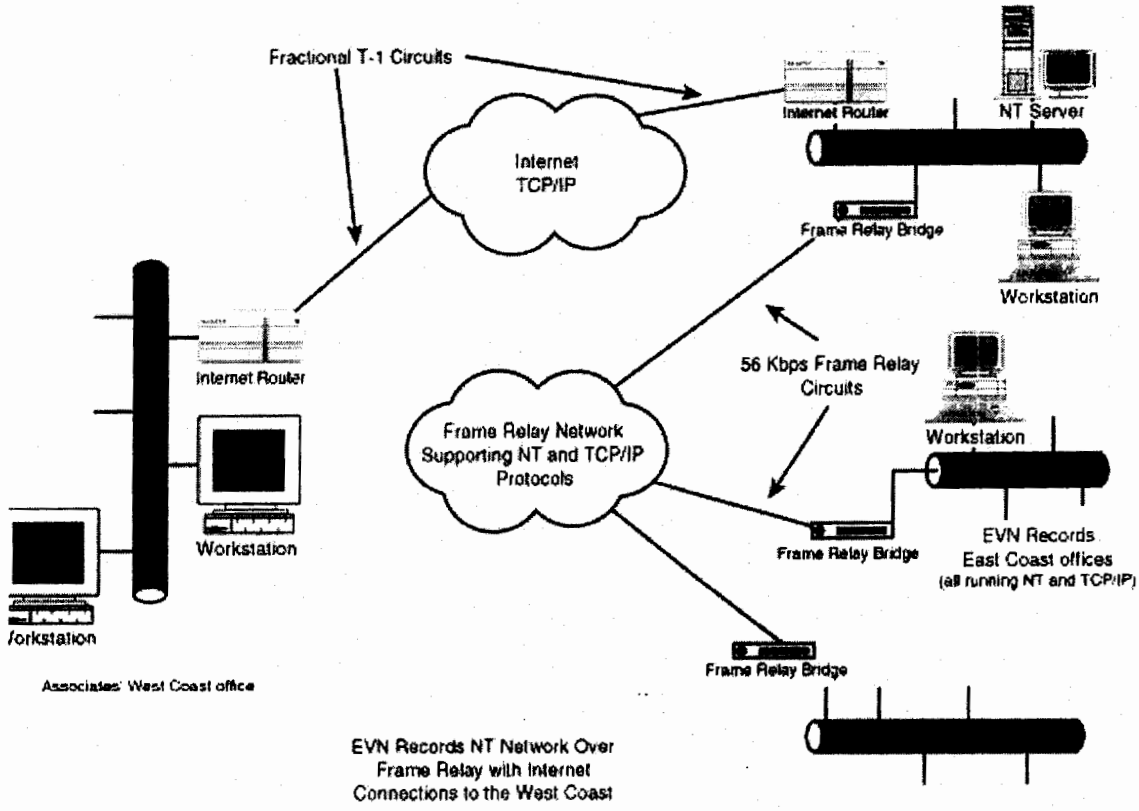


Figure 1 : *A WAN implementation with Internet access.*

Sonet

Sonet (Synchronous Optical Network) is the latest in high-capacity fiber optic WANs. Sonet transmission rates usually start at the OC-3 (Optical Carrier-3 level), which is roughly the equivalent of 3 T-3s or a 155Mbps rayed circuit. Sonet can be deployed at the OC-12 level, which would be in excess of 600Mbps. Services like Sonet are deployed in environments such as medical imaging, intensive computer-aided design applications, or combinations of video, voice, and high-bandwidth LAN applications. There is little justification for using Sonet even if you are linking two 100Mbps LANs together, as the cost of Sonet versus the performance benefits is usually prohibitive unless your applications demand it. In any event, the deployment of Sonet service integration to your LAN is outside the scope of this document. If you have a requirement for such high transmission rates, speak with a network consultant about Sonet services.

SMDS

SMDS (Switched Multimegabit Data Service) is somewhat like frame relay in that it provides multiple virtual channels within a single SMDS service so that each can be routed to a different location. One of the main differences between frame relay and SMDS is that SMDS transmission rates start at the T-1 level (roughly 1.5Mbps) and go up to the T-3 level around 45Mbps. If

you have a high-bandwidth data application that is being shared among three sites at T-3 transmission rates, SMDS is probably a good choice.

GOODBODY COMMUNITY HOSPITAL

Goodbody Hospital is a small hospital outside of the city. The two larger hospitals in the city have agreed to share their medical imaging staff expertise with Goodbody Hospital, but the doctors in the city do not have time to drive out to Goodbody Community Hospital just to review CAT scans. Therefore, the doctors decide to deploy a high-speed WAN that will link the LAN at all three locations. The WAN service must support the transmission of CAT scan images from Goodbody over to the other two hospitals' networks, where the images can be analyzed and compared against other CAT scans stored on the file servers at the two city hospitals. The CAT scan images are huge files that can be hundreds of megabytes or gigabytes each. A T-1 would be far too slow for the efficient transmission of these size files. A standard point-to-point T-3 would be effective, but to link all three hospitals the doctors would need several T-3s, which is an expensive option.

In this case, the SMDS service was the solution. With this service, the hospitals could switch the full T-3 bandwidth of 45Mbps among the three sites as needed. The hospitals needed to purchase a router for each site to direct the LAN traffic over the SMDS network. The phone company is providing the SMDS access equipment as part of the service (see Figure 2).

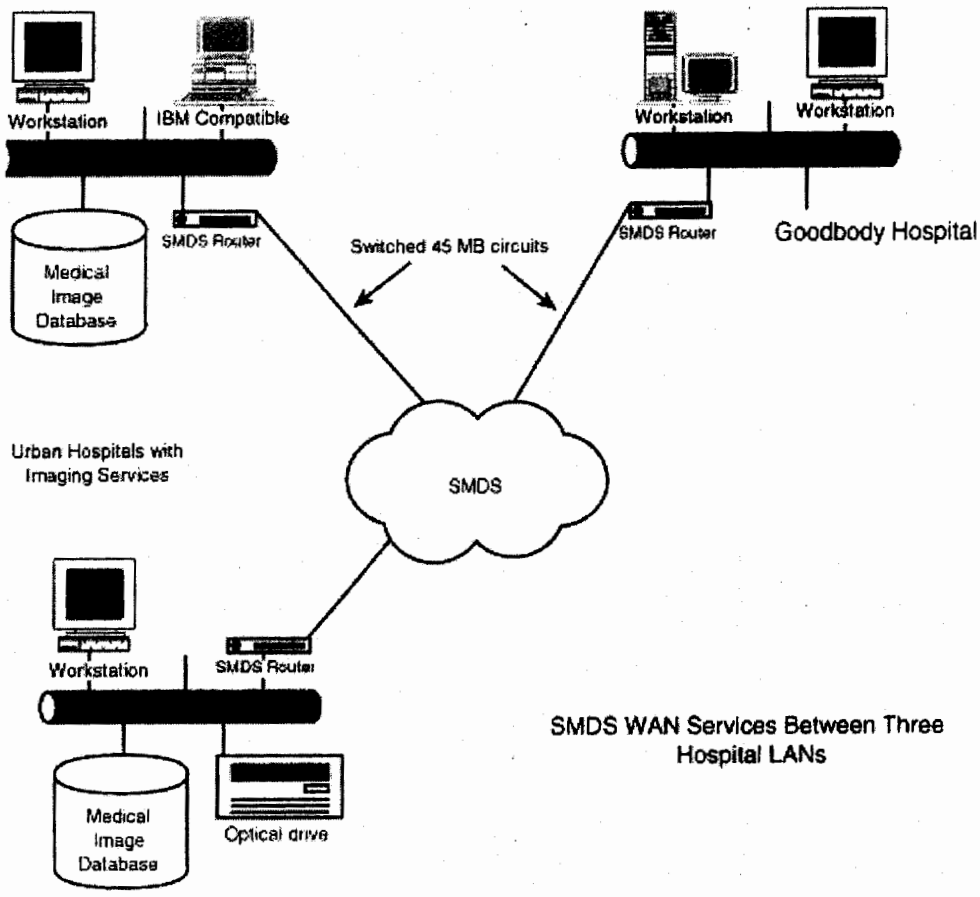


Figure 2: *An SMDS network directs LAN traffic among three locations.*

ATM

ATM (Asynchronous Transport Mode) is a transport service that will run over Sonet networks. In the previous chapter, I discussed ATM as a LAN technology; however, it makes the transition to WAN service easily. Indeed, using ATM to connect the average LAN workstations is somewhat like using a 747 jet to transport a letter to a nearby town: You could do it, but it isn't generally necessary. In large campus LANs, ATM provides a good backbone used to link multiple FDDI LANs together into one larger LAN. For those environments that need to extend the high-bandwidth capacities over greater distances than just a campus LAN, ATM is an excellent way to integrate and share not only LAN services but audio- (phone systems) and video-conferencing. ATM is still not being used widely for WANs, but many phone companies are offering some type of ATM WAN. In the future, ATM may become the standard delivery method for all computer communications, including transmissions headed into the home; television, Internet access, banking, shopping, and video phones may all be sent via ATM.

WAN Implementation

After you have determined that you need a WAN service, you must decide what applications will be running over the WAN circuit and how many people will be using them. If you have a Novel network of 200 users in one office and you want them to share e-mail and a database with a 50-user Novel LAN across town, you must figure the number of users accessing the database and sending mail simultaneously across the WAN. If only 5 users of the 50 in the remote office will be accessing the database at any given time, a 56K WAN circuit may be adequate. However, if all 50 users will be accessing the database at the same time, plus sending e-mail, you should plan for a T-1 or a fractional T-1, which is only 512Kbps or 768Kbps. There are no hard and fast rules about how fast a WAN circuit should be. It may require that you talk to the users of the applications to ascertain what their usage patterns are before you size the WAN circuit. A good general guideline is 128Kbps per 25 frequent users.

Connecting the LANs

Connecting the WAN to the LAN is usually accomplished in one of two ways for data traffic that you will find in a LAN: bridging or routing. Both of these networking services are achieved by means of a hardware device installed on the connecting LANs. The bridge or router equipment is connected to your LAN just as the computers are connected to the LAN. The bridge or router also is connected to the WAN and acts as the "server" providing a path to the other LAN at the far end of the WAN.

Bridges

A bridge is a device that passes all data on the ethernet, token ring, or whatever type of LAN you have over the WAN to the other LAN. Essentially, the LANs that are bridged over the WAN appear to be all one LAN. The advantage to this type of networking is that you can set up all the devices in both LANs as if they were all local to one another. All the numbering used to provide computers on the LANs with unique network addresses reflects a single LAN. Having a single network may simplify administration, as there is only one network to "look after." However, the disadvantage is that there may be data being sent over the bridge that should stay local, thus taking up valuable "space" on your WAN circuit. Bridges use filtering and a bridging algorithm to learn which network addresses are on the LAN and which are on the WAN, but there generally is more traffic passing through a bridge than with a router. Bridging is appropriate for small networks on either side of the WAN, but if you have large networks on either side of the WAN, you probably should use a router.

Routers

Routers are devices that are installed on the LAN much as bridges are; a router connects to both the WAN and the LAN. The difference between a router and a bridge is in the way it handles the data it receives. In the

bridging world, data bits on the LAN (called packets) are passed across the WAN with minimum effort on the bridge. The bridge doesn't look at the packets very closely to examine the data, because it doesn't care what the data is; it just passes the packets over to the other side of the WAN. Routers, on the other hand, examine the data sent in the packets to see whether it needs to go over the WAN or if it should stay in the LAN. Think of a data application, e-mail for instance, as if it were a letter being sent over the LAN. It is put into a Novell or TCP/IP envelope (or whatever network you have), which is addressed by Novell or TCP/IP to show you sent it and who the recipient is. That envelope (or packet) is then "stuffed" into an ethernet or token ring envelope (whatever type of network you have) and is addressed again by the ethernet card to show from which computer it came. A bridge doesn't care about the Novell or TCP/IP addressed packet; it only looks at the ethernet or token ring address. A router, however, will "open up" the ethernet envelope to see the addressing on the packet inside the ethernet packet. The router provides an additional criteria for deciding where a particular packet should be sent. This is less important in a small network, but in a large network this function is critical to efficient use of both WAN and LAN resources. If you are connecting your network to the Internet, you must have a router. The network addresses you set up on your LAN to get on to the Internet will be unique to your network and must be routed as a separate network to the Internet, not bridged.

ABC WIDGETS, INC.

The ABC company makes widgets. ABC says it doesn't produce your run-of-the-mill widgets, but rather one-of-a-kind, top-of-the-line widgets. ABC's business has really taken off, and it has decided to open an office in Normal, Illinois, to facilitate the growing orders for widgets in the Midwest. All the company's inventory and shipping information is stored on the Novell LAN file servers in the main office in Fort Lee, New Jersey. The new Illinois office has a Novell LAN but needs access to all the information at the headquarters LAN. ABC has decided to implement a WAN so it can be linked to corporate headquarters.

The administrators found, after talking with upper management, that the ten-user LAN in Illinois will grow to more than 50 in the next six months. The users on the LAN in Midwest office will spend most of their time entering orders into the database in Fort Lee. The orders for widgets must be checked against the existing stock, ordered, and shipped using information stored in the central database with little delay. The administrators decide to purchase a point-to-point fractional T-1 from a long-distance company. The T-1 will provide a 256Kbps

transmission rate initially and, with a simple call to their provider, the administrators can up the bandwidth to 512Kbps or higher when the additional employees join the Illinois office.

Because the Novell network in Fort Lee is already set up, another Novell purchase is planned for the Illinois office. This new Novell network is a separate network with its own numbers so the administrators in Illinois can number the computers on their LAN with out having to check whether a particular address is already in use by a computer in Fort Lee. Because these are separate networks, they cannot be bridged, so administrators have selected a router with an internal CSU/DSU so they can connect directly to the WAN circuit. The router also supports Novell protocol routing (called IPX routing)(see Figure3)

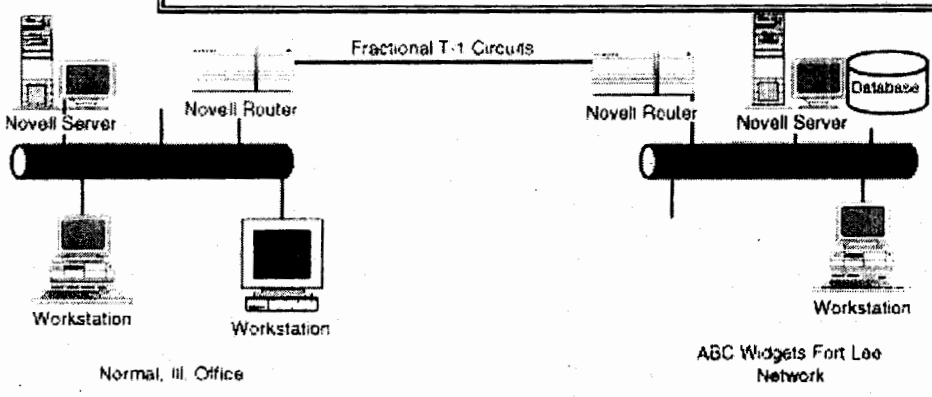


Figure 3: *A Novell network with a WAN in place.*

Accessing the WAN

To access any WAN service with a router or a bridge, you will need an access device. This equipment will vary with the type of WAN service you use. Each WAN service requires some hardware device, and some services, such as frame relay, requires software as well. The access equipment connects to the bridge or router with a V.35 cable, for example, and then connects to the WAN circuit using whichever cable the WAN service requires, like a fiber or twisted pair cable. When you purchase your bridge or router you must know the type of WAN service you will be using and make sure you have technical support for that service. Frame relay, as an example, can be delivered over a 56K circuit, which almost any bridge or router can support, but frame relay access requires software on the router or bridge; so you must match the equipment to both the circuit and possibly the service on that WAN circuit. Your WAN service provider should know how the WAN circuit will be delivered (that is, on fiber or twisted pair) and what access equipment you will need. Many phone companies will rent or provide the access equipment

as part of the service. You then only need to supply the router or bridge with the appropriate WAN port option, such as V.35, RS-449, EIA-530 or RS-232 and software, if required.

56K Circuits

For accessing a 56K circuit, use a DSU (data service unit). The DSU connects to your router or bridge and to the phone company's circuit. The DSU formats the data from the bridge or router so it can be transmitted over the 56K line. Each bridge or router that connects to a 56K circuit must have a DSU-type access device. The DSU can usually be purchased through the vendor that sells the router or bridge. Many routers and bridges come with a 56K DSU-type interface so the WAN circuit can be directly plugged into them.

T-1 Circuits

To access T-1s, you need a CSU/DSU (channel service unit/data service unit). This device provides access to all 24 channels on the T-1, and like the DSU, the CSU/DSU formats the data from the bridge or router so it can be transmitted over the line. Many routers and bridges now come with internal CSU/DSU-type interfaces so you can plug them directly intothe T-1.

T-3

To access a T-3 you will probably need a fiber optic access device. Most T-3 services are now delivered on fiber optic cable, and the access device will be a fiber interface on the WAN side and more than likely a V.35 connection on the LAN side. Most routers and bridges do not support T-3s directly and require a separate access device.

Frame Relay

Frame relay services typically are accessed over T-1s or 56K lines and require the appropriate DSU or CSU/DSU. Again, many routers and bridges support direct 56K or T-1 connections; however, the router or bridge you choose must support frame relay service in its operating software.

SMDS

To access SMDS, you will probably need a fiber optic access device. SMDS is usually delivered over a T-3 or fractional T-3 using fiber optic cable, and it requires the appropriate SMDS/T-3 access device on the WAN side. Like frame relay, you need a router that supports SMDS in its software. You need the support of the SMDS provider, which may furnish the SMDS access device, in making this connection.

Sonet

Sonet WANs also require a fiber optic access device. This device is specific to the Sonet WAN, and if it is not supplied by the Sonet access provider directly, your provider should know where you can get a unit that will interface with your LAN and the Sonet service.

ATM

ATM is usually delivered over Sonet in WAN applications, so you will need the Sonet access equipment described in the "Sonet" section. ATM has been deployed over T-3s in some environments, though, and in those instances, the appropriate T-3 access equipment is used. ATM is somewhat like the frame relay or SMDS services in that it is a networking service delivered using another networking technology. Accordingly, just as with frame relay or SMDS, you need a router or other system that provides the software support for ATM.

Why a WAN for Your Intranet?

After you have decided on what kind of connectivity you want, what speed you need, and what kind of hardware and software you need to accomplish that speed, the issue remains: What do I do with a WAN?

The nice thing about a WAN is that, when it is set up correctly, it functions almost exactly like your LAN. You can set it up so that the difference between connecting to a computer across the country is not all that different from connecting to a computer down the hall. The only difference might be the speed of the connection.

For the purposes of your intranet, a WAN can help you solve several problems at once.

Connectivity

A WAN can help you to improve connectivity among the offices as well as a connection to the Internet. If you have two or more offices connected by high-speed data lines, only one needs a connection to the Internet. The other offices can connect through that single connection.

Security

With a WAN, your intranet server can be located inside your own private network. Technically you don't even have to be connected to the Internet for several offices to share documents or communicate by a web or e-mail interface. Even if you have an Internet connection, your web server can be located inside your firewall and can be made accessible only to users on the WAN; in this way you can make your intranet information very secure.

Communications

It also is possible to use these lines for telephone and fax communications among two or more offices. It is possible that your organization will save more money in long-distance phone charges with your WAN than the data lines cost.

The bottom line is that when you have a working WAN in place and are running TCP/IP, setting up an intranet Web site for those machines is pretty easy-as easy as installing Web server software on a machine and giving the computer a name. Instant intranet!

MCKEON & JEFFRIES

M&J had had a WAN up and running for some time. The Philadelphia office and the Washington, DC office had been connected by an ISDN line for more than a year. The WAN needs were twofold. First, to connect the Raleigh office to the WAN, and second, to connect the three offices to the Internet.

To connect the Raleigh office to the WAN, the simplest and least inexpensive alternative was to run an ISDN line directly to the Washington, DC office. This option did not provide the best performance but was the least expensive. The performance was hurt because the intranet server, as well as the Internet connection, were both in the Philadelphia office, so to access either one, the Raleigh employees had to go through the Washington, DC office. It was decided that this was the best option because Raleigh had the fewest employees and was not likely to have too much problem with the speed of the connection.

The Internet connection from the Philadelphia office was a little more difficult to set up. Finding a local service provider and getting the line installed was easy, but configuring the router was a little more difficult. It took several days to get the connection to work right with M&J's system.

THE SPORTING GOODS AND APPAREL ASSOCIATION

The SGAA's WAN needs were very simple: a T-1 connection to the Internet. Their Internet service provider (ISP) installed the CSU/DSU and their local telephone company installed the line itself. It took a couple trips by the ISP techie and a little tweaking from the consultants hired to build the intranet to get it to work right, but it wasn't too much of a problem.

Summary

Anyone who maintains a central database or a central resource center and who needs to service offices that are located geographically apart from each other should consider utilizing a WAN. If you begin with a clear goal of what your WAN needs to accomplish, the WAN will began to build itself. Use the information in this chapter as a reference guide to making the most beneficial choices for your WAN. With a grasp of the framework and a knowledge of the basic connecting tools, your WAN soon will allow you and your users to perform your jobs more efficiently.

A Word of Thanks

Rendering this project was not only satisfying but an honor for us. We were the candidates who were selected to practically develop and implement a national level project. The delegating authorities were very humble and understanding. They assigned this task to us with faith and may Allah help us in keeping their faith and confidence.

At the end of the project we delivered a working software and a feasibility study of the Ministry of Interior's citizen database. That software was much appreciated and like any software developers dream was also implemented in the Ministry of Interior's premises.

The software delivered was easy to use and effective. It solved many problems of the clients. It eradicated all the short falls of the old system. The software was developed after the extensive research and survey of the system. Thus the end product was just what the client needed. Along with the software came the change in the general procedures of the Ministry. It revolutionized the way the inter office and extra office communication takes place. In the end we again thank the Authorities for the opportunity, especially **Mr. Jawad (Joint Secy, Min. of Interior)**

We are also very thankful to our beloved teacher, Head of Department and project Analyst **Mr. Furrukh Khan**, for his guidance and support.

Basit Ali Khan
MBA-IT (Final)

Syed Sajjad Ali
MBA-IT (Final)

Glossary

BROWSER

A client program (software) which permits users to view information and navigate through the World Wide Web or their own Intranet. Netscape Navigator and Microsoft Internet Explorer are two examples of browsers

CGI (Common Gateway Interface)

A standard that allows Web servers to run external applications such as search engines.

CLIENT

A software program used to contact and obtain data from a Server software program of another computer, often across a great distance.

FIREWALL

Hardware or software that restricts traffic to a private network from an unsecured network.

FTP (File Transfer Protocol)

A method of transferring one or more files from one computer to another on a network or phone lines.

HOME PAGE

The initial entry point to a Web document collection. The home page often is used as a main menu that provides access to other Web documents.

HTML (HyperText Markup Language)

The text format used by documents on the World Wide Web, which allows the author to define elements such as headers, paragraph boundaries and text formatting.

HTTP (HyperText Transfer Protocol)

The protocol that negotiates document delivery to a Web browser from a Web server.

HYPERTEXT

A system of writing and displaying text in which there are links from one document to another.

JAVA

Java is a programming language invented by Sun Microsystems that is specifically designed for writing programs that can be safely downloaded to your computer through the Internet and

immediately run without fear of viruses or other harm to your computer or files. Using small Java programs (called "Applets"), Web pages can include functions such as animation, calculators and other custom tricks.

SSL (Secure Socket Layer)

A transport-level technology for authentication and data encryption between a Web server and a Web browser.

TCP/IP (Transmission Control Protocol / Internet Protocol)

The collection of transport and application protocols used to communicate on the Internet and other networks.

URL (Uniform Resource Locator)

The standard way to give the address of any resource on the Internet that is part of the World Wide Web. The URL defines the protocol used, the name of the server (domain name), and the port address, which is often a default and the path to a particular file.

Web Server

A server that stores and receives HTML documents and other Internet or intranet resources using HTTP. Also called an HTTP server.

WWW (World Wide Web)

The Internet's worldwide, HTML-based, hypertext-linked information system.

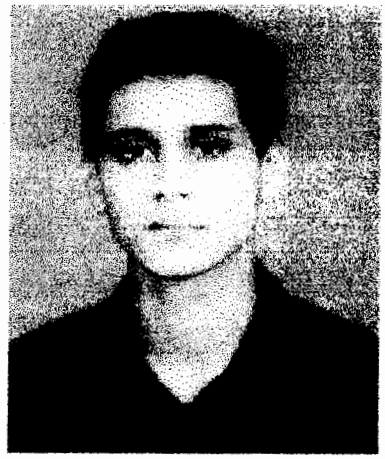
The Authors

Both the authors are final semester students of International Islamic University. They specialize in Web development and Networks deployment. Besides being distinction holders in the university, nowadays they work as Associate Consultants in an August consultancy company by the name of Applied Excellence Pvt. Ltd.

Mr. Basit Ali Khan is MCSE and MCDBA and has a keen interest in web development. His specialty on the web is the backend scripting and web database connectivity. His future plans include developing a web based solution of distant learning.

Mr. Syed Sajjad is also an MCSE. His area of Interest are web graphics and Intranets. He has also worked for French Embassy in Pakistan as a web developer. His greatest achievement up till date include launching and enhancing Pakistan's first city web guide called www.islamabad.net.

Basit Ali Khan



Syed Sajjad Ali