DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

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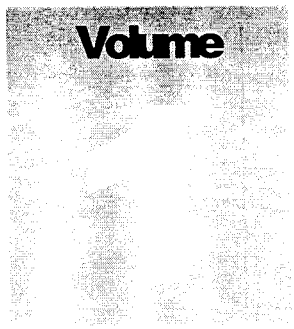
Content



Non Aligned Movement

Center for South-South Technical Cooperation

Database on Expert

DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

Database on Expert

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The Need for Database on Expert

Background

The Non Alignment Movement Center for South-South Technical Cooperation (NAM CSSTC) was developed to assist developing countries in technical cooperation for accelerating the development of those countries. It was officially initiated in Belgrade, Yugoslavia in 1961 as an obvious act to institutionalize the Dasa Sila Bandung or the Ten Principal of Bandung, in order that the position of the developing countries will be put forward with the result that their struggle direction is clearer.

Dasa Sila Bandung is an important principal document issued by the Five Countries preceded in Asia-Africa Conference. It is a substantively emphasize the important roles of Human Rights, State Sovereignty, Non-Aggression, Cooperative and Justice must be act as the base of International Cooperation.

The Non Alignment Movement is committed to wage war on poverty, illiteracy and underdevelopment. It is planned to advance broad-based and people centered development, including the quality improvement of the human resources. Based on that, the developing countries, which are member of NAM, can accelerate their development program based on equitable distribution, growth and stability. All programs of NAM CSSTC designed could have immediate as well as longer-term impacts to render the economics of developing countries of NAM member to be more broad-based, efficient and resilient to participate in the globalization process and strengthen cooperation among developing countries.

The mission of NAM CSSTC is to contribute and enhancement of development and collective self-reliance of the developing countries by strengthening and expanding South-South technical cooperation in the context of international development cooperation.

The objective of NAM CSSTC is enhancement of people centered development and capitalization of local resources through constructive interaction among development actors and partnership in development.

The Importance of ICT

Information - Communication Technology (ICT) is recognized by NAM members as an important technology will significantly enhance such development among member countries. The implementation of ICT worldwide has however resulted in a widening digital

divide not only between developed countries and developing countries, but also among NAM members.

ICT has become an indispensable tool in the fight against world poverty. It provides developing countries with an unprecedented opportunity to meet vital development goals such as poverty reduction, basic healthcare and education, which will become more effectively, including illiteracy reduction. Access to information networks will also allows countries using the networks to share information & experience from the others, action coordination, and improve their welfare.

This technology could accelerate development in far more than just the economic sphere. Indeed, connecting the world will transform it beyond recognition. It also could unlock the productivity of developing countries. Greater connectivity will also help fulfill the nearly insatiable human thirst for information and expose geographically isolated communities to wider information and new opportunities, which could create a more advance social and political outlook. Access to ICT networks can help people at all economic levels to meet their basic needs.

Finally, countries that succeed in harnessing the potential of ICT can look forward to greatly expanded economic growth, improved human welfare and stronger forms of democratic system.

In the information age, countries that do not provide access to information networks will not grow, no matter how rich their natural resources. ICT appears to be an essential component of development initiatives and can act as a powerful overall enable of development.

Advances in ICT have driven the last decade's economic boom and the integration of markets around the world. A lot of benefits from ICT and the rapid rise of the Internet have so far accrued to the developed world. Money spent on the digital infrastructure that supports these burgeoning new services that become a major engine of economic growth in some countries.

In the developing countries, ICT connectivity is growing, but the increased productivity and other benefits of the digital revolution are still pretty low. NAM CSSTC want to play the role to assist developing countries in taking advantage of ICT's potential and integrating ICT into the mainstream of their development activities.

Using ICT connectivity, developing countries can take benefits from on-line databases that are giving the important information, the latest discoveries, and also sharing experience with some experts.

The Need of Online Database

The global gap among developed & developing countries is quite real. Almost all of developed countries have no constraint in developing their own research for finding the newest technology & methodology, especially from the financial aspect. Majority of those technology are published through the on-line database developed by some institutional of developed countries.

The existence of database is very needed, especially for developing countries. It becomes an indispensable tool in the fight against world poverty. Majority of developing countries has

some constraints to develop their own research for improving their welfare - even solving their basic problems such as medical treatment & technology, educational method & material, agricultural system, biotechnology, energy exploration etc. With countries in the developing world stretching their budgets to the limit, and with education & research ranking low on some governments' list of spending priorities, the role of on-line database become very important.

The further enhance of the on-line database is a sharing experience and an optional consultancy with the experts. People can get additional information needed that is not available through the database with make a direct contact to the expert. It can be also used by the consultant, who can provide their service such as additional suggestion or analysis.

Access to on-line database can help people at all economic levels to meet their basic needs. Greater connectivity to the experts will help fulfill the nearly insatiable human thirst for the latest information, discovery & method needed for welfare improving. Wiring the planet with on-line database will transform the poverty into the prosperity. It will increase access to the educational materials, basic health information and other critical resources. For example, a single database in English, French, Spanish, Chinese or Hindi could serve a lot of continent and help so many people in the world. It could unlock the productivity level of developing countries, even the poor communities. It also could save human life in the rural areas while the experience manpower & equipped hospital is not available to handle some complicated cases and the patient has to race in time.

Majority of communities in developing countries is depending on agriculture. Agricultural development program will become the highest priority to increase the prosperity of their community. Latest information, new method & technology on agriculture will help them to improve the productivity.

The global economy in the world is relying more than ever on brain power and innovation rather than raw materials and labors only, as a generator of good wealth. A good education has become the key factor determining who will succeed and who will be left behind. The developing countries should pay attention on education program to prepare educated & skilled human resources in facing the high competition of labor market. It could allow them to reduce the gap among developing countries and developed countries. In eliminating the financial constraint, the governments of developing countries could expand the educational opportunities to as many people as possible with keeping down costs through bench mark educational methods & materials of other developed countries. Some cases of successful educational program in on-line database could be used in improving educational system of developing countries.

Connectivity to the on-line database allow developing countries to save their budget & time for getting the latest method or knowledge to meet their basic needs & improve their prosperity. Using the published experiences in the on-line database, developing countries should not allocate special budget for developing their own expensive research.

Cost can be contained by making full use of existing database. The database web sites would also be self-financing when fully developed. To facilitate regular updating information, an automatic prompting system could be set up. Finally, a search mechanism could be developed that will ensure the compatibility and connectivity of the diverse databases.

Database on Expert

The complete on-line database has to offer direct contact to the expert besides the cases published based on experts' experiences. Majority of the on-line database contents is coming from experts' experiences in developed countries. Sometimes, cases happened in developing countries that have a different geographic environment & specific characteristic, is not happened in other developed countries.

Case # 1:

A young and healthy athlete was brought to the hospital in a critical situation. He was suffering from high fever, weakness and serious infection. Laboratory tests confirmed that the infection was *necrotising fasciitis* (commonly know as the "flesh-eating bacteria"). Urgent amputation of the leg seemed the only possible solution to stop the flesh-eating bacteria process and save his life, until one of the physicians recalled seeing an article at the MedLine database - one of the most important medical database on Internet - that referred to new ways of treating limbs infected with *necrotising fasciitis*. After a quick consultant in MedLine, the doctors were able to find and retrieve the article then apply the procedure and treatment recommended. The young man was able to save both his life and his leg, and he can back in athletics. *(source: UNDP)*

Case # 2:

A young child in a poor, rural town, playing football by the side of a busy road, runs out on the street to chase the ball and is hit by a car. The frightened parents take the unconscious child to the nearest medical center for emergency aid. The doctor, a young, eager but inexperienced practitioner fresh out of medical school, takes an X-ray of the child's skull to determine the extent of the injuries. Although the child is stable, the doctor faces the difficult dilemma of either providing treatment locally, based on his or her own diagnosis or sending the child on a long, arduous and perhaps dangerous journey to the capital for treatment at the country's better-equipped hospital. It is a choice, which could have life or death consequence. Then his colleagues - a guess doctor from other city - suggest him for seeing related article to that injury in a med-database.

Chapter 2

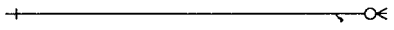
Database Structure

The Data Model

A data model is a collection of conceptual tools for describing data, data relationships, data semantics, and data constraints. The model is needed to describe the structure of database on expert.

The overall logical structure of data relationships of database on expert is visualized below which consist of the following components:

- Rectangles, which represents set record(s) of a table.
- Symbol of :

  which represents "one to many" relationship.

  It means one key record in table A could have any associated records in table B. However, one record in B could only have one associated record in A. For example:

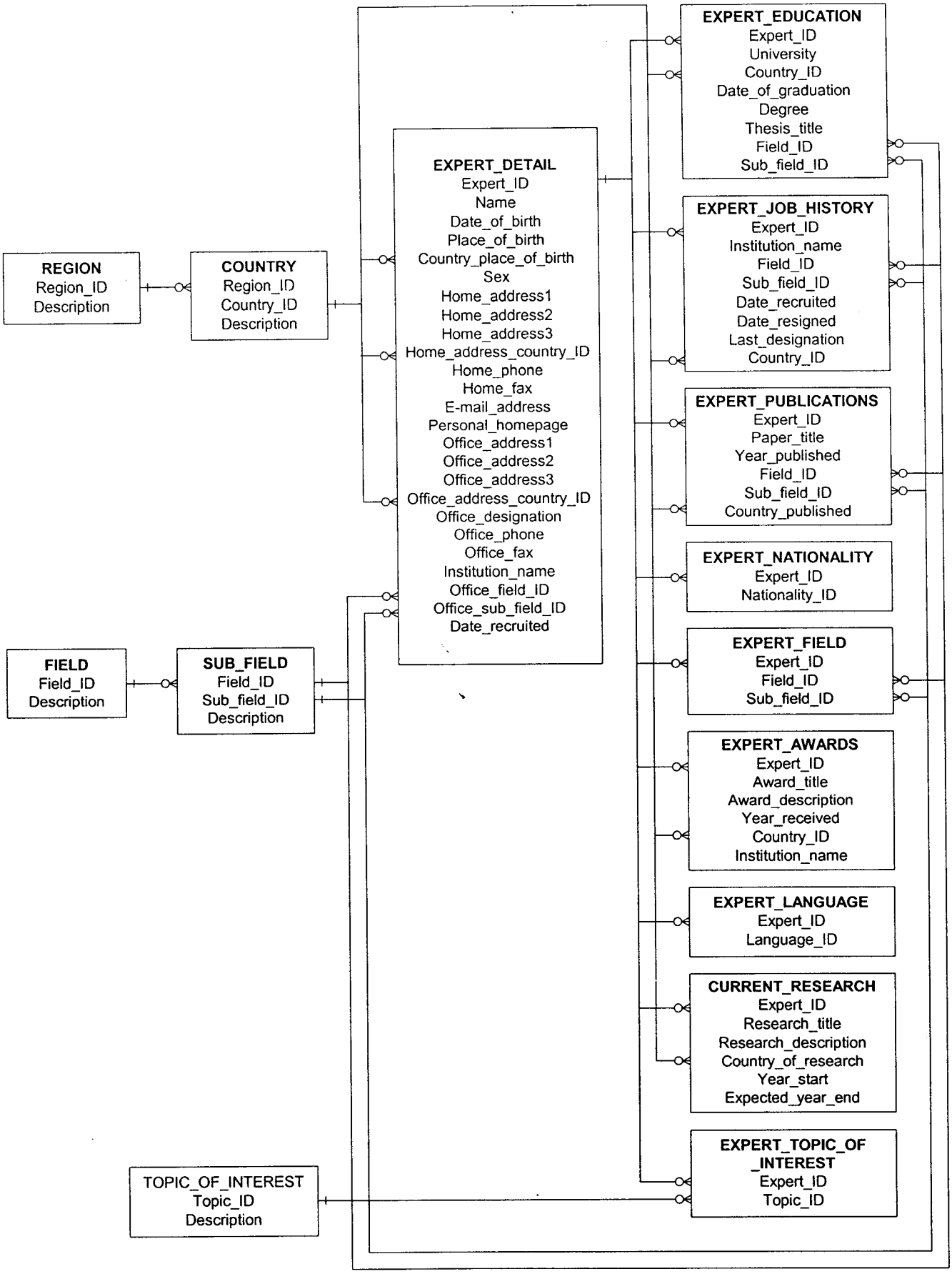
REGION

Region_ID	Description
AP	Asia Pacific
SA	South America

COUNTRY

Region_ID	Country_ID	Description
AP	PH	Philippines
AP	ID	Indonesia
AP	MY	Malaysia
SA	BR	Brazil
SA	GT	Guatemala

The following layout shows how the model is constructed.


EXPERT_EDUCATION
Expert_ID
University
Country_ID
Date_of_graduation
Degree
Thesis_title
Field_ID
Sub_field_ID
EXPERT_DETAIL
Expert_ID
Name
Date_of_birth
Place_of_birth
Country_place_of_birth
Sex
Home_address1
Home_address2
Home_address3
Home_address_country_ID
Home_phone
Home_fax
E-mail_address
Personal_homepage
Office_address1
Office_address2
Office_address3
Office_address_country_ID
Office_designation
Office_phone
Office_fax
Institution_name
Office_field_ID
Office_sub_field_ID
Date_recruited
EXPERT_JOB_HISTORY
Expert_ID
Institution_name
Field_ID
Sub_field_ID
Date_recruited
Date_resigned
Last_designation
Country_ID
REGION
Region_ID
Description
COUNTRY
Region_ID
Country_ID
Description
EXPERT_PUBLICATIONS
Expert_ID
Paper_title
Year_published
Field_ID
Sub_field_ID
Country_published
EXPERT_NATIONALITY
Expert_ID
Nationality_ID
FIELD
Field_ID
Description
SUB_FIELD
Field_ID
Sub_field_ID
Description
EXPERT_FIELD
Expert_ID
Field_ID
Sub_field_ID
EXPERT_AWARDS
Expert_ID
Award_title
Award_description
Year_received
Country_ID
Institution_name
EXPERT_LANGUAGE
Expert_ID
Language_ID
CURRENT_RESEARCH
Expert_ID
Research_title
Research_description
Country_of_research
Year_start
Expected_year_end
EXPERT_TOPIC_OF
_INTEREST
Expert_ID
Topic_ID
TOPIC_OF_INTEREST
Topic_ID
Description

The data model of database on experts pivots around the EXPERT_DETAIL. This is the table where the most common data of experts stored.

Tables and Indexes

Tables

EXPERT_DETAIL

EXPERT_DETAIL is the main table which stores common detail information of experts. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Primary key**
Name	alphanumeric(40)	
Date_of_birth	Date	
Place_of_birth	alphanumeric(20)	
Country_place_of_birth	**alphanumeric(2)**	**Foreign key**
Sex	alphanumeric(1)	
Home_address1	alphanumeric(40)	
Home_address2	alphanumeric(40)	
Home_address3	alphanumeric(40)	
Home_address_country_ID	**alphanumeric(2)**	**Foreign key**
Home_phone	alphanumeric(15)	
Home_fax	alphanumeric(15)	
E-mail_address	alphanumeric(40)	
Personal_homepage	alphanumeric(40)	
Office_address1	alphanumeric(40)	
Office_address2	alphanumeric(40)	
Office_address3	alphanumeric(40)	
Office_address_country_ID	**alphanumeric(2)**	**Foreign key**
Office_designation	alphanumeric(30)	
Office_phone	alphanumeric(15)	
Office_fax	alphanumeric(15)	
Institution_name	alphanumeric(30)	
Office_field_ID	**alphanumeric(2)**	**Foreign key**
Office_sub_field_ID	**alphanumeric(4)**	**Foreign key**
Date_recruited	Date	

EXPERT_EDUCATION

This is the sub-table of EXPERT_DETAIL which stores education history of an expert. The complete format of EXPERT_EDUCATION is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
University	alphanumeric(40)	
Country_ID	**alphanumeric(2)**	**Foreign key**
Date_of_graduation	date	
Degree	alphanumeric(10)	
Thesis_title	alphanumeric(40)	
Field_ID	**alphanumeric(2)**	**Foreign key**
Sub_field_ID	**alphanumeric(4)**	**Foreign key**

EXPERT_JOB_HISTORY

This is the sub-table of EXPERT_DETAIL which stores job history of an expert. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Institution_name	alphanumeric(40)	
Field_ID	**alphanumeric(2)**	**Foreign key**
Sub_field_ID	**alphanumeric(4)**	**Foreign key**
Date_recruited	date	
Date_resigned	date	
Last_designation	alphanumeric(30)	
Country_ID	**alphanumeric(2)**	**Foreign key**

EXPERT_PUBLICATIONS

This is the sub-table of EXPERT_DETAIL which stores information of papers published by experts. The complete structure of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Paper_title	alphanumeric(40)	
Year_published	alphanumeric(4)	
Field_ID	**alphanumeric(2)**	**Foreign key**
Sub_field_ID	**alphanumeric(4)**	**Foreign key**
Country_published	**alphanumeric(2)**	**Foreign key**

EXPERT_NATIONALITY

This is the sub-table of EXPERT_DETAIL which stores nationality(ies) of experts. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Nationality_ID	**alphanumeric(2)**	**Foreign key**

EXPERT_FIELD

This is the sub-table of EXPERT_DETAIL which stores expertise's field(s) and sub_field(s). The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	alphanumeric(4)	Foreign key
Field_ID	alphanumeric(2)	Foreign key
Sub_field_ID	alphanumeric(4)	Foreign key

FIELD

This is the look-up table that stores field ID and its description. The format of the table is as follows:

Field_Name	Data_type	Remarks
Field_ID	Alphanumeric(2)	Primary key
Description	Alphanumeric(40)	

SUB_FIELD

This is the look-up table which stores sub field ID and its descriptions. The format of the table is as follows:

Field_Name	Data_type	Remarks
Field_ID	alphanumeric(2)	Foreign key
Sub_field_ID	alphanumeric(4)	Primary key
Description	alphanumeric(40)	

COUNTRY

This is the look-up table which stores country ID and name. The country ID will be based on ISO-3166 which consists of only 2 character. Please refer to appendix A to see the complete list of ISO-3166 country ID.

The format of country table is as follows:

Field_Name	Data_type	Remarks
Region_ID	Alphanumeric(4)	Foreign key
Country_ID	alphanumeric(2)	Primary key
Description	alphanumeric(30)	

LANGUAGE

This is the look-up table which stores the information of languages exists all over the world. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Language ID	**alphanumeric(2)**	**Primary key**
Description	alphanumeric(30)	

EXPERT_LANGUAGE

This is the sub-table of EXPERT_DETAIL which stores language spoken by experts. The format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Language_ID	**alphanumeric(2)**	**Foreign key**

EXPERT_AWARDS

This is the sub-table of EXPERT_DETAIL which stores information of awards honored to experts. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Award_title	alphanumeric(20)	
Award_description	alphanumeric(80)	
Year_received	alphanumeric(4)	
Country_ID	**alphanumeric(2)**	**Foreign key**
Institution_name	alphanumeric(20)	

CURRENT_RESEARCH

This is the sub table of EXPERT_DETAIL which stores topic of researches being worked out by experts. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Research_title	alphanumeric(40)	
Research_description	alphanumeric(200)	
Country_of_research	**alphanumeric(2)**	**Foreign key**
Year_start	alphanumeric(4)	
Expected_year_end	alphanumeric(4)	

TOPIC_OF_INTEREST

This is the look-up table of topic of interest. The format of the table is as follows:

Field_Name	Data_type	Remarks
Topic_ID	alphanumeric(4)	Primary key
Description	alphanumeric(40)	

EXPERT_TOPIC_OF_INTEREST

This is the sub table of EXPERT_DETAIL which stores topic of interests of experts. The format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	alphanumeric(4)	Foreign key
Topic_ID	alphanumeric(4)	Foreign key

REGION

This is the look-up table which stores regions. The format of the table is as follows:

Field_Name	Data_type	Remarks
Region_ID	alphanumeric(4)	Primary key
Description	alphanumeric(40)	

Indexes

Index is required to increase the performance of searching. Usually index is put on all key fields. The list of index used for database on expert is as follows.

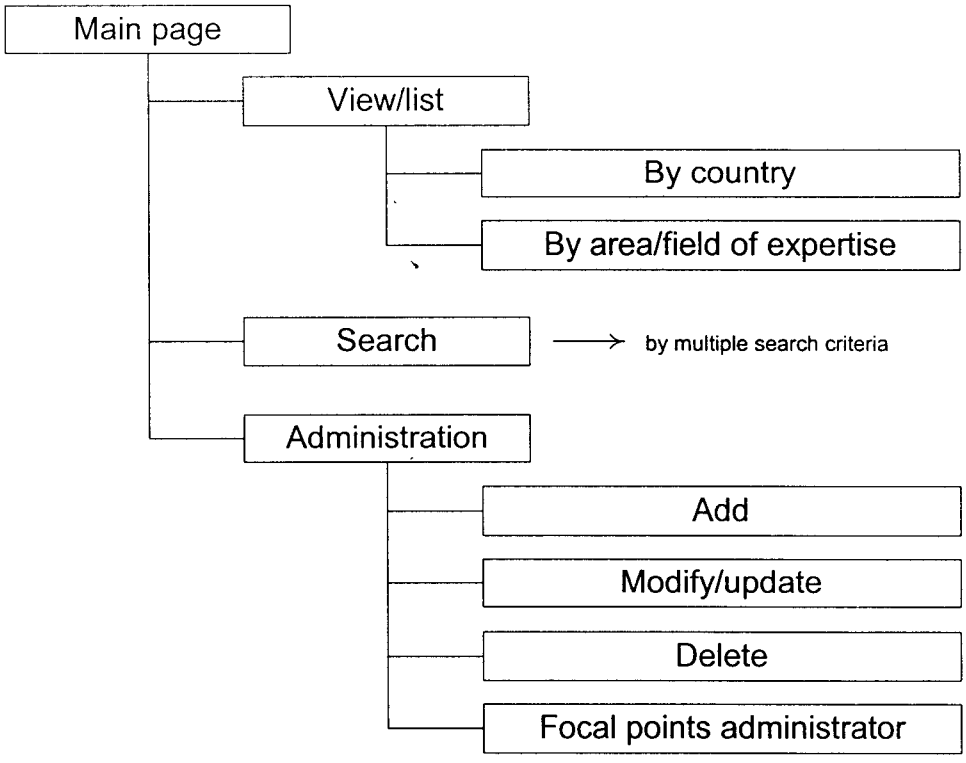
Field Name	Table Name	Index Name
Expert_ID	Expert_Detail	Idx.Expert_Detail.Expert_ID
Country_place_of_birth	Expert_Detail	idx.Expert_Detail.Country_place_of_birth
Home_address_country_ID	Expert_Detail	idx.Expert_Detail.Home_address_country_ID
Office_address_country_ID	Expert_Detail	idx.Expert_Detail.Office_address_country_ID
Office_field_ID	Expert_Detail	idx.Expert_Detail.Office_field_ID
Office_sub_field_ID	Expert_Detail	idx.Expert_Detail.Office_sub_field_ID
Expert_ID	Expert_education	idx.Expert_education.Expert_ID
Country_ID	Expert_education	idx.Expert_education.Country_ID
Field_ID	Expert_education	idx.Expert_education.Field_ID
Sub_field_ID	Expert_education	idx.Expert_education.Sub_field_ID
Expert_ID	Expert_job_history	idx.Expert_job_history.Expert_ID
Field_ID	Expert_job_history	idx.Expert_job_history.Field_ID
Sub_field_ID	Expert_job_history	idx.Expert_job_history.Sub_field_ID
Country_ID	Expert_job_history	idx.Expert_job_history.Country_ID
Expert_ID	Expert_publications	idx.Expert_publications.Expert_ID
Field_ID	Expert_publications	idx.Expert_publications.Field_ID
Sub_field_ID	Expert_publications	idx.Expert_publications.Sub_field_ID
Country_published	Expert_publications	idx.Expert_publications.Country_published
Expert_ID	Expert_nationality	idx.Expert_nationality.Expert_ID
Nationality_ID	Expert_nationality	idx.Expert_nationality.Nationality_ID
Expert_ID	Expert_field	idx.Expert_field.Expert_ID
Field_ID	Expert_field	idx.Expert_field.Field_ID

Sub_field_ID	Expert_field	idx.Expert_field.Sub_field_ID
Field_ID	Field	idx.Field.Field_ID
Field_ID	Sub_field	idx.Sub_field.Field_ID
Sub_field_ID	Sub_field	idx.Sub_field.Sub_field_ID
Region_ID	Country	idx.Country.Region_ID
Country_ID	Country	idx.Country.Country_ID
Language ID	Language	idx.Language.Language ID
Expert_ID	Expert_language	idx.Expert_language.Expert_ID
Language_ID	Expert_language	idx.Expert_language.Language_ID
Expert_ID	Expert_awards	idx.Expert_awards.Expert_ID
Country_ID	Expert_awards	idx.Expert_awards.Country_ID
Expert_ID	Current_research	idx.Current_research.Expert_ID
Country_of_research	Current_research	idx.Current_research.Country_of_research
Topic_ID	Topic_of_interest	idx.Topic_of_interest.Topic_ID
Expert_ID	Expert_topic_of_interest	idx.Expert_topic_of_interest.Expert_ID
Topic_ID	Expert_topic_of_interest	idx.Expert_topic_of_interest.Topic_ID
Region_ID	Region	idx.Region.Region_ID

System Architecture

Web page structure

The database on expert will be presented through web-based interface. The menu tree of the web presentation is as follow:



Main page

- welcome page and messages whenever the web page of expert opened
- shows three submenus: view/list, search, and administration

View/list menu

- menu to view or list the content of database on expert
- shows two submenus: view by country and view by field of expertise

Search menu

- menu to search expert data based on multiple search criteria
- shows fields of search criteria. At least one criteria must be filled in to start searching. The list of search criteria is as follows:
  - Expert ID
  - Expert Name
  - Sex
  - Country of current address
  - Country of current office
  - Nationality
  - Field of expertise
  - Publication/paper title
  - Region
  - Active language
  - Award title
  - Current research title

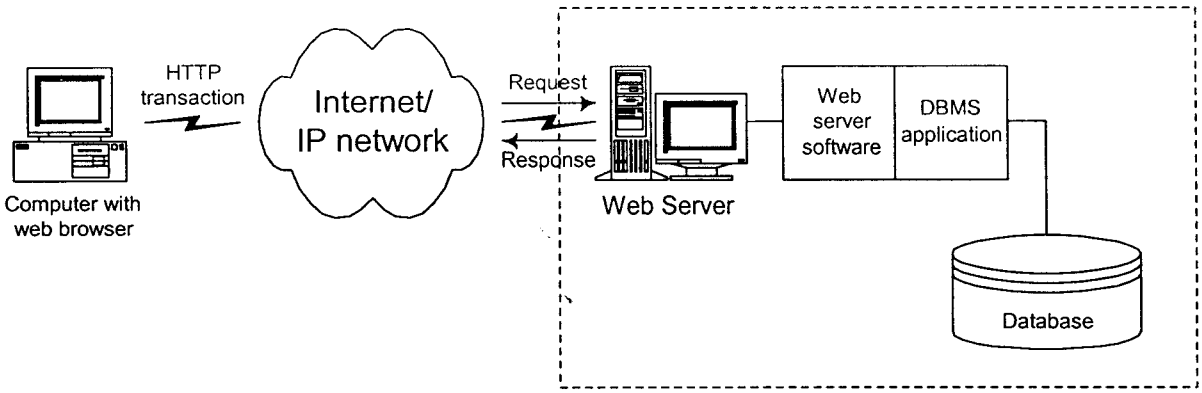
Administration

- menu to administer the content of the database. "Administer" here refers to add, modify/update, and delete data.
- only authorized users have the grant to administer.

- to prevent disturbance from illegal administrator, a login form is shown whenever the module is run.
- rule to administer the data:
  - only focal points administrator can add, modify, and delete data of experts
  - only NAM Centre administrator can maintain data of focal points administrators
  - every change of the data has to be logged

Web System Architecture

In the initial stage, the database on expert will be stored centrally in NAM-CSSTC web server. Tools required in the server to enable people connected to the Internet all over the world to browse the information are web server software and DBMS applications. The complete diagram on how the tools are linkaged each other is as follows.



Web server software

As mentioned in the previous chapter, a web server software is required to handle requests from browsers. It receives requests from the network, interprets, send a system call internally to process the request, receive the result of the system call, and then send the response to the request sender. The system call can run a DBMS application if the request wants to query a particular database to search information in it. Two of the most popular commercial web browsers in the market are Internet Information Server (IIS) and Personal Web Server (PWS).

DBMS Application

DBMS application is the tool to communicate with the database to search particular information or data in it. Usually a DBMS application is written under a tool which packaged together with its native database. However, nowadays there are a lot of commercial DBMS development tools which comes independently.

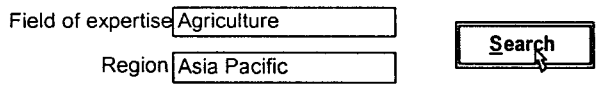
Chapter 6

Future Improvement and Enhancement

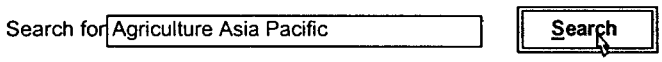
Search Engine

Searching capability can be enhanced by using meta language search. By using this, user will only type word(s) he wants to find, then the search engine will try to find out where the associated word(s) can be found from. There is no need to show which field(s) the user will search from.

For example, if a user wants to find experts in the field of agriculture and live in region of Asia Pacific, he has to fill in two fields: field of expertise and region.



In meta language search, the user will only fill in one blank space, and then the search engine will work the rest:



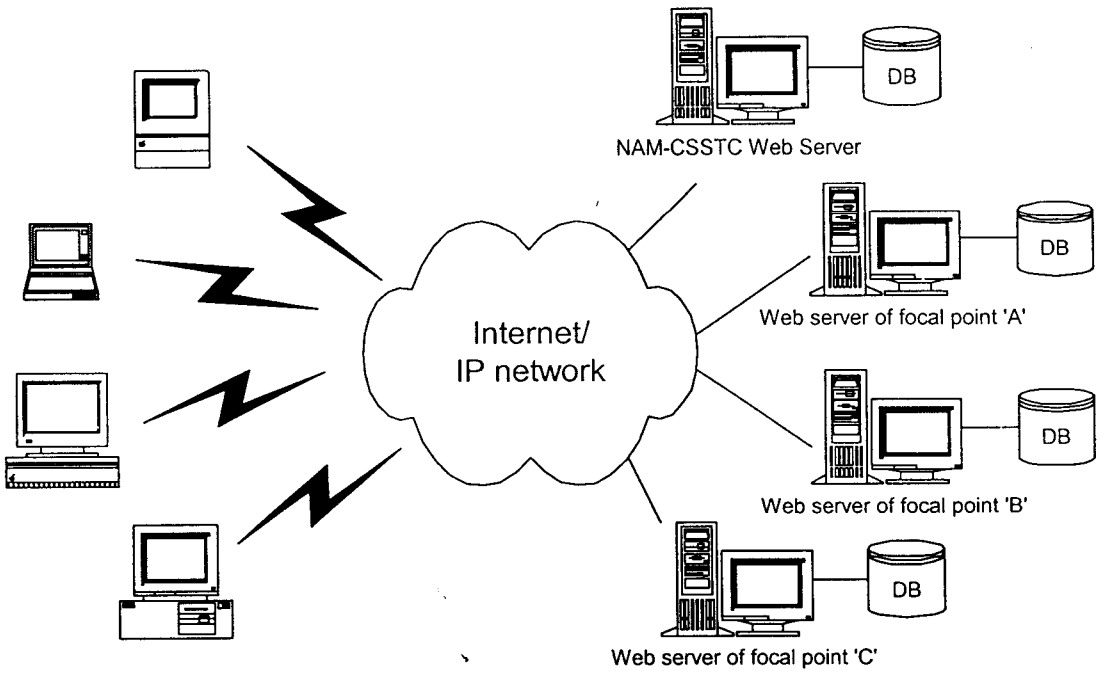
Infrastructure

At the initial stage, database on experts will be placed centrally in NAM-CSSTC web server. This should be adequate to handle small number of access (in Internet term, it is called 'hit'). In the future, when the number of hits grow rapidly, the database on expert should be distributed on every focal point in order to:

- Reduce the workload of NAM-CSSTC web server
- Keeping up the database availability whenever NAM-CSSTC web server shut down for whatever purpose. While NAM-CSSTC web server shut down, the other focal point web server can take over the work.
- Increase the browsing performance. In a single centralized database server configuration, every request to query the information from all over the world will

always be routed to NAM-CSSTC web server. In distributed database configuration, every request to query need to be routed only to its nearest focal point in its region. Only if the nearest focal point web server is down then the request has to be routed to the other available focal points.

However, the distributed database configuration needs more attention and effort to maintain. Data integrity and consistency have to be managed carefully, in order to avoid any data duplication and corruption.



Distributed database

Website

It is important to note that the website is developed upon the concept of gradually building web pages as new content becomes available. Information may be provided as soon as it is known, then updated or changed as time moves on and plans become firm. Anticipating the changes that will come can make this aspect of Web site maintenance a bit easier.

In order to improve the web's content integrity, availability, and ease of navigation, several improvements and advanced technique should be addressed in the near future.

Highlighting new or updated information

Many sites have adopted a means of drawing attention to information, which is *new* or recently *changed*. However, we should be certain to review pages looking for such notations on a regular basis. To make it even easier to locate those that are obsolete, consider adding a comment tag to indicate when the notation was posted or when it should be taken down.

Formatted Web pages for e-mail or print

Although most browsers provide a means for saving or printing the displayed Web page as a formatted text file, it will be helpful to provide such a dedicated, convenient facility. A quick way to do this (rather than wait for a full-function browser to start up) is to use the -dump switch in Lynx and redirect the output to a file. The result is a flat text rendering of the page, which can be included in or attached to your e-mail message and read by the recipient.

Forms and feedback

In the near future, we will provide simple forms to permit readers to send questions and comments to the webmaster in case they had problems reading a particular page. This was soon followed by more advanced forms, such as: the on-line membership form, our "Thank You" form, and a few others. As more involved questions began being submitted, several advanced technique can be introduced. The pull-down menu fields on this form made it easier to identify who could best resolve the question and be certain it could be routed to them more quickly. More recently, a special form was added to allow membership records to be updated easily, without the need to submit a complete new membership form.

All of these forms resulted in a simple e-mail message to the appropriate staff or volunteers. These people would then deal with the e-mail as needed. It is simple, but effective.

Saving data and generating pages

A Web interface can be created to allow webmasters to create a summary of all information or materials submitted to the webpage. This summary listed such items as needed, depend on requirements. Webmaster can select, track, view, edit, and make necessary changes. The summary could then be viewed by stakeholder on-line immediately.

Further extensions to this interface allowed automatic creation and saving of the detailed information and track breakout that has been available on-line. Thus, any of the stakeholder could create a response or reply and post it for readers as it changed -- without the webmaster being a bottle-neck in the process as had happened in past years.

Image maps

Image map can be a very effective way to help readers navigate to the information they need. Most pages on the website contain two image maps:

- the header logo may be used to return to the welcome page, move to the related site, get some general information about the author, or view the site's Table of Contents.

- the footer graphic allows readers to move directly to any of the major portions of the site quickly.

Both were created to provide maximum information using minimum bandwidth. As was recommended above, both client-side and server-side implementations are provided so that the majority of readers can use the maps.

Pages for internal or limited use only

If we have information targeted at a particular group of readers that we would prefer not be seen by others on the same side of the firewall, we can authorize the readers by using the user ID and password feature of the Web.

Special sub-directories are set up with unique access passwords on each. The IDs and passwords are shared with the appropriate committee members so they may access the pages required. A single ID can be a member of multiple groups, so that they only need to remember one access mechanism to get to all the pages they need. More simple way, we can create a single generic ID to pass to all members of the same group or committee if you prefer.

Off-line browsing

Provide off-line browsing, which means readers can view the entire site on their own computer much faster than if they were on-line. And, readers save money on dial-up costs

Provide an index page for each directory

This may be obvious, but it is very important to provide a default page in each subdirectory which is displayed when just the directory name is passed from the browser to the server. This allows visitors to simply erase the file name from their URL and "back up" to what they expect to be our index or pointer into the subject matter.

Use of a default index page also prevents visitors from viewing site's directory listing and selecting a page which may be under construction and not yet ready for public viewing.

Provide a directory for each topic

Proper segmentation into directories of related information makes it easier to locate similar information and it provides a simpler mechanism for granting access to related files either for content editors (via file permissions) or for site visitors (via server authorization files, passwords, etc.) In addition, it facilitates analysis of site metrics if we are using a program which can "roll-up" the counts for all pages beneath each directory.

It is best to keep each directory addressing a single topic. Try not to mix multiple topics together, even if they are relatively small. As soon as they begin to grow (and they usually do), it is likely you will want to have separate directories. However, by then the various page URLs will be know by search engines and be referenced by other sites' pages and contained in visitors' bookmarks. Remember to provide adequate cross-reference links both to other pages within the same topic and to other topics, which may be related.

A directory for Images

While it is possible to intersperse images with the text files, separating them into their own commonly named directories provides a number of benefits. The separate directories "unclutter" our text directories, making maintenance easier. Tools, which manipulate text, check links, and analyze logs can be configured or written to avoid descending into or considering known image directories, saving time and simplifying reporting.

Slash or relative links (vs domain-specific)

If we are mirroring your site, in general we should be careful to use links which do not contain the site's domain name. This keeps all cross-references working on the mirror site

at which the visitor first began reading your pages. If we use a domain-specific link, they will be shuttled to that particular domain (or physical machine) and remain there for all future site-relative links. This may mean that someone trying to use our European mirror suddenly will be making multiple trans-Atlantic accesses to a US based site and suffering the related latency or expense involved with such links.

Places non-domain-specific links hurt

Despite what we just covered above, there *are* times when domain-specific links are not only desired, but required. For example, if we have a CGI application which submits or alters data or pages, such manipulation needs to take place on the "master" site. Otherwise, only that particular mirror will contain the change, and only for a short time at that. Subsequent mirror operations will cover up the change with the original content, causing it to be lost.

Un-mirrored subdirectories

There are some directories and types of data probably we *do not* want to mirror. While we may want to store the analyzed reports of site acccess on all mirrors, it is unlikely we want to mirror the actual raw log files. Private files, certain password protected files, and user-specific files are other categories we should consider when designing mirror.

Each server will normally have its own configuration files. When functional configuration changes are made (e.g. access restriction and page redirection) these changes will need to be made in each mirror's configuration files. This can be facilitated by mirroring the master configuration files, but saving them in a side directory on the mirror, not into the location actually used by the mirror for its own configuration. Then, the changes can be discovered and implemented by hand, or automated in full or in part by a `cron` job.

Permissions

Since the mirror process may not run as the same user or group as the Web server or the site maintainers, particular attention must be paid to file and directory permissions. It is all too easy for a maintainer to make a local copy of a file but leave it with permissions preventing the mirror process from reading it (even if the Web server can). This then results in extraneous error log entries which must be reconciled. Worse yet, the page may later be determined to be something of value and commissioned for public viewing on the master site, but be unavailable on the mirror. (The error was logged, but it became one of those "expected" errors and was ignored when the page "went public".)

Compatible versions of installed programs

Finally, once all required information may be found on each of the mirrors, it is equally important that compatible revisions of system and application software be available. For example, it may not be important whether `perl` 5.003 or 5.004 is available, but it probably must be a version of 5.x.

If we have control of each of the mirrors, it should be a simple matter to upgrade certain programs to be of a compatible version. However, if we are sharing a mirror machine, that may not be possible. In certain circumstances, it may be necessary to modify our web site so that it may be accommodated on all mirrors.

Appendix

The ISO-3166 Country Code

Code	Country name
AF	Afghanistan (Islamic Republic of)
AL	Albania (Republic of)
DZ	Algeria (People's Democratic Republic of)
AS	American Samoa
AD	Andorra (Principality of)
AO	Angola (People's Republic of)
AI	Anguilla
AQ	Antarctica
AG	Antigua and Barbuda
AR	Argentina (Argentine Republic)
AM	Armenia
AW	Aruba
AU	Australia
A T	Austria (Republic of)
AZ	Azerbaijan
BS	Bahamas (Commonwealth of the)
BH	Bahrain (State of)
BD	Bangladesh (people's Republic of)
BB	Barbados
BY	Belarus
BE	Belgium (Kingdom of)
BZ	Belize
BJ	Benin (people's Republic of)
BM	Bermuda
BT	Bhutan (Kingdom of)
BO	Bolivia (Republic of)
BA	Bosnia-Herzegovina
BW	Botswana (Republic of)
BV	Bouvet Island
BR	Brazil (Federative Republic of)
IO	British Indian Ocean Territory
BN	Brunei Darussalam
BG	Bulgaria (Republic of)
BF	Burkina Faso (Fonnerly Upper Volta)
BI	Burundi (Republic of)

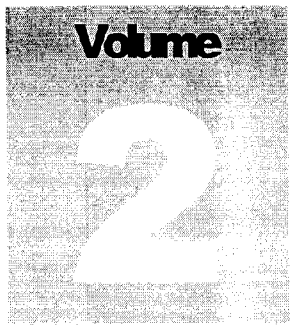
KH	Cambodia
CM	Cameroon (Republic of)
CA	Canada
CV	Cape Verde (Republic of)
KY	Cayman Islands
CF	Central African Republic
TD	Chad (Republic of)
CL	Chile (Republic of)
CN	China (People's Republic of)
CX	Christmas Island (Indian Ocean)
CC	Cocos (Keeling) Islands
CO	Colombia (Republic of)
KM	Comoros (Islamic Federal Republic of the)
CG	Congo (Republic of the)
CK	Cook Islands
CR	Costa Rica (Republic of)
CI	Cote d'Ivoire (Republic of)
HR	Croatia
CU	Cuba (Republic of)
CY	Cyprus (Republic of)
CZ	Czech Republic
DK	Denmark (Kingdom of)
DJ	Djibouti (Republic of)
DM	Dominica (Commonwealth of)
DO	Dominican Republic
EC	Ecuador (Republic of)
EG	Egypt (Arab Republic of)
SV	El Salvador (Republic of)
GQ	Equatorial Guinea (Republic of)
ER	Eritrea
EE	Estonia (Republic of)
ET	Ethiopia (People's Democratic Republic of)
FK	Falkland Islands (Malvinas) .
FO	Faroe Islands
FJ	Fiji (Republic of)
FI	Finland (Republic of)
FR	France (French Republic)
GF	French Guiana
PF	French Polynesia
TF	French Southern Territories
GA	Gabon (Gabonese Republic)
GM	Gambia (Republic of the)
GE	Georgia (Republic of)
DE	Germany (Federal Republic of)
GH	Ghana (Republic of)
GI	Gibraltar
GR	Greece (Hellenic Republic)
GL	Greenland
GD	Grenada

GP	Guadeloupe (French Department of)
GU	Guam
GT	Guatemala (Republic of)
GN	Guinea (Republic of)
GW	Guinea-Bissau (Republic of)
GY	Guyana (Republic of)
HT	Haiti (Republic of)
HM	Heard and McDonald Islands
HN	Honduras (Republic of)
HK	Hong Kong
HU	Hungary (Republic of)
IS	Iceland (Republic of)
IN	India (Republic of)
ID	Indonesia (Republic of)
IR	Iran (Islamic Republic of)
IQ	Iraq (Republic of)
IE	Ireland
IL	Israel (State of)
IT	Italy (Italian Republic)
JM	Jamaica
JP	Japan
JO	Jordan (Hashemite Kingdom of)
KZ	Kazakhstan
KE	Kenya (Republic of)
KI	Kiribati (Republic of)
KP	Korea (Democratic People's Republic of)
KR	Korea (Republic of)
KW	Kuwait (State of)
KG	Kyrgyz Republic
LA	Lao People's Democratic Republic
LV	Latvia (Republic of)
LB	Lebanon (Lebanese Republic)
LS	Lesotho (Kingdom of)
LR	Liberia (Republic of)
LY	Libyan Arab Jamahiriya
LI	Liechtenstein (Principality of)
LT	Lithuania
LU	Luxembourg (Grand Duchy of)
MO	Macau (Ao-me'n)
MK	Macedonia (Former Yugoslav Republic of)
MG	Madagascar (Democratic Republic of)
MW	Malawi (Republic of)
MY	Malaysia
MV	Maldives (Republic of)
ML	Mali (Republic of)
MT	Malta (Republic of)
MH	Marshall Islands (Republic othe)
MQ	Martinique (French Department of)
MR	Mauritania (Islamic Republic of)

MU	Mauritius
YT	Mayotte
MX	Mexico (United Mexican States)
FM	Micronesia (Federated States of)
MD	Moldova (Republic of)
MC	Monaco (Principality of)
MN	Mongolia
MS	Montserrat
MA	Morocco (Kingdom of)
MZ	Mozambique (People's Republic of)
MM	Myanmar (Union of)
NA	Namibia (Republic of)
NR	Nauru (Republic of)
NP	Nepal (Kingdom of)
NL	Netherlands (Kingdom othe)
AN	Netherlands Antilles
NT	Neutral Zone (between Saudi Arabia and Iraq)
NC	New Caledonia
NZ	New Zealand
NI	Nicaragua (Republic of)
NE	Niger (Republic of the)
NO	Nigeria (Federal Republic of)
NU	Niue
NF	Norfolk Island
MP	Northern Mariana Islands (Commonwealth of the)
NO	Norway (Kingdom of)
OM	Oman (Sultanate of)
PK	Pakistan (Islamic Republic of)
PW	Palau (Republic of)
PA	Panama (Republic of)
PO	Papua New Guinea
PY	Paraguay (Republic of)
PE	Peru (Republic of)
PH	Philippines (Republic of the)
PN	Pitcaim
PL	Poland (Republic of)
PT	Portugal (portuguese Republic)
PR	Puerto Rico
QA	Qatar (State of)
RE	Re'union (French Deparbnent of)
RO	Romania
RU	Russian Federation
RW	Rwanda (Rwandese Republic)
SH	Saint Helena
KN	Saint Kitts and Nevis
LC	Saint Lucia
PM	Saint Pierre and Miquelon (French Department of)
VC	Saint Vincent and the Grenadines i
WS	Samoa (Independent State of)

SM	San Marino (Republic of)
ST	Sao Tome and Principe (Democratic Republic of)
SA	Saudi Arabia (Kingdom of)
SN	Senegal (Republic of)
SC	Seychelles (Republic of)
SL	Sierra Leone (Republic of)
SG	Singapore (Republic of)
SK	Slovakia
SI	Slovenia
SB	Solomon Islands
SO	Somalia (Somali Democratic Republic)
ZA	South Africa (Republic of)
ES	Spain (Kingdom of)
LK	Sri Lanka (Democratic Socialist Republic of)
SD	Sudan (Democratic Republic of the)
SR	Suriname (Republic of)
SJ	Svalbard and Jan Mayen Islands
SZ	Swaziland (Kingdom of)
SE	Sweden (Kingdom of)
CH	Switzerland (Swiss Confederation)
SY	Syria (Syrian Arab Republic)
TW	Taiwan, Province of China
TJ	Tajikistan
TZ	Tanzania (United Republic of)
TH	Thailand (Kingdom of)
TG	Togo (Togolese Republic)
TK	Tokelau i
TO	Tonga (Kingdom of)
TT	Trinidad and Tobago (Republic of)
TN	Tunisia
TR	Turkey (Republic of)
TM	Turkmenistan
TC	Turks and Caicos Islands
TV	Tuvalu
UG	Uganda (Republic of)
UA	Ukraine
AE	United Arab Emirates
GB	United Kingdom (United Kingdom of Great Britain and Northern Ireland)
US	United States (United States of America)
UM	United States Minor Outlying Islands
UY	Uruguay (Eastern Republic of)
UZ	Uzbekistan
VU	Vanuatu (Republic of, formerly New Hebrides)
VA	Vatican City State (Holy See)
VE	Venezuela (Republic of)
VN	Vietnam (Socialist Republic of)
VG	Virgin Islands (British)
VI	Virgin Islands (U.S.)
WF	Wallis and Futuna Islands

EH	Western Sahara
YE	Yemen (Republic of)
YU	Yugoslavia (Socialist Federal Republic of)
ZR	Zaire (Republic of)
ZM	Zambia (Republic of)
ZW	Zimbabwe (Republic of)



Non Aligned Movement

Center for South-South Technical Cooperation

Database on Cases

DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

Database on Cases

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Chapter

The Need for Database on Expert

Background

The Non Alignment Movement Center for South-South Technical Cooperation (NAM CSSTC) was developed to assist developing countries in technical cooperation for accelerating the development of those countries. It was officially initiated in Belgrade, Yugoslavia in 1961 as an obvious act to institutionalize the Dasa Sila Bandung or the Ten Principal of Bandung, in order that the position of the developing countries will be put forward with the result that their struggle direction is clearer.

Dasa Sila Bandung is an important principal document issued by the Five Countries preceded in Asia-Africa Conference. It is a substantively emphasize the important roles of Human Rights, State Sovereignty, Non-Aggression, Cooperative and Justice must be act as the base of International Cooperation.

The Non Alignment Movement is committed to wage war on poverty, illiteracy and underdevelopment. It is planned to advance broad-based and people centered development, including the quality improvement of the human resources. Based on that, the developing countries, which are member of NAM, can accelerate their development program based on equitable distribution, growth and stability. All programs of NAM CSSTC designed could have immediate as well as longer-term impacts to render the economics of developing countries of NAM member to be more broad-based, efficient and resilient to participate in the globalization process and strengthen cooperation among developing countries.

The mission of NAM CSSTC is to contribute and enhancement of development and collective self-reliance of the developing countries by strengthening and expanding South-South technical cooperation in the context of international development cooperation.

The objective of NAM CSSTC is enhancement of people centered development and capitalization of local resources through constructive interaction among development actors and partnership in development.

The Importance of ICT

Information - Communication Technology (ICT) is recognized by NAM members as an important technology will significantly enhance such development among member countries. The implementation of ICT worldwide has however resulted in a widening digital

divide not only between developed countries and developing countries, but also among NAM members.

ICT has become an indispensable tool in the fight against world poverty. It provides developing countries with an unprecedented opportunity to meet vital development goals such as poverty reduction, basic healthcare and education, which will become more effectively, including illiteracy reduction. Access to information networks will also allows countries using the networks to share information & experience from the others, action coordination, and improve their welfare.

This technology could accelerate development in far more than just the economic sphere. Indeed, connecting the world will transform it beyond recognition. It also could unlock the productivity of developing countries. Greater connectivity will also help fulfill the nearly insatiable human thirst for information and expose geographically isolated communities to wider information and new opportunities, which could create a more advance social and political outlook. Access to ICT networks can help people at all economic levels to meet their basic needs.

Finally, countries that succeed in harnessing the potential of ICT can look forward to greatly expanded economic growth, improved human welfare and stronger forms of democratic system.

In the information age, countries that do not provide access to information networks will not grow, no matter how rich their natural resources. ICT appears to be an essential component of development initiatives and can act as a powerful overall enable of development.

Advances in ICT have driven the last decade's economic boom and the integration of markets around the world. A lot of benefits from ICT and the rapid rise of the Internet have so far accrued to the developed world. Money spent on the digital infrastructure that supports these burgeoning new services that become a major engine of economic growth in some countries.

In the developing countries, ICT connectivity is growing, but the increased productivity and other benefits of the digital revolution are still pretty low. NAM CSSTC want to play the role to assist developing countries in taking advantage of ICT's potential and integrating ICT into the mainstream of their development activities.

Using ICT connectivity, developing countries can take benefits from on-line databases that are giving the important information, the latest discoveries, and also sharing experience with some experts.

The Need of Online Database

The global gap among developed & developing countries is quite real. Almost all of developed countries have no constraint in developing their own research for finding the newest technology & methodology, especially from the financial aspect. Majority of those technology are published through the on-line database developed by some institutional of developed countries.

The existence of database is very needed, especially for developing countries. It becomes an indispensable tool in the fight against world poverty. Majority of developing countries has

some constraints to develop their own research for improving their welfare - even solving their basic problems such as medical treatment & technology, educational method & material, agricultural system, biotechnology, energy exploration etc. With countries in the developing world stretching their budgets to the limit, and with education & research ranking low on some governments' list of spending priorities, the role of on-line database become very important.

The further enhance of the on-line database is a sharing experience and an optional consultancy with the experts. People can get additional information needed that is not available through the database with make a direct contact to the expert. It can be also used by the consultant, who can provide their service such as additional suggestion or analysis.

Access to on-line database can help people at all economic levels to meet their basic needs. Greater connectivity to the experts will help fulfill the nearly insatiable human thirst for the latest information, discovery & method needed for welfare improving. Wiring the planet with on-line database will transform the poverty into the prosperity. It will increase access to the educational materials, basic health information and other critical resources. For example, a single database in English, French, Spanish, Chinese or Hindi could serve a lot of continent and help so many people in the world. It could unlock the productivity level of developing countries, even the poor communities. It also could save human life in the rural areas while the experience manpower & equipped hospital is not available to handle some complicated cases and the patient has to race in time.

Majority of communities in developing countries is depending on agriculture. Agricultural development program will become the highest priority to increase the prosperity of their community. Latest information, new method & technology on agriculture will help them to improve the productivity.

The global economy in the world is relying more than ever on brain power and innovation rather than raw materials and labors' only, as a generator of good wealth. A good education has become the key factor determining who will succeed and who will be left behind. The developing countries should pay attention on education program to prepare educated & skilled human resources in facing the high competition of labor market. It could allow them to reduce the gap among developing countries and developed countries. In eliminating the financial constraint, the governments of developing countries could expand the educational opportunities to as many people as possible with keeping down costs through bench mark educational methods & materials of other developed countries. Some cases of successful educational program in on-line database could be used in improving educational system of developing countries.

Connectivity to the on-line database allow developing countries to save their budget & time for getting the latest method or knowledge to meet their basic needs & improve their prosperity. Using the published experiences in the on-line database, developing countries should not allocate special budget for developing their own expensive research.

Cost can be contained by making full use of existing database. The database web sites would also be self-financing when fully developed. To facilitate regular updating information, an automatic prompting system could be set up. Finally, a search mechanism could be developed that will ensure the compatibility and connectivity of the diverse databases.

Database Structure

The Data Model

A data model is a collection of conceptual tools for describing data, data relationships, data semantics, and data constraints. The model is needed to describe the structure of database on cases.

The overall logical structure of data relationships of database on cases is visualized below which consist of the following components:

Rectangles, which represents set record(s) of a table.

Symbol of :

which represents "one to many" relationship.

It means one key record in table A could have any associated records in table B. However, one record in B could only have one associated record in A. For example:

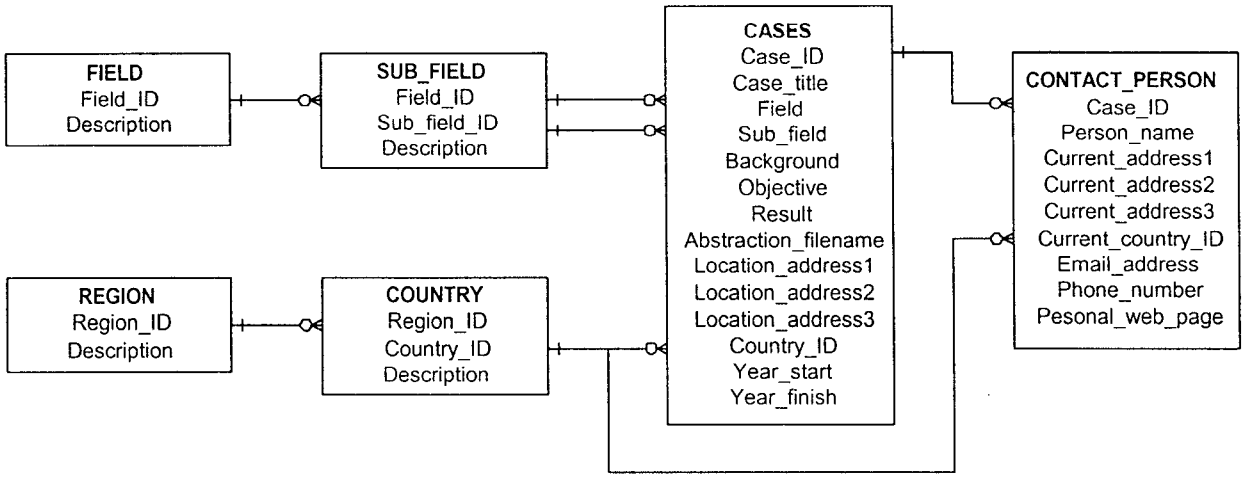
REGION

Region_ID	Description
AP	Asia Pacific
SA	South America

COUNTRY

Region_ID	Country_ID	Description
AP	PH	Philippines
AP	ID	Indonesia
AP	MY	Malaysia
SA	BR	Brazil
SA	GT	Guatemala

The following layout shows how the model is constructed.



The data model of database on cases pivots around the CASES. This is the table where the most common data of cases stored.

Tables and Indexes

Tables

CASES

CASES is the main table which stores common detail information of cases. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Case_ID	**alphanumeric(4)**	**Primary key**
Case_title	alphanumeric(40)	
Field	alphanumeric(2)	
Sub_field	alphanumeric(4)	
Background	alphanumeric(200)	
Objective	alphanumeric(200)	
Result	alphanumeric(200)	
Abstraction_filename	alphanumeric(20)	
Location_address1	alphanumeric(40)	
Location_address2	alphanumeric(40)	
Location_address3	alphanumeric(40)	
Country_ID	**alphanumeric(2)**	**Foreign key**
Year_start	alphanumeric(4)	
Year_finish	alphanumeric(4)	

CONTACT_PERSON

This is the sub-table of CASES which stores contact person(s) of the particular case(s). The complete format of CONTACT_PERSON is as follows:

Field_Name	Data_type	Remarks
Case_ID	**alphanumeric(4)**	**Foreign key**
Person_name	alphanumeric(40)	
Current_address1	alphanumeric(40)	
Current_address2	alphanumeric(40)	
Current_address3	alphanumeric(40)	
Current_country_ID	**alphanumeric(2)**	**Foreign key**
Email_address	alphanumeric(40)	
Phone_number	alphanumeric(15)	
Pesonal_web_page	alphanumeric(40)	

FIELD

This is the look-up table that stores field ID and its description. The format of the table is as follows:

Field_Name	Data_type	Remarks
Field_ID	**Alphanumeric(2)**	**Primary key**
Description	Alphanumeric(40)	

SUB_FIELD

This is the look-up table which stores sub field ID and its descriptions. The format of the table is as follows:

Field_Name	Data_type	Remarks
Field_ID	**alphanumeric(2)**	**Foreign key**
Sub_field_ID	**alphanumeric(4)**	**Primary key**
Description	alphanumeric(40)	

COUNTRY

This is the look-up table which stores country ID and name. The country ID will be based on ISO-3166 which consists of only 2 character. Please refer to appendix A to see the complete list of ISO-3166 country ID.

The format of country table is as follows:

Field_Name	Data_type	Remarks
Region_ID	**Alphanumeric(4)**	**Foreign key**
Country_ID	**alphanumeric(2)**	**Primary key**
Description	alphanumeric(30)	

REGION

This is the look-up table which stores regions. The format of the table is as follows:

Field_Name	Data_type	Remarks
Region_ID	**alphanumeric(4)**	**Primary key**
Description	alphanumeric(40)	

Indexes

Index is required to increase the performance of searching. Usually index is put on all key fields. The list of index used for database on cases is as follows.

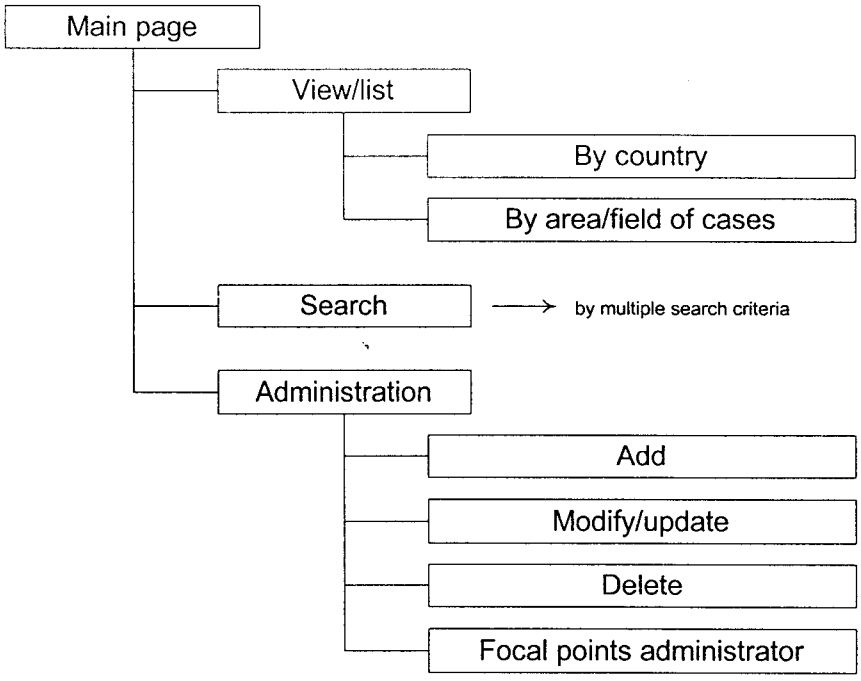
Field Name	Table Name	Index Name
Case_ID	Cases	Idx.Cases.Case_ID
Country_ID	Cases	Idx.Cases.Case_ID
Case_ID	Contact_Person	Idx.Cases.Case_ID
Current_country_ID	Contact_Person	Idx.Cases.Case_ID
Field_ID	Field	Idx.Cases.Case_ID
Field_ID	Sub_Field	Idx.Cases.Case_ID
Sub_field_ID	Sub_Field	Idx.Cases.Case_ID
Region_ID	Country	Idx.Cases.Case_ID
Country_ID	Country	Idx.Cases.Case_ID
Region_ID	Region	Idx.Cases.Case_ID

Chapter 3

System Architecture

Web page structure

The database on cases will be presented through web-based interface. The menu tree of the web presentation is as follows:



Main page

welcome page and messages whenever the web page of cases opened

shows three submenus: view/list, search, and administration

View/list menu

menu to view or list the content of database on cases

shows two submenus: view by country and view by field of cases

Search menu

menu to search cases data based on multiple search criteria

shows fields of search criteria. At least one criteria must be filled in to start searching. The list of search criteria is as follows:

- Case ID
- Case Name
- Field/Sub field of cases
- Region/Country
- Objective of the cases
- Contact person

Administration

menu to administer the content of the database. "Administer" here refers to add, modify/update, and delete data.

only authorized users have the grant to administer.

to prevent disturbance from illegal administrator, a login form is shown whenever the module is run.

rule to administer the data:

- only focal points administrator can add, modify, and delete data of cases
- only NAM Centre administrator can maintain data of focal points administrators
- every change of the data has to be logged

Web System Architecture

The database on expert will be stored in NAM-CSSTC web server. Tools required in the server to enable people connected to the Internet all over the world to browse the information are web server software and DBMS applications. The complete diagram on how the tools are linkaged each other is as follows.

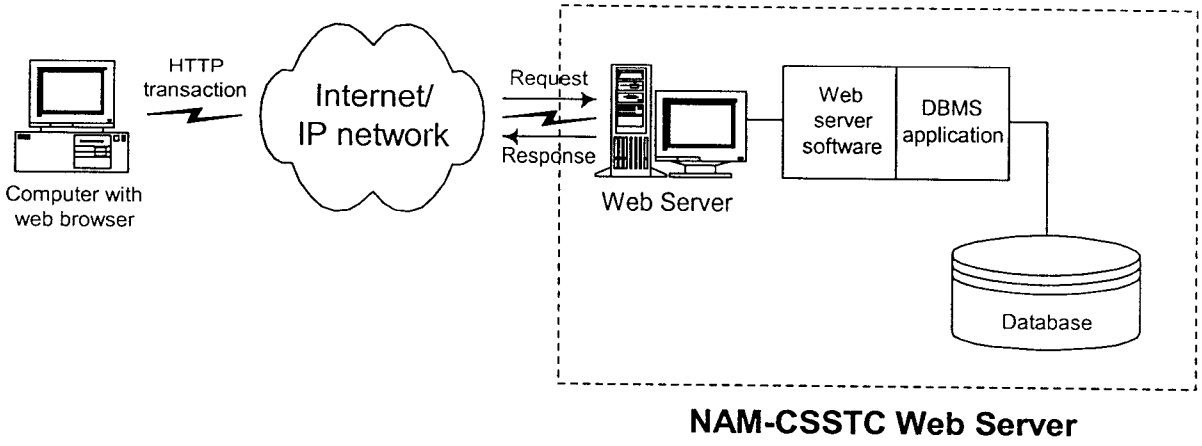
Web server software

As mentioned in the previous chapter, a web server software is required to handle requests from browsers. It receives requests from the network, interprets, send a system call internally to process the request, receive the result of the system call, and then send the response to the request sender. The system call can run a DBMS application if the request

wants to query a particular database to search information in it. Two of the most popular commercial web browsers in the market are Internet Information Server (IIS) and Personal Web Server (PWS).

DBMS Application

DBMS application is the tool to query a database to search particular information or data in the database. Usually a DBMS application is written under a tool which packaged together with its native database. However, nowadays there are a lot of commercial DBMS development tools which comes independently.

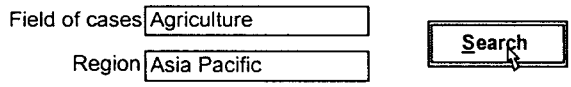


Future Improvement and Enhancement

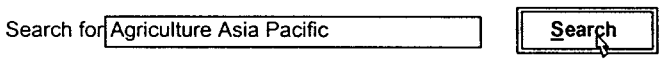
Search Engine

Searching capability can be enhanced by using meta language search. By using this, user will only type word(s) he wants to find, then the search engine will try to find out where the associated word(s) can be found from. There is no need to show which field(s) the user will search from.

For example, if a user wants to find case(s) in the field of agriculture and the occurred in Asia Pacific region, he has to fill in two fields: field of cases and region.



In meta language search, the user will only fill in one blank space, and then the search engine will work the rest:



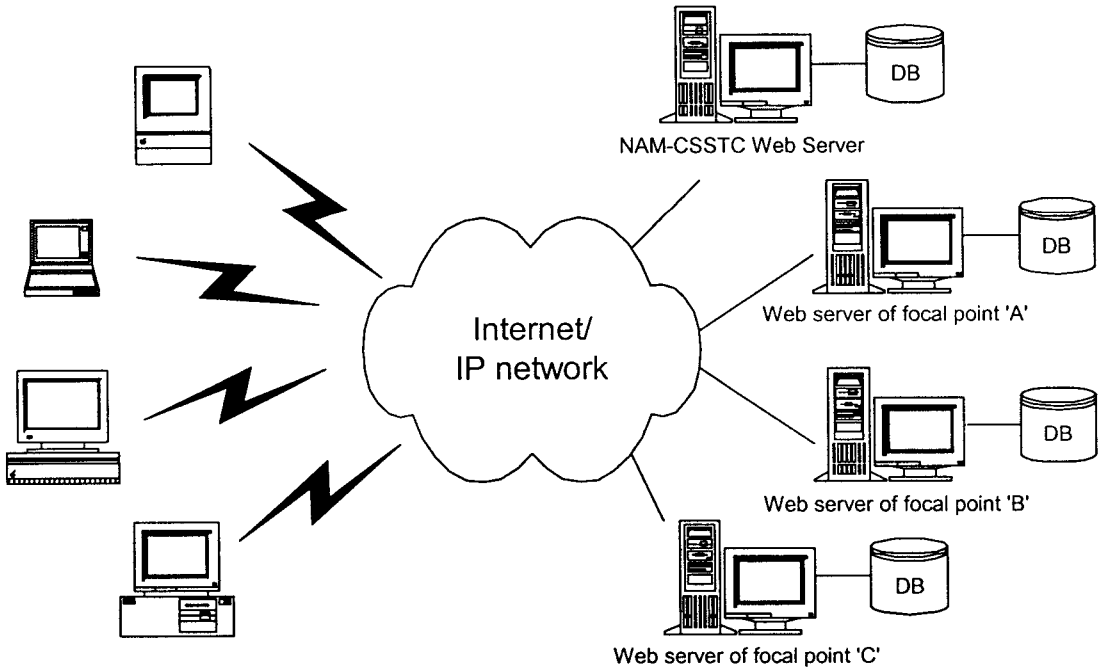
Infrastructure

At the initial stage, database on experts will be placed centrally in NAM-CSSTC web server. This should be adequate to handle small number of access (in Internet term, it is called 'hit'). In the future, when the number of hits grow rapidly, the database on expert should be distributed on every focal point in order to:

- Reduce the workload of NAM-CSSTC web server
- Keep up the database availability whenever NAM-CSSTC web server be shut down for whatever purpose. While NAM-CSSTC web server shut down, the other focal point web server can take over the work.
- Increase the browsing performance. In single centralized database server configuration, every request to query the information from all over the world will always be routed to

NAM-CSSTC web server. In distributed database configuration, every request to query need to be routed only to its nearest focal point in its region. Only if the nearest focal point web server is down then the request has to be routed to the other available focal points.

However, the distributed database configuration needs more attention and effort to maintain. Data integrity and consistency have to be managed carefully, therefore there is no duplicated and corrupted data anywhere.



Distributed database

Website

It is important to note that the website is developed upon the concept of gradually building web pages as new content becomes available. Information may be provided as soon as it is known, then updated or changed as time moves on and plans become firm. Anticipating the changes that will come can make this aspect of Web site maintenance a bit easier.

In order to improve the web's content integrity, availability, and ease of navigation, several improvements and advanced technique should be addressed in the near future.

Highlighting new or updated information

Many sites have adopted a means of drawing attention to information, which is *new* or recently *changed*. However, we should be certain to review pages looking for such notations on a regular basis. To make it even easier to locate those that are obsolete, consider adding a comment tag to indicate when the notation was posted or when it should be taken down.

Formatted Web pages for e-mail or print

Although most browsers provide a means for saving or printing the displayed Web page as a formatted text file, it will be helpful to provide such a dedicated, convenient facility. A quick way to do this (rather than wait for a full-function browser to start up) is to use the -dump switch in Lynx and redirect the output to a file. The result is a flat text rendering of the page, which can be included in or attached to your e-mail message and read by the recipient.

Forms and feedback

In the near future, we will provide simple forms to permit readers to send questions and comments to the webmaster in case they had problems reading a particular page. This was soon followed by more advanced forms, such as: the on-line membership form, our "Thank You" form, and a few others. As more involved questions began being submitted, several advanced technique can be introduced. The pull-down menu fields on this form made it easier to identify who could best resolve the question and be certain it could be routed to them more quickly. More recently, a special form was added to allow membership records to be updated easily, without the need to submit a complete new membership form.

All of these forms resulted in a simple e-mail message to the appropriate staff or volunteers. These people would then deal with the e-mail as needed. It is simple, but effective.

Saving data and generating pages

A Web interface can be created to allow webmasters to create a summary of all information or materials submitted to the webpage. This summary listed such items as needed, depend on requirements. Webmaster can select, track, view, edit, and make necessary changes. The summary could then be viewed by stakeholder on-line immediately.

Further extensions to this interface allowed automatic creation and saving of the detailed information and track breakout that has been available on-line. Thus, any of the stakeholder could create a response or reply and post it for readers as it changed -- without the webmaster being a bottle-neck in the process as had happened in past years.

Image maps

Image map can be a very effective way to help readers navigate to the information they need. Most pages on the website contain two image maps:

- the header logo may be used to return to the welcome page, move to the related site, get some general information about the author, or view the site's Table of Contents.

- the footer graphic allows readers to move directly to any of the major portions of the site quickly.

Both were created to provide maximum information using minimum bandwidth. As was recommended above, both client-side and server-side implementations are provided so that the majority of readers can use the maps.

Pages for internal or limited use only

If we have information targeted at a particular group of readers that we would prefer not be seen by others on the same side of the firewall, we can authorize the readers by using the user ID and password feature of the Web.

Special sub-directories are set up with unique access passwords on each. The IDs and passwords are shared with the appropriate committee members so they may access the pages required. A single ID can be a member of multiple groups, so that they only need to remember one access mechanism to get to all the pages they need. More simple way, we can create a single generic ID to pass to all members of the same group or committee if you prefer.

Off-line browsing

Provide off-line browsing, which means readers can view the entire site on their own computer much faster than if they were on-line. And, readers save money on dial-up costs

Provide an index page for each directory

This may be obvious, but it is very important to provide a default page in each subdirectory which is displayed when just the directory name is passed from the browser to the server. This allows visitors to simply erase the file name from their URL and "back up" to what they expect to be our index or pointer into the subject matter.

Use of a default index page also prevents visitors from viewing site's directory listing and selecting a page which may be under construction and not yet ready for public viewing.

Provide a directory for each topic

Proper segmentation into directories of related information makes it easier to locate similar information and it provides a simpler mechanism for granting access to related files either for content editors (via file permissions) or for site visitors (via server authorization files, passwords, etc.) In addition, it facilitates analysis of site metrics if we are using a program which can "roll-up" the counts for all pages beneath each directory.

It is best to keep each directory addressing a single topic. Try not to mix multiple topics together, even if they are relatively small. As soon as they begin to grow (and they usually do), it is likely you will want to have separate directories. However, by then the various page URLs will be know by search engines and be referenced by other sites' pages and contained in visitors' bookmarks. Remember to provide adequate cross-reference links both to other pages within the same topic and to other topics, which may be related.

A directory for Images

While it is possible to intersperse images with the text files, separating them into their own commonly named directories provides a number of benefits. The separate directories "unclutter" our text directories, making maintenance easier. Tools, which manipulate text, check links, and analyze logs can be configured or written to avoid descending into or considering known image directories, saving time and simplifying reporting.

Slash or relative links (vs domain-specific)

If we are mirroring your site, in general we should be careful to use links which do not contain the site's domain name. This keeps all cross-references working on the mirror site

at which the visitor first began reading your pages. If we use a domain-specific link, they will be shuttled to that particular domain (or physical machine) and remain there for all future site-relative links. This may mean that someone trying to use our European mirror suddenly will be making multiple trans-Atlantic accesses to a US based site and suffering the related latency or expense involved with such links.

Places non-domain-specific links hurt

Despite what we just covered above, there *are* times when domain-specific links are not only desired, but required. For example, if we have a CGI application which submits or alters data or pages, such manipulation needs to take place on the "master" site. Otherwise, only that particular mirror will contain the change, and only for a short time at that. Subsequent mirror operations will cover up the change with the original content, causing it to be lost.

Un-mirrored subdirectories

There are some directories and types of data probably we *do not* want to mirror. While we may want to store the analyzed reports of site acccess on all mirrors, it is unlikely we want to mirror the actual raw log files. Private files, certain password protected files, and user-specific files are other categories we should consider when designing mirror.

Each server will normally have its own configuration files. When functional configuration changes are made (e.g. access restriction and page redirection) these changes will need to be made in each mirror's configuration files. This can be facilitated by mirroring the master configuration files, but saving them in a side directory on the mirror, not into the location actually used by the mirror for its own configuration. Then, the changes can be discovered and implemented by hand, or automated in full or in part by a `cron` job.

Permissions

Since the mirror process may not run as the same user or group as the Web server or the site maintainers, particular attention must be paid to file and directory permissions. It is all too easy for a maintainer to make a local copy of a file but leave it with permissions preventing the mirror process from reading it (even if the Web server can). This then results in extraneous error log entries which must be reconciled. Worse yet, the page may later be determined to be something of value and commissioned for public viewing on the master site, but be unavailable on the mirror. (The error was logged, but it became one of those "expected" errors and was ignored when the page "went public".)

Compatible versions of installed programs

Finally, once all required information may be found on each of the mirrors, it is equally important that compatible revisions of system and application software be available. For example, it may not be important whether `perl` 5.003 or 5.004 is available, but it probably must be a version of 5.x.

If we have control of each of the mirrors, it should be a simple matter to upgrade certain programs to be of a compatible version. However, if we are sharing a mirror machine, that may not be possible. In certain circumstances, it may be necessary to modify our web site so that it may be accommodated on all mirrors.

The ISO-3166 Country Code

Code	Country name
AF	Afghanistan (Islamic Republic of)
AL	Albania (Republic of)
DZ	Algeria (People's Democratic Republic of)
AS	American Samoa
AD	Andorra (Principality of)
AO	Angola (People's Republic of)
AI	Anguilla
AQ	Antarctica
AG	Antigua and Barbuda
AR	Argentina (Argentine Republic)
AM	Armenia
AW	Aruba
AU	Australia
A T	Austria (Republic of)
AZ	Azerbaijan
BS	Bahamas (Commonwealth of the)
BH	Bahrain (State of)
BD	Bangladesh (people's Republic of)
BB	Barbados
BY	Belarus
BE	Belgium (Kingdom of)
BZ	Belize
BJ	Benin (people's Republic of)
BM	Bermuda
BT	Bhutan (Kingdom of)
BO	Bolivia (Republic of)
BA	Bosnia-Herzegovina
BW	Botswana (Republic of)
BV	Bouvet Island
BR	Brazil (Federative Republic of)
IO	British Indian Ocean Territory
BN	Brunei Darussalam
BG	Bulgaria (Republic of)
BF	Burkina Faso (Fonnerly Upper Volta)
BI	Burundi (Republic of)

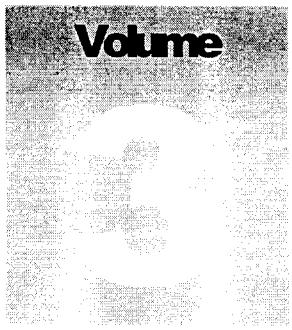
KH	Cambodia
CM	Cameroon (Republic of)
CA	Canada
CV	Cape Verde (Republic of)
KY	Cayman Islands
CF	Central African Republic
TD	Chad (Republic of)
CL	Chile (Republic of)
CN	China (People's Republic of)
CX	Christmas Island (Indian Ocean)
CC	Cocos (Keeling) Islands
CO	Colombia (Republic of)
KM	Comoros (Islamic Federal Republic of the)
CG	Congo (Republic of the)
CK	Cook Islands
CR	Costa Rica (Republic of)
CI	Cote d'Ivoire (Republic of)
HR	Croatia
CU	Cuba (Republic of)
CY	Cyprus (Republic of)
CZ	Czech Republic
DK	Denmark (Kingdom of)
DJ	Djibouti (Republic of)
DM	Dominica (Commonwealth of)
DO	Dominican Republic
EC	Ecuador (Republic of)
EG	Egypt (Arab Republic of)
SV	El Salvador (Republic of)
GQ	Equatorial Guinea (Republic of)
ER	Eritrea
EE	Estonia (Republic of)
ET	Ethiopia (People's Democratic Republic of)
FK	Falkland Islands (Malvinas) .
FO	Faroe Islands
FJ	Fiji (Republic of)
FI	Finland (Republic of)
FR	France (French Republic)
GF	French Guiana
PF	French Polynesia
TF	French Southern Territories
GA	Gabon (Gabonese Republic)
GM	Gambia (Republic of the)
GE	Georgia (Republic of)
DE	Germany (Federal Republic of)
GH	Ghana (Republic of)
GI	Gibraltar
GR	Greece (Hellenic Republic)
GL	Greenland
GD	Grenada

GP	Guadeloupe (French Department of)
GU	Guam
GT	Guatemala (Republic of)
GN	Guinea (Republic of)
GW	Guinea-Bissau (Republic of)
GY	Guyana (Republic of)
HT	Haiti (Republic of)
HM	Heard and McDonald Islands
HN	Honduras (Republic of)
HK	Hong Kong
HU	Hungary (Republic of)
IS	Iceland (Republic of)
IN	India (Republic of)
ID	Indonesia (Republic of)
IR	Iran (Islamic Republic of)
IQ	Iraq (Republic of)
IE	Ireland
IL	Israel (State of)
IT	Italy (Italian Republic)
JM	Jamaica
JP	Japan
JO	Jordan (Hashemite Kingdom of)
KZ	Kazakhstan
KE	Kenya (Republic of)
KI	Kiribati (Republic of)
KP	Korea (Democratic People's Republic of)
KR	Korea (Republic of)
KW	Kuwait (State of)
KG	Kyrgyz Republic
LA	Lao People's Democratic Republic
LV	Latvia (Republic of)
LB	Lebanon (Lebanese Republic)
LS	Lesotho (Kingdom of)
LR	Liberia (Republic of)
LY	Libyan Arab Jamahiriya
LI	Liechtenstein (Principality of)
LT	Lithuania
LU	Luxembourg (Grand Duchy of)
MO	Macau (Ao-me'n)
MK	Macedonia (Former Yugoslav Republic of)
MG	Madagascar (Democratic Republic of)
MW	Malawi (Republic of)
MY	Malaysia
MV	Maldives (Republic of)
ML	Mali (Republic of)
MT	Malta (Republic of)
MH	Marshall Islands (Republic othe)
MQ	Martinique (French Department of)
MR	Mauritania (Islamic Republic of)

MU	Mauritius
YT	Mayotte
MX	Mexico (United Mexican States)
FM	Micronesia (Federated States of)
MD	Moldova (Republic of)
MC	Monaco (Principality of)
MN	Mongolia
MS	Montserrat
MA	Morocco (Kingdom of)
MZ	Mozambique (People's Republic of)
MM	Myanmar (Union of)
NA	Namibia (Republic of)
NR	Nauru (Republic of)
NP	Nepal (Kingdom of)
NL	Netherlands (Kingdom othe)
AN	Netherlands Antilles
NT	Neutral Zone (between Saudi Arabia and Iraq)
NC	New Caledonia
NZ	New Zealand
NI	Nicaragua (Republic of)
NE	Niger (Republic of the)
NO	Nigeria (Federal Republic of)
NU	Niue
NF	Norfolk Island
MP	Northern Mariana Islands (Commonwealth of the)
NO	Norway (Kingdom of)
OM	Oman (Sultanate of)
PK	Pakistan (Islamic Republic of)
PW	Palau (Republic of)
PA	Panama (Republic of)
PO	Papua New Guinea
PY	Paraguay (Republic of)
PE	Peru (Republic of)
PH	Philippines (Republic of the)
PN	Pitcaim
PL	Poland (Republic of)
PT	Portugal (portuguese Republic)
PR	Puerto Rico
QA	Qatar (State of)
RE	Re'union (French Deparbnent of)
RO	Romania
RU	Russian Federation
RW	Rwanda (Rwandese Republic)
SH	Saint Helena
KN	Saint Kitts and Nevis
LC	Saint Lucia
PM	Saint Pierre and Miquelon (French Department of)
VC	Saint Vincent and the Grenadines i
WS	Samoa (Independent State of)

SM	San Marino (Republic of)
ST	Sao Tome and Principe (Democratic Republic of)
SA	Saudi Arabia (Kingdom of)
SN	Senegal (Republic of)
SC	Seychelles (Republic of)
SL	Sierra Leone (Republic of)
SG	Singapore (Republic of)
SK	Slovakia
SI	Slovenia
SB	Solomon Islands
SO	Somalia (Somali Democratic Republic)
ZA	South Africa (Republic of)
ES	Spain (Kingdom of)
LK	Sri Lanka (Democratic Socialist Republic of)
SD	Sudan (Democratic Republic of the)
SR	Suriname (Republic of)
SJ	Svalbard and Jan Mayen Islands
SZ	Swaziland (Kingdom of)
SE	Sweden (Kingdom of)
CH	Switzerland (Swiss Confederation)
SY	Syria (Syrian Arab Republic)
TW	Taiwan, Province of China
TJ	Tajikistan
TZ	Tanzania (United Republic of)
TH	Thailand (Kingdom of)
TG	Togo (Togolese Republic)
TK	Tokelau i
TO	Tonga (Kingdom of)
TT	Trinidad and Tobago (Republic of)
TN	Tunisia
TR	Turkey (Republic of)
TM	Turkmenistan
TC	Turks and Caicos Islands
TV	Tuvalu
UG	Uganda (Republic of)
UA	Ukraine
AE	United Arab Emirates
GB	United Kingdom (United Kingdom of Great Britain and Northern Ireland)
US	United States (United States of America)
UM	United States Minor Outlying Islands
UY	Uruguay (Eastern Republic of)
UZ	Uzbekistan
VU	Vanuatu (Republic of, formerly New Hebrides)
VA	Vatican City State (Holy See)
VE	Venezuela (Republic of)
VN	Vietnam (Socialist Republic of)
VG	Virgin Islands (British)
VI	Virgin Islands (U.S.)
WF	Wallis and Futuna Islands

EH	Western Sahara
YE	Yemen (Republic of)
YU	Yugoslavia (Socialist Federal Republic of)
ZR	Zaire (Republic of)
ZM	Zambia (Republic of)
ZW	Zimbabwe (Republic of)



Non Aligned Movement

Center for South-South Technical Cooperation

Database and The Internet

DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

Database and The Internet

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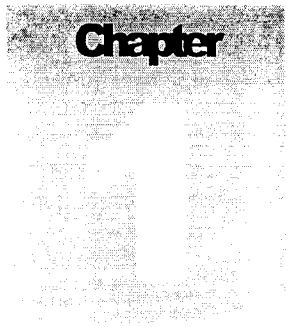


Introduction

A *database management system* (DBMS) consists of a collection of interrelated data and set of programs to access that data. The collection of data is usually referred to as the database. The database contains information about one particular enterprise.

The primary goal of a DBMS is to provide an environment that is both convenient and efficient to use in retrieving information from and storing information into the database.

Database system are designed to manage large bodies of information. The management of data involves both the definition of structures for the storage of information and the provision of mechanism for the manipulation of information. In addition, the database system must provide safety of information stored in the database, despite system crashes or attempts at unauthorized access. If data is to be shared among several users, the system must avoid possible anomalous results.

Purpose of Database System

Consider part of a savings bank enterprise that keeps information about all customers and savings accounts maintained at the bank. The savings account and customer records are kept in permanent system files. In addition to these files, the system has a number of application programs that allow one to manipulate the files, including:

- A program to debit or credit an account
- A program to add a new account
- A program to find the balance of an account
- A program to generate monthly statements

These application programs have been written by system programmers in response to the needs of the bank organization.

New application programs are added to the system as the need arises. As a result, new permanent files are created that contain information about all the checking accounts maintained in the bank, and new application programs may need to be written. Thus, as time goes by, more files and more application programs are added to the system. Since these files and programs have been created over a long period of time, presumably by different programmers, the files are likely to have different formats and the programs may be written in several programming languages.

The environment described above is a typical *file-processing system*, which is supported by a conventional operating system. Permanent records are stored in various files, and a number of different application programs are written to extract records from and add records to the appropriate files. This scheme has a number of major disadvantages:

- **Data redundancy and consistency.** Since the files and application programs are created by different programmers over a long period of time, the same piece of information may be duplicated in several places (files). This leads to higher storage and access cost as well as potential data inconsistency. By data inconsistency means that the various copies of the same data no longer agree.

- **Difficulty in accessing data.** Suppose that one of the officers in the bank needs to find out the names of all the customers who live in the area of the city with zip code 78733. The officers calls the data processing department and asks them to generate such a list. As this is an unusual request that was not anticipated when the original system was designed, there is no application program on hand to generate such a list. There is, however, an application program to generate the list of *all* customers. The bank officer has two choices now: either he can get the list of customers and ask one of his secretaries to extract manually the needed information, or he can ask the data-processing department to have one of the system programmers write such a program. Both alternatives are obviously unsatisfactory.

  What pointed out us is that this environment does not allow one to retrieve needed data in a convenient and efficient manner. Better data retrieval systems must be developed for general use.

- **Data isolation.** Since data is scattered in various files, and files may be in different formats, it is difficult to write new application programs to retrieve the appropriate data.

- **Multiple users.** In order to improve the overall performance of the system and obtain a faster response time, many systems allows multiple users to update the data simultaneously. In such an environment, interaction of concurrent updates may result in inconsistent data. In order to prevent any inconsistency, some form of supervision must be maintained in the system. Since data may be accessed by many different application programs which have not been previously coordinated, such a supervisor is very difficult to obtain.

- **Security problems.** Not every user of the database system should be able to access all data. Since applications programs are added to the system in an ad hoc manner, it is difficult to enforce such security constraint.

- **Integrity problems.** The data values stored in the database must satisfy certain types of *consistency constraints*. For example, the balance of a bank account may never fall below a prespecified amount (for example, $25). These constraints must be enforced in the system. This enforcement can be carried out by adding appropriate code in the various application programs. However, when new constraints are added, it is difficult to change the programs to enforce them. This is compounded in the case where constraints involve several data items from different files.

These difficulties, among others, have prompted the development of database management systems.

Data Abstraction

A database management system is a collection of interrelated files and a set of programs that allow several users to access and modify these files. A major purpose of a database system is to provide users with an *abstract* view of the data. That is, the system hides certain details of how the data is stored and maintained. However, in order for the system to be usable, data must be retrieved efficiently.

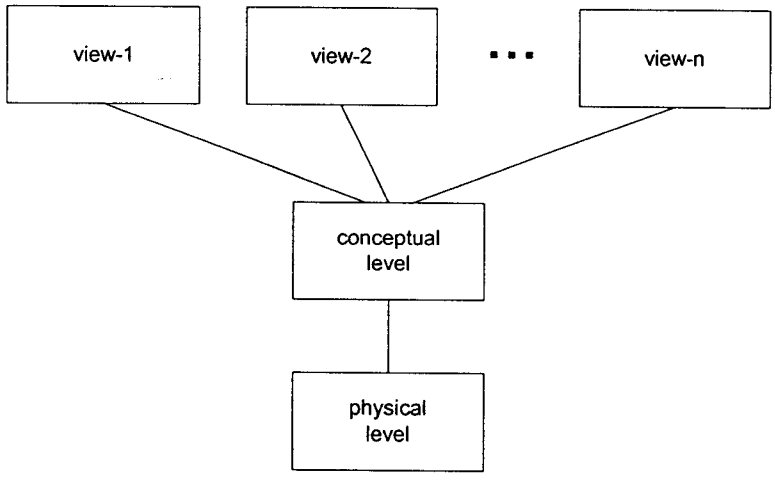
The concern for efficiency leads to the design of complex data structures for the representation of data in the database. However, since database system are often used by non-computer-trained personnel, this complexity must be hidden from database system users. This is accomplished by defining several levels of abstraction at which the database may be viewed.

- **Physical level.** This is the lowest level of abstraction, at which one describes *how* the data are actually stored. At this level, complex, low-level data structures are described in detail.

- **Conceptual level.** This is the next higher level of abstraction at which one describes *what* data are actually stored in the database, and the relationships that exist among data. This level describes the entire database in terms of a small number of relatively simple structures. Although the implementation of the simple structures of the conceptual level may involve complex physical-level structures, the user of the conceptual level need not be aware of this.

- **View level.** This is the highest level of abstraction at which one describes only part of the entire database. Despite the use of simpler structures at the conceptual level, there remains a form of complexity resulting from the large size of the database. Many users of the database system will not be concerned with all of this information. Instead, such users need only a part of the database. To simplify the interaction of such users with the system, the view level of abstraction is defined. There may be many views provided by the system for the same database.

The interrelationship among these three levels of abstraction is illustrated below.



Here is an analogy to illustrate the distinction among levels of abstraction. Most high-level programming languages support the notion of record type. For example, in a Pascal-like language, a record may be declared as follows:

```
type   customer = record
                    name : string;
                    address : string;
                    city : string;
                  end;
```

This defines a new record called customer with three fields. Each field has a name and a type associated with it. In a banking enterprise, the is a possibility to have several such record types, including among others:

- account, with fields *number* and *balance*.
- employee, with fields *name* and *salary*.

At physical level, a *customer*, *account*, or *employee* record can be described as a block of consecutive storage locations (for example, bytes or words). A the conceptual level, each such record is described by a type definition, illustrated above, and the interrelation among these record types is defined. Finally, at the view level, several views of the database are defined. For example, people needing to prepare the payroll checks can only see that part of the database that has information about the employees of the bank. The cannot access information about customer accounts. Similarly, tellers can access only account information. They cannot access information concerning salaries of employees.

Chapter

Data Models

A data model is a collection of conceptual tools for describing data, data relationships, data semantics, and data constraints. There are a number of different data models. These are partitioned into three different groups: object-based logical models, record-based logical models, and physical data models.

Object-Based Logical Models

Object-based logical models are used in describing data at the conceptual and view levels. They are characterized by the fact that they provide fairly flexible structuring capabilities and allow one to specify data constraints explicitly. One of the widely known object-based logical models is the *entity-relationship* model.

The entity-relationship (E-R) data model is based on a perception of a real world which consists of a collection of basic objects called *entities*, and *relationships* among these objects. An entity is an object that exists and is distinguishable from other objects. The distinction is accomplished by associating with each entity a set of attributes which describes the objects. For example, the attributes *number* and *balance* describe one particular account in a bank. A *relationship* is an association among several entities. For example, a *CustAcct* relationship associates a customer with each account that the customer has. The set of all entities of the same type and relationships of the same type are termed an *entity set* and *relationship set*, respectively.

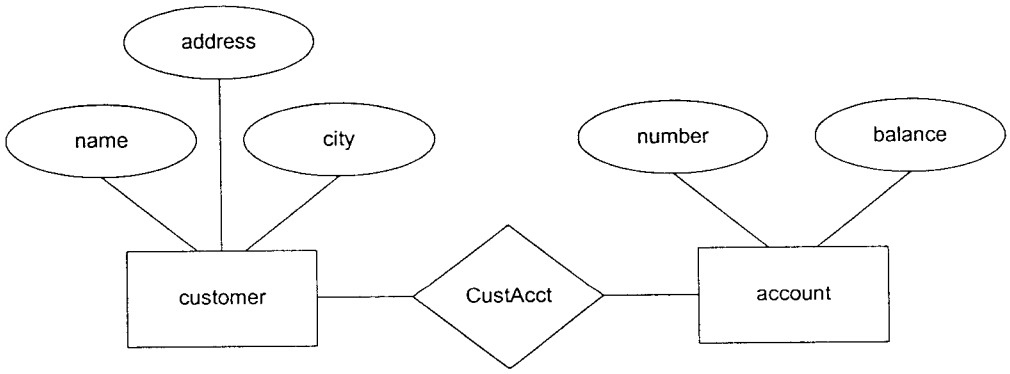
In addition to entities and relationships, the E-R model represents certain constraints to which the contents of a database must conform. One such important constraint is *mapping cardinalities* which express the number of entities to which another entity can be associated via a relationship set.

The overall logical structure of a database can be expressed graphically by an *E-R diagram* which consists of the following components:

- **rectangles**, which represents entity sets
- **ellipses**, which represents attributes
- **diamonds**, which represents relationships among entity sets
- **lines**, which link attributes to entity sets and entity sets to relationships

Each components is labeled with its corresponding name.

To illustrate, consider part of a database banking system consisting of customers and the accounts they have. The E-R diagram corresponding to this scheme is shown below. The E-R model is covered in detail in chapter 3.



Record-Based Logical Models

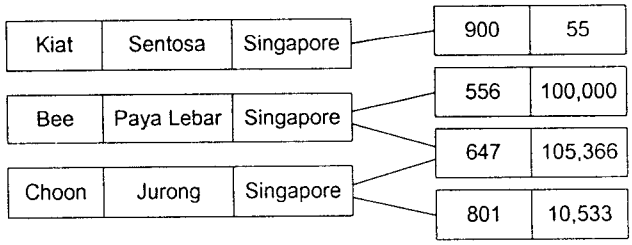
Record-based logical models are used in describing data at the conceptual and view levels. In contrast to object-based data models, these models are used to specify both the overall logical structure of the database and a higher-level description of the implementation. They do not, however, provide facilities for specifying data constraints explicitly. The three most widely accepted data models are:

- **Relational model.** The data and the relationships among data are represented by a collection of tables each of which has a number of columns with unique names. To illustrate this, consider a database consisting of customers and the accounts they have. A sample of relational model is shown below. It shows, for example, that customer Choon lives in Jurong, Singapore, that he has two accounts, one numbered 647 with a balance of $105,366 and the other 801 with a balance of $10,533. Note that customers Bee and Choon share account number 647 (they may share a business venture).

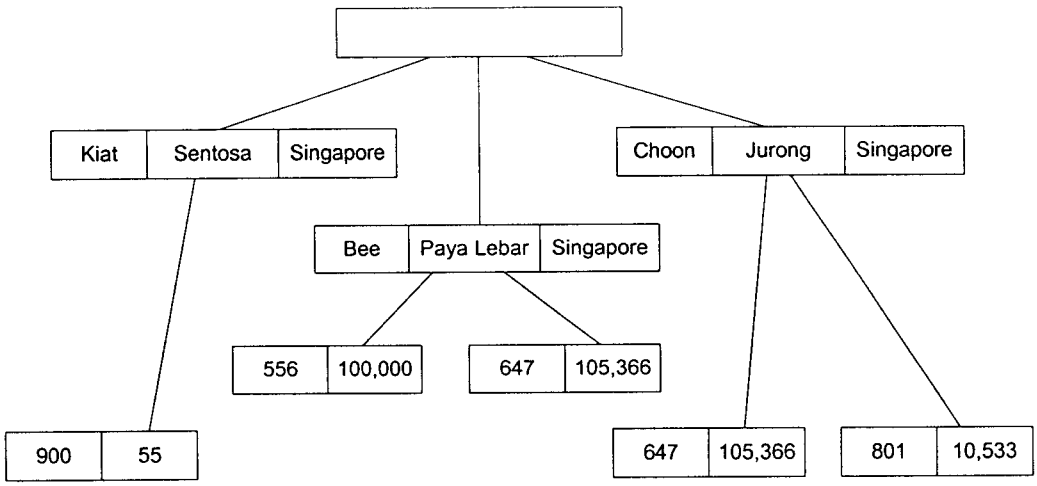
name	*address*	*city*	*number*
Kiat	Sentosa	Singapore	900
Bee	Paya Lebar	Singapore	556
Bee	Paya Lebar	Singapore	647
Choong	Jurong	Singapore	801
Choong	Jurong	Singapore	647

number	*balance*
900	55
556	100,000
647	105,366
801	10,533

- **Network model**. Data in network model are represented by collections of *records*, and relationships among data are represented by *links*, which can be viewed as pointers. The records in the database are organized as collections of arbitrary graphs. A sample of network model that has the same information as in figure relational model above is as shown below.



- **Hierarchical Model**. The hierarchical model is similar to the network model in sense that data and relationships among data are represented by records and links respectively. The hierarchical model differs from the network model in that the records are organized as collection of trees rather than arbitrary graphs. A sample of hierarchical model that has the same information as in figure relational model above is as shown below.



Chapter

Entity-Relationship Model

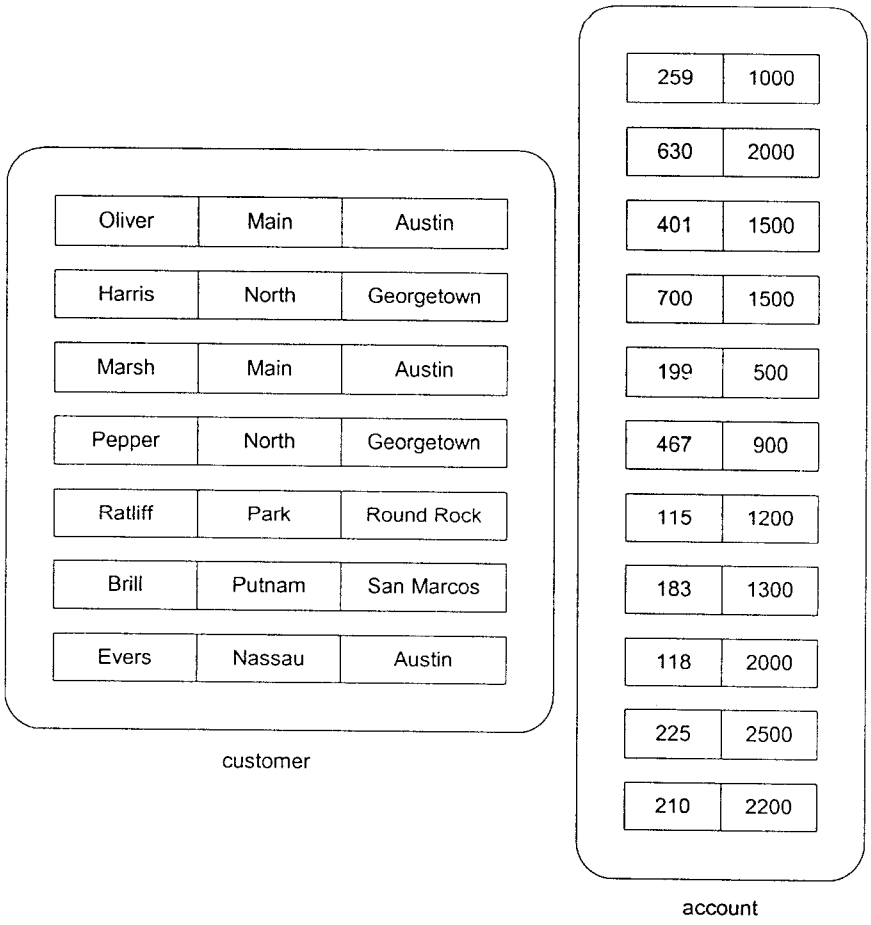
The entity-relationship (E-R) data model is based on a perception of a real world which consists of a set of basic objects called *entities* and *relationships* among these objects. In was developed in order to facilitate database design by allowing the specification of an *enterprise scheme*. Such a scheme represents the overall logical structure of the database.

Entities and Entity Sets

An *entity* is an object that exists and is distinguishable from other objects. An *entity set* is a set of entities of the same type. The set of all persons having an account at a bank, for example, can be defined as the entity set *customer*. Similarly, the entity set *account* might represent the set of all accounts in a particular bank.

Entity sets need not be disjoint. For example, it is possible to define the entity set of all employees of a bank (*employee*) and the entity set of all customers of the bank (*customer*). A *person* entity may be an *employee* entity, a *customer* entity, both, or neither.

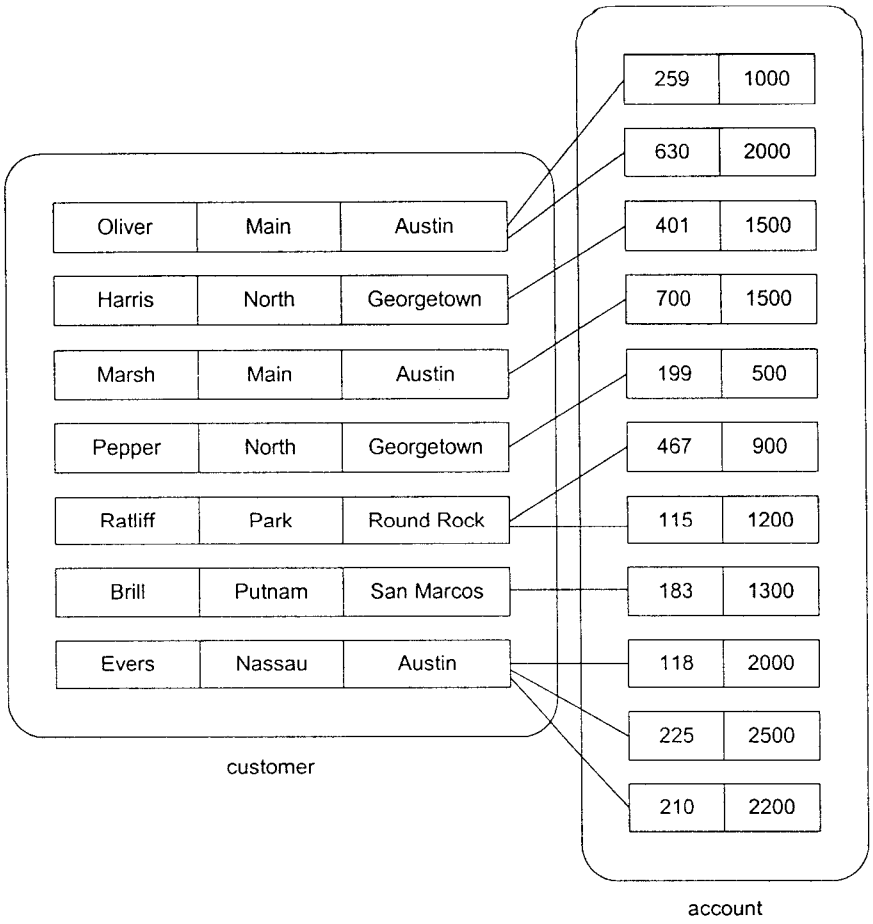
An entity is represented by a set of *attributes*. Possible attributes of the *customer* entity set are *name*, *address*, and *city*. Possible attributes of the *account* entity set are *number* and *balance*. For each attribute there is a set of permitted values, called the *domain* of that attribute. The domain of attribute *name* might be the set of all text strings of a certain length. Similarly, the domain of attribute *number* might be the set of all positive integers.



Relationships and Relationship Sets

A *relationship* is an association among several entities. For example, relationship of a customer named 'Choong' with account 401. This specifies that Choong is a customer with bank account number 401.

To illustrate this, consider the two entity sets *customer* and *account* of the figure below. A relationship set *CustAcct* is defined to denote the association between customer and bank account that they have.



The relationship *CustAcct* is an example of a binary relationship set, that is, one which involves two entity sets. Most of the relationship sets in a database system are binary. Occasionally, however, there are relationship sets with involve more than two entity sets.

The function that an entity plays in a relationship is called its *role*. Roles are normally implicit and are not usually specified. However, they are useful when the meaning of a relationship needs clarification. Such is the case when the entity sets of a relationship set are not distinct. For instance, the relationship *works-for* might be modeled by ordered pairs of *employee* entities. The first employee of a pair takes the role of manager, while the second takes the role of worker. In this way, all relationship of *works-for* are characterized by (manager, worker) pairs.

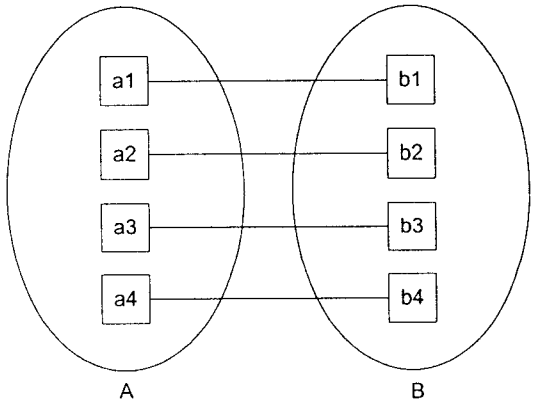
Mapping Constraints

An E-R enterprise scheme may define certain constraints to which the contents of a database must conform. One important constraints is *mapping cardinalities* which express the number of entities to which another entity can be associated via a relationship.

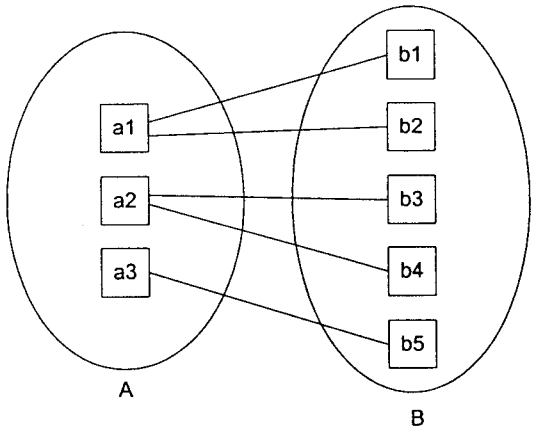
Mapping cardinalities are most useful in describing binary relationship sets, although occasionally they contribute to the description of relationship sets that involve more than

two entity sets. For a binary relationship set between entity sets *A* and *B*, the mapping cardinality must be one of the following:

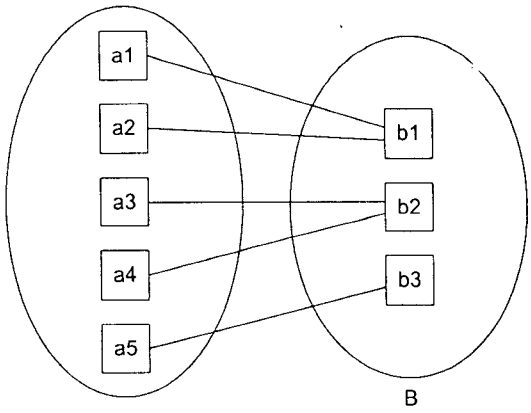
- **One-to-one.** An entity in A is associated with at most one entity in B, and an entity in B is associated with at most one entity in A. The figure of one-to-one relationship is visualized below.



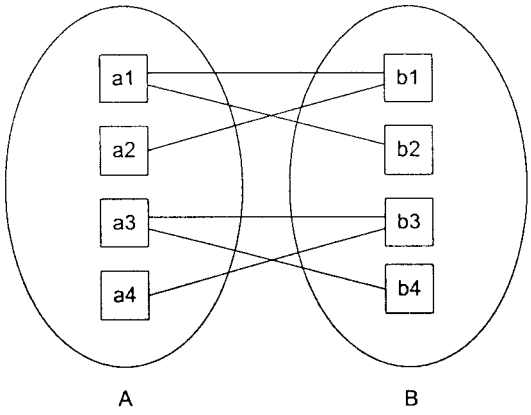
- **One-to-many.** An entity in A is associated with any number of entities in B, and an entity in B is associated with at most one entity in A. The figure of one-to-many relationship is visualized below.



- **Many-to-one.** An entity in A is associated with at most one entity in B. An entity in B, however, can be associated with any number of entities in A. The figure of many-to-one relationship is visualized below.



- **Many-to-many.** An entity in A is associated with any number of entities in B, and an entity in B is associated with any number of entities in A. The figure of many-to-many relationship is visualized below.



Primary Keys

An important task in database modeling is to specify how entities and relationships are distinguished. Conceptually, individual entities and relationships are distinct, but from a database perspective, the difference among them must be expressed in terms of their attributes. To make such distinctions, a *superkey* is assigned to each entity set. The superkey is a set of one or more attributes, which, taken collectively, allow us to identify uniquely an entity in the entity set. For example, the *Customer_ID* attribute of the entity set *customer* is sufficient to distinguish one *customer* entity from another. The term of primary key is used to denote a candidate key that is chosen by a database designer as the principal means of identifying entities within an entity set.

It is possible that an entity set does not have sufficient attributes to form a primary key. For example, consider the entity set *transaction* which has three attributes: *transaction_number*, *date*, and *amount*. Although each *transaction* entity is distinct, transaction on different accounts may share the same transaction number. Thus, this entity set does not have a primary key. Such an entity set is termed a *weak entity*. An entity which has a primary key is termed a *strong entity*.

Relationship sets also have primary keys. Their primary keys are formed by taking all the attributes that comprise the primary keys of the entity sets that define the relationship set. For example, *Customer_ID* is the primary key of *customer* and *Account_Number* is the primary key of *account*. Thus, the primary key of the relationship set *CustAcct* is (*Customer_ID*, *Account_Number*).

Entity-Relationship Diagram

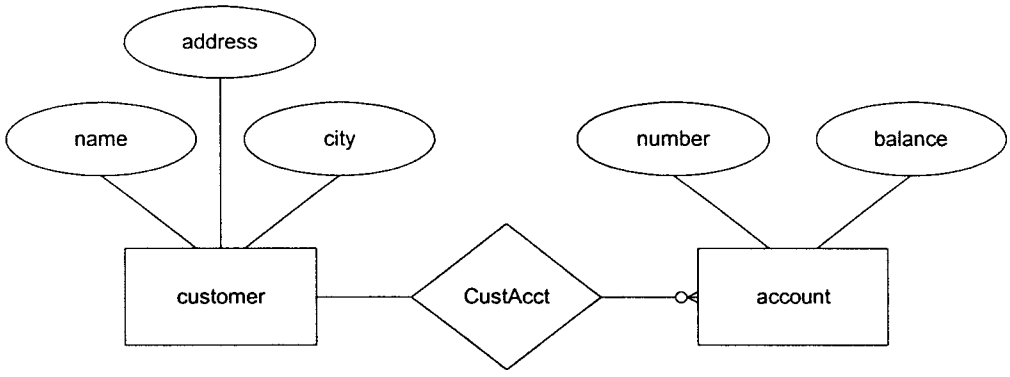
The overall logical structure of a database can be expressed graphically by an *E-R diagram* which consists of the following components:

- **Rectangles**, which represents entity sets.
- **Ellipses**, which represents attributes.
- **Diamonds**, which represents relationship sets.
- **Lines**, which link attributes to entity sets and entity sets to relationship sets.

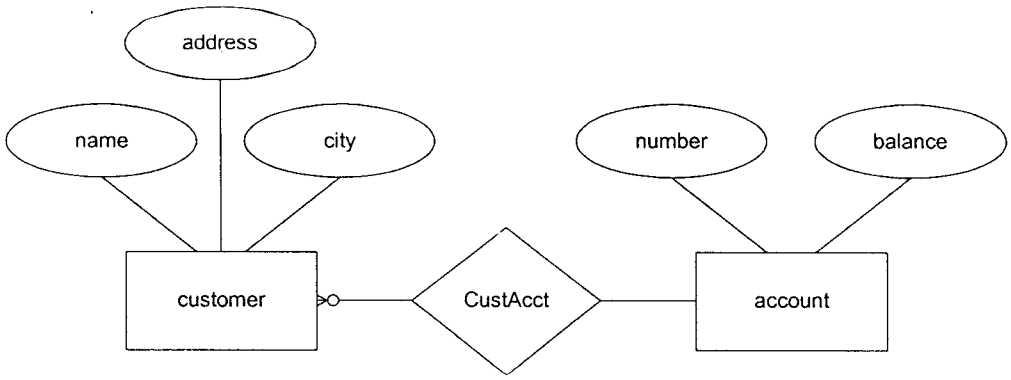
Each component is labeled with its corresponding name. A weak entity set is indicated in E-R diagrams by a doubly outlined box.

The relationship may be many-to-many, one-to-many, many-to-one, or one-to-one. To distinguish among these, a special end-up line is drawn on each 'many' relationship:

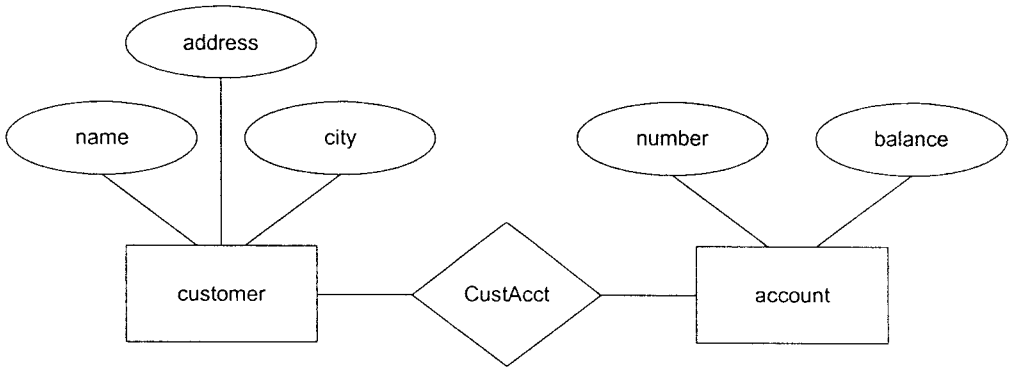
Illustration of all possibilities of E-R diagram is as shown below:



example of one-to-many relationship



example of many-to-one relationship

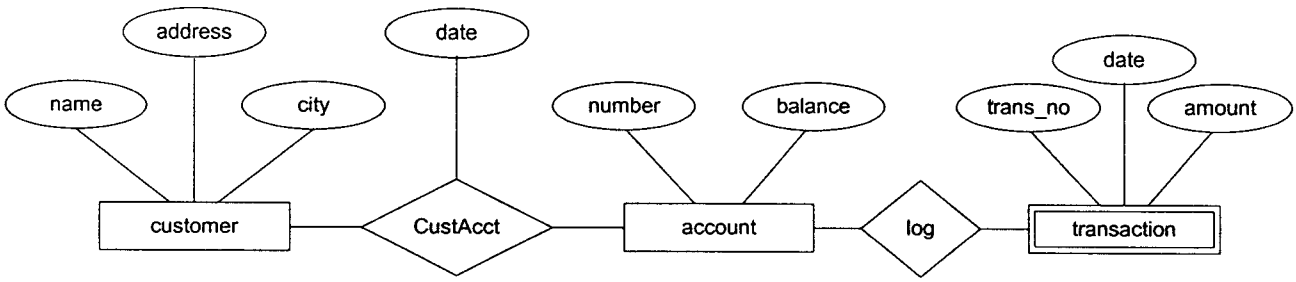


example of one-to-one relationship

Reducing E-R Diagram to Tables

A database which conforms to an E-R diagram can be represented by a collection of tables. For each entity set and for each relationship set in the database, there is a unique table which is assigned the name of the corresponding entity set or relationship set. Each table has a number of columns which, again, have unique names.

Figures below show how an E-R diagram can be reduced into tables:



E-R diagram

customer-name	*address*	*city*
Oliver	Main street	Austin
Harris	North street	Georgetown
Marsh	Main street	Austin
Pepper	North street	Georgetown
Ratliff	Parkway	Round Rock
Brill	Putnam drive	San Marcos
Evers	Nassau	Austin

The customer table

account-number	*balance*
259	1,000
630	2,000
401	1,500
700	1,500
199	500
467	900
115	1,200
183	1,300
118	2,000
225	2,500
210	2,200

The account table

account-number	*transaction-number*	*date*	*amount*
29	5	17-May-95	50
630	11	17-May-95	70
401	22	23-May-95	-300
700	69	28-May-95	-500
199	103	03-Jun-95	900
259	6	07-Jun-95	-44
115	53	07-Jun-95	120
299	104	16-Jun-95	-200
259	7	17-Jun-95	-79

The transaction table

account-number	*date*
259	17-Jun-95
630	17-May-95
401	23-May-95
700	28-May-95
199	13-Jun-95
467	07-Jun-95
115	07-Jun-95
183	13-Jun-95
118	17-Jun-95
225	19-Jun-95
210	27-Jun-95

The CustAcct table

Chapter

The Internet

Connecting to the Worldwide Internet

The worldwide Internet grows from original ARPANET, an early research computer networks belongs to the US Dept. of Defense. ARPANET then evolves, connecting more computer networks, until today, form a worldwide Internet, which interconnects thousands of networks containing millions of computers in universities, laboratories, and commercial organizations. The Internet has seen staggering growth due to two factors – the ease which TCP/IP networks can be interconnected with and the open-door policy that allowed organizations of all types to gain easy access to the Internet.

The benefits of Internet

- Cross-platform

  Many corporate computing environments use different computing platforms. The capability to exchange information across platforms is crucial. The Intranet enables companies to unify communication within a multi-platform environment. Hence, companies can mix and match platforms as needed with no adverse effect on the overall environment.

  Within an Intranet, universal browsers such as Netscape Navigator and Microsoft Internet Explorer enable the users to perform the following tasks independent of the platforms used.

- Breaking down the barriers

  Intranets dissolve the barriers of communication that are created by department walls, geographical location and decentralized resources. Intranets create global accessibility by bringing together individuals and resources from a distributed environment. Employees, customers and vendors are able to access information stored in multiple locations simultaneously.

- Reducing distribution cost

  By combining computing and communication in the same system, Intranets reduce distribution costs by eliminating the traditional paper-based internal corporate communication media, such as printed pages, pamphlets, booklets and flyers. Instead, they are published electronically on the company's Intranet, saving the resources needed to print, distribute and update them.

- Immediate delivery

  Information delivered using an Intranet becomes available almost instantaneously throughout the entire organization. With HTML form-support, users may even fill out forms, post sign-up sheets and schedules on the Intranet. Information can move much more quickly and effectively by removing the need for human intervention.

- Open standards

  Internet technologies follow a set of open standards, which facilitate software developers to develop cost effective and easy-to-implement Intranet solutions. Users can choose from a number of vendors for software products.

  The growth of Internet technologies provides companies with a greater pool of resources to develop their own Intranets. Conversely, traditional GroupWare products have a more limited range of compatible products and fewer specially trained consultants to install and administer them.

- Scalability

  Since Intranets are based on Internet technologies, size is not a limitation with Intranets.

Reason for Connection to the Internet

In the early years of the operation of the Internet, only academic and research organizations could gain access to the network. Current days, any organizations can apply to the NIC for name and address assignment, and can connect their own private network to the Internet. An individual or commercial organization, as well, can gain access to the Internet via a dial-up or dedicated connection.

There are three reasons that organization or person might want to consider connecting to the Internet :

- **Accessing Internet resources.** The Internet provides access to a wide variety of different types of information resources that may be useful/valuable to them

- **Communicating with other organizations.** The organizations may need to communicate one another via computers already connects to the Internet. Connecting to the Internet allows them to communicate without having to install separate communication links to those organizations.

- **Interconnecting among internal-private networks.** The organizations may want to use the Internet as a high-speed backbone for communication within their own private internet. They don't want to communicate with other organizations on the Internet. They simply use the Internet as a means of interconnecting their own set of private internets.

Component in Computer Internetworking

TCP/IP Architecture and Network Components

Host

In TCP/IP, host is referred to any computing device/system that is attached to an internet and communicates using the TCP/IP protocols. Host runs application programs that communicate with one another. A host can be a large mainframe, a minicomputer, a midrange departmental processor, a workstation or a personal computer.

Router

A router or gateway is a computing device that provides connectivity between the various individual networks making up the internet. The function of a router is to move network traffic from one physical network to another when a program running in a host attached to one physical network has to communicate with a host attached to some other physical networks. The routing function can be performed by an ordinary host that runs routing software, or by a specialized device that is dedicated to the routing function. In large internets, routing is generally performed by dedicated routers.

Network and Cabling System

Networks tie TCP/IP hosts. An individual network is a collection of two or more hosts that are interconnected using a particular form of data link technology via cabling system. Several individual networks can be interconnected using routers. Many data-link technologies are available nowadays for LAN and WAN topography. However, The TCP/IP architecture is independent of any particular form of networking technology.

Client and Server

Other terminologies that are very close related to the computer networks are client and server. These terminologies do not refer to specific hardware components; instead they represent different role in process on a computing model. *Client* is a host or an application component that makes a request for a service of some other application components operating in a role of a server. While *server* is a computing component running in the remote host that process the request and provides a well-defined service required by the client. The client is responsible for establishing communication with the server. The client then makes a request for a service by transmitting data to the server. The server then carries out the service and replies by sending data back to the client. There can be multiple clients sharing the services of a single server, and the client applications need not to be aware that processing is not being performed locally.

General speaking assumes that clients are generally small and desktop hosts, like workstations or PCs, while servers mean bigger and more powerful hosts like mainframes or minicomputers. TCP/IP topology allows several specific servers

provide specific functions. The following are a few type of server systems that is popular in the client-server environment nowadays :

- **File Server**, provides file access and file management services
- **Print Server**, provides printing services
- **Database Server**, provides database access and database management services
- **Communication Server**, provides access to modem or other specialized communication facilities
- **Application Server**, provide access to application logic, allowing an application to be distributed among more than one host computer.

Network Software

Networking Operating System → NOS

NOS is a software product, typically used in the personal computer environment, that provides high-level networking functions to users and application programs. This TCP/IP networking software allows user to communicate over an internet with other users. It is a unified interface and independent of the underlying networking technology. Most of computer system in the world can run TCP/IP networking software.

A network operating system controls how different hardware and software in a network function together properly. The Internet consists of various hardware platforms running various network operating systems. Theoretically, one company may not stay with one network operating system, however, using only one network operating system will simplify network installation, maintenance and administration.

The primary choices of network operating systems are Unix, Windows NT and Novell's NetWare.

Many large organizations are using Unix-based machines since Unix is well suited for the Internet's open system model and its Web server can be set up with little cost. However, most users find Unix difficult to set up and maintain. Using a Unix-based machine also precludes access to various low-priced software applications to enhance the Intranet.

Many companies choose Windows NT due to its ease of installation, maintenance and administration. Windows NT can support various workstation operating systems, such as Windows 3.1, Windows 95, Windows NT, Unix and Mac. It also supports popular network protocols, like TCP/IP and IPX/SPX. Novell's NetWare is a popular local area network solution based on the IPX/SPX protocol. Since it is only designed to operate file and print servers, NetWare may constrain the types of applications provided and the number of Intranet users.

Workstation operating systems

Client computers can run a number of operating systems, such as Windows, Macintosh, OS/2 and Unix operating systems. To let the workstation operating system use the network, special drivers must be installed on the client computer's network-interface card in order to communicate with the network.

Web Server Software

To establish an Internet, server software is required to handle requests from browsers. Currently, a number of free Web servers are available in the market. Apart from the cost of a Web server, how the server software supports the Web developers must also be considered. For small operations, an Intranet can be first built with servers that are easy to use and maintain and then moves to higher performance servers as the Intranet's use increases. The performance of the Intranet depends more on the performance of the server machine than on the server software.

Web Browsers

Currently, the most popular browsers are Netscape's Navigator and Internet Explorer. In a few years, Microsoft will integrate the browser's functionality into all of its business application software and may make the browser part of the operating system.

On the Unix side, the markets will probably continue to be dominated by Netscape. Therefore, for a network that includes Unix, Macintosh and Windows clients, and must standardize on one browser, Netscape's Navigator is the only choice at this time.

Hypertext markup language (HTML)

The Web (or more properly, the World Wide Web) is a highly used tool by Internet users. It was developed at CERN in Switzerland as a new form of communicating text and graphics across the Internet making use of the hypertext markup language (HTML) as a way to describe the attributes of the text and the placement of graphics, sounds, or even movie clips. HTML is a programming language used to create documents (pages) on the WWW. HTML allows the user to insert formatting directives into the text, much like some of the first word processors for home computers. Until now, the number of users has blossomed and the number of sites containing information and searchable archives has been growing at an unprecedented rate. The web is collections of "Web pages" contain anything from personal information to broad topics of interest.

The Web requires a client program (such as Netscape, Internet Explorer, or Lynx) and a server (http) to send information to the client. There are two important aspects in the Web: first, in order to use the Web, someone needs to be running a Web server on a machine for which such a server exists. Second, the local user needs to run an application program to connect to the server; this application is known as a client program. Server programs are available for UNIX machines, Windows and Macintosh. Client programs are available from NCSA for UNIX, Windows, and the Macintosh, which provide a graphical interface for the Web and allow the user to view pictures. On UNIX an application called Lynx is also available which allows the user to just view the text off of a server.

Security and Firewall System

Security Functions in the Network

Security mechanism should provide facilities for implementing secure communication in a networked environment and allows access to resources in the computing environment to be controlled. Security system should cover following security functions that are useful in a large network such as the Internet :

- **Data Protection.** Data protection is to ensure that the messages can be sent over the network privately, so they cannot be read by unauthorized parties. One popular example of this function is a cryptographic technique, in which messages are enciphered before transmission and deciphered after receipt. A channel using a cryptographic technique is called a secure channel. Cryptography also protects data integrity because an intruder cannot modify, relay or suppress data in transit without the receiver detecting it.

- **Authentication.** Authentication is to verify the identity of an end-user or an application component that is making a request for a service. The end-user should acquire the credentials required, called ticket, in order to be authenticated by a server. This procedure could be in form of login-and-password mechanism.

- **Authorization.** Authorization is to provide facilities for specifying which users or application components can have access to individual resources in the computing environment. In the beginning of a session, an end-user conducting an authentication process, and if he is successful, then authorization function determines what operations are valid for him during his session. Authorization describes the resources he is authorized to access and the type of accesses he can perform to each resource, until end of the session.

Planning the Network Security Policy

Securing a site involves evaluating an organization's information assets, its vulnerabilities, and defenses. A security policy reflects the management's outlook on security. The policy is enforced using both technical and non-technical means. A firewall policy is a set of rules that determine what types of connections are or are not allowed across a firewall. An Internet firewall is a technical mechanism used to enforce a firewall security policy. Based on a security policy, a firewall architecture can be evaluated and selected. An overall security policy and a firewall security policy are prerequisites to proper firewall implementation.

A network security policy is a set of rules applied to a network for restricting user access to the network resources and Internet services. It is designed based on a site security policy.

Regardless of the size of the network to be protected, we have to identify the resources we have to protect, the Internet services to be accepted and rejected, the network topology and the post-attack policy. A network security policy is designed for a particular computer network. Although there are generic network security policies available to help the security policy designer, the appropriateness of these policies for a particular network needs to be evaluated.

A security policy should address the following issues:

1. Selecting the Internet services and resources

Resources such as hardware, software, data, documents, and manpower need to be identified. Whether or not these resources should be shared depend on several factors:

1. *requirements for sharing these resources*. Some resources may have special requirements for being shared. For example, setting up an FTP server to share files may require a dedicated machine to host an FTP server as well as a leased line for communication.

2. *whether resources should be shared*. The reason for sharing resources needs to be clearly identified. For example, if an FTP server is to be used internally, the files it stores should not be made publicly available.

3. *potential risks*. The risks involved with sharing a resource needs to be identified. For example, if access control is not enforced, it may be possible for an Internet-based attacker to launch a denial-of-service attack on the internal FTP server.

A firewall can be designed to allow or deny access to the shared resources across a network.

2. Determining the authorized and unauthorized accesses

Companies and organizations enforce access control to limit user access to resources. Information may be made available only to specific groups or individual users. Changes in access control policies can be made once for an entire group rather than for individual users. File access permissions are commonly used to enforce the information access policy.

3. Restricting access locations

The locations from which services can be accessed should be controlled. Typical policies restrict access to internal network services from external users, but allow internal users to access external network services. Problems may arise if an internal user accesses an un-trusted external host. These hosts could be set up by a hacker and could, for example, contain malicious executable code in the form of a rouge Java applet or a program containing a virus. Some policies restrict internal users from accessing untrusted hosts.

Network administrators may also need to define a list of external servers for which access by internal clients is to be denied based on the criteria of their organizations. Based on these security criteria, a list of external servers to be derived can be defined.

Another problem is unauthorized external hosts attempting to access internal network. For example, multiple unsuccessful login attempts from a particular host may indicate the host is attempting to get unauthorized access to the system. All network access from this host should therefore be denied. A host probing Internet server ports may also indicate a system under the control of a hacker. Some information services such as finger and DNS (external DNS) should be made accessible only to trusted external hosts.

4. Publicizing internal documents

Many organizations would like to publicize their products or services on the Internet using the Web or make software or documents available via FTP. Many organizations set up web servers that provide several functions: **Intranet** - internal users accessing internally available documents, **Extranet** - a closed group of external users accessing information, **Internet** - information available publicly to all Internet users.

Access to Internet information services can be restricted based on network address and/or on user authentication (username/passwords). Strong authentication such as tokens can also be used.

5. Reconstructing Network topology

Since smaller networks are easier to manage than larger ones, it sometimes makes sense to subdivide a network into several parts based on the resources they share. Separating the network and using dedicated services can simplify the enforcement of network security policies.

Critical network components, including the firewall and Internet servers, need to be physically secured. An attacker using a pair of wire cutters on the web server communication line can launch a very effective, albeit crude, denial-of-service attack.

6. Managing user accounts

Attackers frequently gain unauthorized access by sniffing user passwords from the network or cracking a user password file. Networks with fewer user accounts tend to be more reliable and more resistant to attacks. User accounts are a source of vulnerability and need to be carefully managed. User accounts should be used only on the local network, or used on Internet servers -- with only limited access, and not used for external access using telnet

Remote file system access may be provided via anonymous ftp to avoid passwords from being sent in clear text over the Internet. Secure Internet servers and firewall hosts should not have user accounts, but can have an administrator account.

Administrator accounts are popular to attack since they typically use a fixed and well-known user name and have the greatest privilege in the machine. In order to prevent the administrator accounts from being hacked, they should use very secure passwords. Changing the name of the administrator account regularly also adds security.

7. Controlling the remote sites

Many organizations today use the Internet to connect their offices all over the world, to transfer sensitive information and data between offices, and to communicate with partners. These data transfer may be vulnerable to eavesdropping since the Internet is an insecure communication channel.

To protect against eavesdropping, documents can be encrypted before they are sent using a package such as PGP. There are several drawbacks to encrypting individual files, including requiring the users to decide which files to encrypt, the time to encrypt the file, and keeping track of the encryption keys.

Virtual Private Networks (VPNs) can be set up to provide secure communication between offices. They set up a 'tunnel' between firewalls that encrypts all network traffic sent through them. They move the responsibility of encrypting interoffice messages from the users to the network administrator and allow centralized control and administration.

Firewall System

A firewall system is a collection of hardware and software that interconnects two or more networks and provides a central location for managing security. Firewall system can also employ routers to filters out data packets based on criteria specified. By properly configuring a firewall using a combination of routers, reasonable security against Internet intruders and proper protection on various servers on the Intranet can be achieved.

The firewall enforces rules, which are derived from the security policy. A rule might specify that access to a particular port on a particular host be accepted from a particular host, but denied from all other hosts. Firewalls accept or reject connection based on the rule sets. Complex rule sets degrade firewall performance for both packet-filtering firewalls as well as application-gateway firewalls.

Application-gateway firewalls are not as directly affected by complex rule sets; however, overloading a dual-homed host with too many proxy servers can degrade firewall performance. The rule sets to be implemented by the firewall should be chosen to efficiently implement a security policy. This includes simplifying the rule set by removing redundant rules. Some vendors have estimated that adding one rule to a router degrades the throughput by 5 - 15%. Individual rules should be combined if possible.

Some general policies are commonly applied for both packet-filtering and application-gateway firewall architecture are:

- all packets flowing into the local network MUST pass through the firewall.
- source routing packets and routing table modification protocols must be denied. If hackers can alter the route they travel into the network, they could bypass the firewall host as well as the bastion host. Therefore, all *incoming network management protocols* including *Simple Network Management Protocol* (*SNMP*) and *Routing Information Protocol* (*RIP*) should be denied. Furthermore, all packets with source routing should be rejected.
- Even though TCP/IP, UDP/IP and other IP protocols communication ports are theoretically protected by application-gateway firewalls, they should still be protected by the same scheme as in packet-filtering firewall.

Three types of firewalls

- **Network-level firewall.** A network-level firewall is typically a router or special computer that examines packet addresses and then decides whether to pass the packet through or to block the packet from entering the Intranet based on the source and/or destination addresses.
- **Application-level firewall.** An application-level firewall is normally a host computer running software known as a proxy server. A proxy server is an application that

controls traffic by restricting and regulating the connections depending on the nature of the services at the application layer. The job of the proxy server is to transfer a copy of the packet from one network to another network. It masks the origin of the initiating connection and protects the Intranet from other Internet users. A proxy server can be configured to control which services are allowed on the network. However, users are required to use client programs that can support proxy operations.

- **Circuit-level firewall.** With the application gateway firewall, the proxy server intercepts the packets between client and server. The firewall is not transparent to user. With circuit-level firewall, the packets are not intercepted. All packets will be relayed through the firewall into the internal network in a transparent manner. A circuit-level firewall does not need to use a special proxy client application by creating a circuit between a client and a server without the need to know anything about the service. The advantage is that it provides service for a wide variety of protocols and there is much less overhead involved. The disadvantage is protection and control are coarse-grained, and not as flexible as that provided by application gateway firewalls.

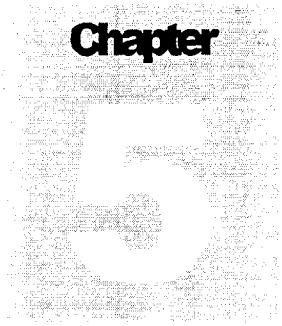
Firewall architecture

The three most popular firewall architectures are the dual-homes host, the screened host and the screened subnet firewall. The last two firewalls use a combination of routers and proxy servers.

- **A Dual-homed Host firewall.** A dual-homed host firewall is a simple and secure configuration in which a host computer is dedicated as the dividing line between the Intranet and the Internet. The host computer uses two separate network cards to connect to each network. The dual-homed host firewall works by running either an application-level or a circuit-level proxy.

- **A Screened host firewall.** This kind of firewall adds a router and places the host computer away from the Internet. The router can be configured so that it sees only one host computer on the Intranet network. Users on the Intranet have to connect to the Internet through this host computer and external users cannot directly access other computers on the Intranet

- **A Screened subnet firewall.** A screened subnet firewall further isolates an Intranet from the Internet by incorporating an intermediate perimeter network. The host computer is placed on the perimeter network which users can access through two separate routers, one controls access to the Intranet and the second connects to the Internet.



Future Development in Computer Network

Current and Future Trends in Software Development

Object-oriented Computing

Object-oriented Programming (OOP) is new methodology of software engineering. A complex piece of software is breakdown into components according to their functionality. Therefore, writing a software is like building a car. One will first build nuts and bolts, gears and bearings. They are put together to make the engine, transmission and wheels. Then, these parts are put together to make a car. In object-oriented design, an application is an integration of objects, each providing specific function.

Java, Applet and ActiveX

Sun Microsystems' development of a new software product named Java has also made a significant impact on the WWW. Java is commonly viewed as a new way to make web pages more dynamic - incorporating sound, animation, or even stock tickers into web page. However, it is becoming known as a new computing platform - the base upon which software developers can build applications.

Java is different from ordinary software in that Java applications, or applets, reside on centralized network servers. The network delivers the applet to your system upon user request. The applet runs inside a "container" such as a Web browser on the client system. This alleviates the user (client) from having to store applications on his/her computer, thus allowing cross-platform operability. Since the application resides on the server, and only the required components are temporarily transferred to the user when requested, client side software needs only be minimal.

The possible ramifications of this are unlimited. Applets could potentially replace most of client-resident software due to its flexibility and open-endedness. Users could download applications on an as-needed basis instead of having to purchase bulky, expensive software packages that most users never fully exploit anyway.

Microsoft has realized the importance of Java and has developed a similar product, ActiveX, Java has been accepted as the industry standard. Both Netscape and Microsoft

have incorporated Java capabilities into their web-browsers, and many companies have begun to develop Internet applications based upon the Java platform.

According to a recent InfoWorld survey, one out of every three Web sites is Java-enabled with more than 20 million people using Java-enabled browsers.

Hardware Convergence

Client/Server Technology

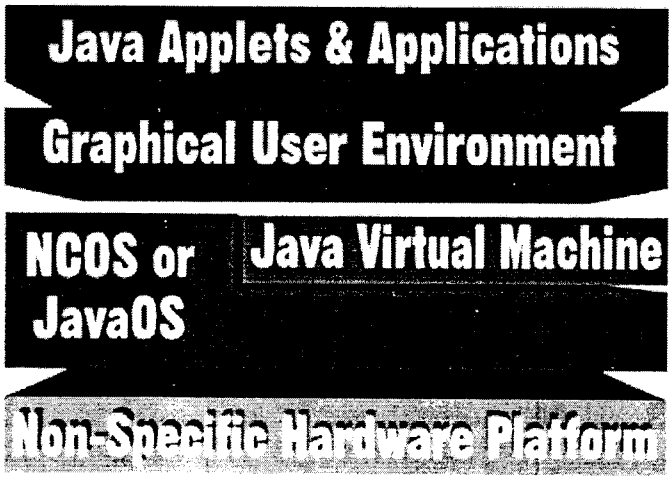
Client/Server (C/S) technology refers to a distributed network of software and hardware components. Applications, such as MS Word, reside on the client computer, while data is stored on the server computer. Each time that a user wishes to alter or retrieve data, he/she must send a request to the server, which in turn returns the requested information to the client. This technology enables users in many different locations to have access to the same data, while freeing up local (user) resources.

Network Computer

Oracle introduced the concept of the Network Computer (NC). The NC is a "new generation of affordable, easy-to-use information devices, optimized for electronic communications, information access, entertainment, and a host of applications."

In simple terms, the NC is a stripped-down version of a PC or PDA (personal digital assistant) which does not have a large local disk to store softwares and data files. Instead, the vast majority of the softwares and data will reside on the server (host) computer, and will only be retrieved as needed, via Java (or similar) software.

The idea of NCs in its current incarnation emerged in late December 1995. Many vendors had been working on prototypes and references and many felt there was a need for coherency in the infant market. With the future in mind, representatives from Apple Computer, IBM, Netscape, Oracle, and Sun Microsystems came together to create NCRef1. The preliminary specification was released on May 20, 1996 called "NC Reference Profile 1", the set of guidelines is designed to make multimedia Internet computing as ubiquitous as telephone and television services. It promotes competition in a new class of communications and commerce devices for use in homes, schools, businesses and institutions and will ensure compatibility of models from different manufacturers.



The Network Computer Reference Profile

The Reference provides a common set of standard features and functions across a broad range of scalable NCs. It is architecturally neutral and intended to facilitate the growth of the network computing industry while protecting investments made by customers, content providers, system providers, service providers and application providers through industry-wide

compatibility. The most important decision -- to make NCRef1 platform-independent -- was a given since the lead vendors needed to maintain their marketshare. NCs complying with the planned NC Reference may take many forms -- from desktops to laptops to video phones, pagers and even conventional PCs. All these devices may be linked to the Internet or Intranet and run basic applications such as Web browsers, e-mail applications, word processors, spreadsheets and presentation packages. In addition, NCs may function as multimedia machines by supporting video e-mail, 16-bit CD-quality sound and digital videos. To allow the flexibility and usability of the NC, network computer would operate on industry standards and protocols, such as TCP/IP, FTP, SNMP, HTML, HTTP, Java, SMTP, IMAP4, POP3, JPEG, GIF, WAV, and AU. This is an attempt to alleviate the problems caused by proprietary (closed) systems which has added to the complexity of PCs.

Network computer supports a variety of client/server models, ranging from the ultra-thin client to the fat client. The thin client is typified by a desktop system which stores applications and data on a network server, but performs all or most of the application processing within itself. Thin-client the preferred model for network computer. The ultra-thin client does not store any applications or data locally, and all actual application processing is performed on a network server. The only local processing is that of graphical display. All the data that transpires between the client and the server consists of graphical updates to the screen. This is close to X-terminal. The fat client stores most of its data locally, as well as processes applications locally.

The promise of the NC lies in it's low cost, ease-of-use, flexibility, and reduced maintenance costs. The first generation of NCs are expected to costs approximately $500, with lower prices for NCs which substitute a monitor with a TV.

Several NCs Hardware Products are :

1. The Desktop Client Station, these devices exist only in a networked computing environment with a core focus on Java applications
2. Minimal or Sealed-Unit PCs, devices to be created according to the NetPC and Odin standards, as well as others made independently, such as the AcerBasic.
3. Hand-Held Devices, like PDAs, but actually rely on a wireless or wired network environment, such as the WebBook and the Acorn PDA.
4. Internet Access Devices (IADs) and Set-Top Boxes (STBs), these boxes connect to television systems and provide access to the Internet through built-in Web browsers. They may or may not have Java support.
5. Java-based X Terminals, with local operating systems have been improved to include a Java Virtual machine, such as those from HDS, NCD, Boundless Technologies, and IBM.
6. Internet appliances, an array of other Internet appliances, such as network-televisions are also in development.
7. Intelligent Telephones, provide executive telephones combined with network access, such as the Acorn ExecuPhone.

NetPc

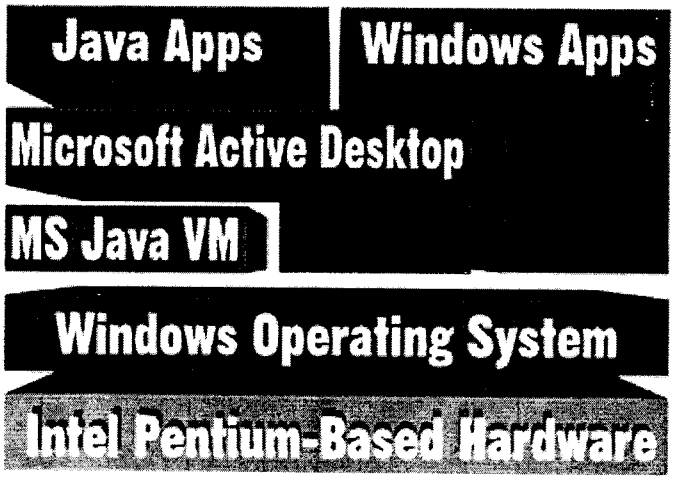
The NetPC is based on Microsoft-only standards for operating systems and device drivers. On October 28th, 1996, Microsoft and Intel, the leaders of the desktop computer industry, announced the joint NetPC initiative. The NetPC standard builds on existing, successful,

hardware and system architecture while improving management and componentization of the overall unit. Microsoft and Intel identified a few of the most powerful issues at the core of the appeal of network computing. The NetPC reference profile is a specification for a low-maintenance PC system that was designed with the network in mind. At the very basic level, it is a Windows-based environment that runs on an Intel/PC-based architecture.

The NetPC is a hardware specification first, and practically defines the desktop platform found in many corporations today. The hardware section of the standard also leaves room for the addition of interesting new technologies into the PC form factor.

Basic hardware components of the NetPC are :

- CPU: Pentium 100MHz or equivalent;
- Memory: 16MB RAM minimum;
- Disk: Internal hard disk as cache;
- Video: 640x480 pixels at 8 bits/pixel (VGA);
- Audio device (type unspecified);
- Plug-and-play BIOS support;
- No expansion slots;
- Network interface (Ethernet, Token Ring, V.34 modem, ISDN, ATM, T-1);
- Keyboard, pointing device/mouse; and
- Locked/sealed case.



Microsoft NetPC Architecture

Optional hardware additions include :

- IDE floppy drive,
- CD-ROM,
- PC (PCMCIA) card slots,
- Universal Serial Bus (USB), and
- 1394 high-speed peripheral bus.

The Universal Serial Bus (USB) provides a generic desktop bus for components ranging from a simple mouse to complex digital video camera systems. The concept for the USB is

to simplify the number of connectors and cables in and out of the PC box. If this sounds familiar to you, think back to the older Macintosh desktop bus. The concept is the same, but the implementation is different. The USB allows you to hook a mouse to a keyboard, a keyboard to a monitor, speakers to the monitor, the monitor to the PC, and so on. Essentially, redundant cables and connectors are reduced, and not all of the cables have to be directly plugged into the PC system unit.

The IEEE 1394 bus (also known as FireWire) is a next-generation serial bus for external devices; it adds increased speed and more data paths. It was designed to suit a large variety of peripheral devices such as keyboards, mice, microphones, digital video cameras, and even common household electronics (of the future), such as stereos and VCRs. Systems based on the USB and 1394 architectures will be appearing on the market this year from vendors such as Sony PC, HP, Gateway, and Dell. Because of the new architecture, however, they will take time to reach a wide audience and even longer to be incorporated into a wide range of non-PC components.

The NetPC defines a specific operating system environment. Based on Windows 95 (and probably Windows 97), the operating system environment will be compatible with current Windows software and will not require any rewrites, recompiles, etc. It is unknown whether the Windows NT environment will also be available for the NetPC design. Technically, this shouldn't be a problem, since the hardware design is not too far from current PC designs. However, the NetPC calls for some features that are still missing from NT 4.0, such as the plug-and-play support. The NetPC design will also not support the lightweight Microsoft Windows CE (Pegasus) environment for portable devices because of core differences in OS architecture.
The filesystem for the NetPC has yet to be specified. One possibility for a future version of the spec is FAT-32, a filesystem Microsoft is developing as a replacement in future Windows system for the age-old DOS FAT (FAT-16) filesystem. This new filesystem provides significant improvements in storage capacity, file names, performance, file information, etc. -- basically, filesystem technologies developed over the last 20 years in other operating systems. It is not, however, the same as the NT's NTFS file system, which is a step beyond even FAT-32 in some respects. The local storage specified for the NetPC is to be used as a cache drive and probably the system disk. User data storage might be specifically moved to the network file server system.

Virtual Network Computing (VNC)

VNC or Virtual Network Computing is, in essence, a remote display system which allows user to view a computing 'desktop' environment not only on the machine where it is running, but from anywhere on the Internet and from a wide variety of machine architectures. The VNC is a development of very-thin-client ATM network computers.

The characteristics of VNC which distinguish it from other remote display systems are as follows:

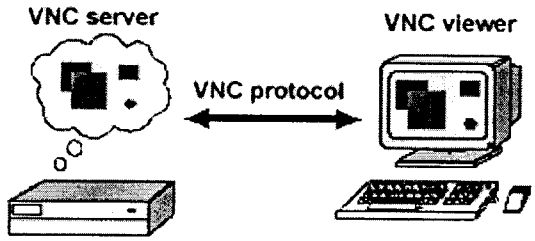
- No state is stored at the viewer. This means you can leave your desk, go to another machine, whether next door or several hundred miles away, reconnect to your desktop from there and finish the sentence you were typing. Even the cursor will be in the same place. With a PC X server, if your PC crashes or is restarted, all the remote applications will die. With VNC they go on running.

- It is small and simple. The Win32 viewer, for example, is about 150K in size and can be run directly from a floppy. There is no installation needed.

- It is truly platform-independent. A desktop running on a Linux machine may be displayed on a PC, or a Solaris machine, or any number of other architectures. The simplicity of the protocol makes it easy to port to new platforms. We have a Java viewer, which will run in any Java-capable browser. We have a Windows NT server, allowing you to view the desktop of a remote NT machine on any of these platforms using exactly the same viewer. And other people have ported VNC to a wide variety of other platforms.

- It is sharable. One desktop can be displayed and used by several viewers at once, allowing CSCW-style applications.

The VNC Protocol. The VNC protocol is a simple protocol for remote access to graphical user interfaces. It is based on the concept of a *remote framebuffer* or *RFB*. The protocol simply allows a server to update the framebuffer displayed on a viewer. Because it works at the framebuffer level it is potentially applicable to all operating systems, windowing systems and applications. This includes X/Unix, Windows 3.1/95/NT and Macintosh, but might also include PDAs, and indeed any device with some form of communications link. The protocol will operate over any reliable transport such as TCP/IP. The VNC protocol is truly a "thin-client" protocol: it has been designed to make very few requirements of the viewer. In this way, clients can run on the widest range of hardware, and the task of implementing a client is made as simple as possible.



VNC Clients. Writing a VNC viewer is a simple task, as it should be for any thin-client system. It requires only a reliable transport (usually TCP/IP), and a way of displaying pixels (either directly writing to the framebuffer, or going through a windowing system). There are several clients available for the networked display devices. This includes the Videotile (the original RFB client), an X-based client (which runs on Solaris, Linux and Digital Unix workstations), a Win32 client which runs on Windows NT and 95, a Macintosh client, and a Java client which runs on any Java-capable browser (including Sun's JavaStation).

VNC Servers. Writing a VNC server is slightly harder than writing a client for a number of reasons. The protocol is designed to make the client as simple as possible, so it is usually up to the server to perform any necessary translations. For example, the server must provide pixel data in the format the client wants. We have servers for our two main platforms, X (i.e. Unix) and Windows NT/95. A Unix machine can run a number of Xvnc servers for different users, each of which represents a distinct VNC desktop. Each VNC desktop is like a virtual X display, with a root window on which several X applications can be displayed. The Windows server (WinVNC) is a little more difficult to create, because there are fewer places to insert hooks into the system to monitor display updates, and a less clearly-defined model of multiuser operation. Our current server simply mirrors the real

display to a remote client, which means that the server is not 'multiuser'. It does, however, provide the primary user of a PC with remote access to their desktop.

Input protocol. The input side of the protocol is based on a standard workstation model of a keyboard and multi-button pointing device. Input events are sent to the server by the client whenever the user presses a key or pointer button, or whenever the pointing device is moved. These input events can also be synthesized from other non-standard I/O devices.

Connection Setup and Shutdown. When the connection between a client and a server is first established, the server begins, by requesting authentication from the client, using a challenge-response scheme, which typically results in the user being prompted for a password at the client end. The server and client then exchange messages to negotiate desktop size, pixel format, and the encoding schemes to be used. The client then requests an update for the entire screen, and the session begins. Because of the stateless nature of the client, either side can close the connection at any time without adverse consequences.

Telecommunication Technology

Telecommunications technology continues to improve. Digital phone lines (ISDN), fiber optics, modem technology, and other communications means allows users to transfer and receive data more efficiently. Big telecom manufacturers are working on ways to improve wireless communications technologies. One recent development in wireless technology (wireless) involves the utilization of radio frequency (RF) waves to transfer data. Radio stations may someday offer Internet access with extremely high bandwidth capacity and fast transfer times.

Glossary of Firewall

- **Abuse of Privilege**
  When a user performs an action that they should not have, according to organizational policy or law.

- **Access Control Lists**
  Rules for packet filters (typically routers) that define which packets to pass and which to block.

- **Access Router**
  A router that connects your network to the external Internet. Typically, this is your first line of defense against attackers from the outside Internet. By enabling access control lists on this router, you'll be able to provide a level of protection for all of the hosts "behind" that router, effectively making that network a DMZ instead of an unprotected external LAN.

- **Application-Layer Firewall**
  A firewall system in which service is provided by processes that maintain complete TCP connection state and sequencing. Application layer firewalls often re-address traffic so that outgoing traffic appears to have originated from the firewall, rather than the internal host.

- **Authentication**
  The process of determining the identity of a user that is attempting to access a system.

- **Authentication Token**
  A portable device used for authenticating a user. Authentication tokens operate by challenge/response, time-based code sequences, or other techniques. This may include paper-based lists of one-time passwords.

- **Authorization**
  The process of determining what types of activities are permitted. Usually, authorization is in the context of authentication: once you have authenticated a user, they may be authorized different types of access or activity.

- **Bastion Host**
  A system that has been hardened to resist attack, and which is installed on a network in such a way that it is expected to potentially come under attack. Bastion hosts are often components of firewalls, or may be "outside" web servers or public access systems. Generally, a bastion host is running some form of general-purpose operating system (e.g., Unix, VMS, NT, etc.) rather than a ROM-based or firmware operating system.

- **Challenge/Response**
  An authentication technique whereby a server sends an unpredictable challenge to the user, who computes a response using some form of authentication token.

- **Chroot**
  A technique under Unix whereby a process is permanently restricted to an isolated subset of the filesystem.

- **Cryptographic Checksum**
  A one-way function applied to a file to produce a unique "fingerprint" of the file for later reference. Checksum systems are a primary means of detecting filesystem tampering on Unix.

- **Data Driven Attack**
  A form of attack in which the attack is encoded in innocuous-seeming data which is executed by a user or other software to implement an attack. In the case of firewalls, a data driven attack is a concern since it may get through the firewall in data form and launch an attack against a system behind the firewall.

- **Defense in Depth**
  The security approach whereby each system on the network is secured to the greatest possible degree. May be used in conjunction with firewalls.

- **DNS spoofing**
  Assuming the DNS name of another system by either corrupting the name service cache of a victim system, or by compromising a domain name server for a valid domain.

- **Dual Homed Gateway**
  A dual homed gateway is a system that has two or more network interfaces, each of which is connected to a different network. In firewall configurations, a dual homed gateway usually acts to block or filter some or all of the traffic trying to pass between the networks.

- **Encrypting Router**
  see Tunneling Router and Virtual Network Perimeter.

- **Firewall**
  A system or combination of systems that enforces a boundary between two or more networks.

- **Host-based Security**
  The technique of securing an individual system from attack. Host based security is operating system and version dependent.

- **Insider Attack**
  An attack originating from inside a protected network.

- **Intrusion Detection**
  Detection of break-ins or break-in attempts either manually or via software expert systems that operate on logs or other information available on the network.

- **IP Spoofing**
  An attack whereby a system attempts to illicitly impersonate another system by using its IP network address.

- **IP Splicing / Hijacking**
  An attack whereby an active, established, session is intercepted and co-opted by the attacker. IP Splicing attacks may occur after an authentication has been made, permitting the attacker to assume the role of an already authorized user. Primary protections against IP Splicing rely on encryption at the session or network layer.

- **Least Privilege**
  Designing operational aspects of a system to operate with a minimum amount of system privilege. This reduces the authorization level at which various actions are performed and decreases the chance that a process or user with high privileges may be caused to perform unauthorized activity resulting in a security breach.

- **Logging**
  The process of storing information about events that occurred on the firewall or network.

- **Log Retention**
  How long audit logs are retained and maintained.

- **Log Processing**
  How audit logs are processed, searched for key events, or summarized.

- **Network-Layer Firewall**
  A firewall in which traffic is examined at the network protocol packet layer.

- **Perimeter-based Security**
  The technique of securing a network by controlling access to all entry and exit points of the network.

- **Policy**
  Organization-level rules governing acceptable use of computing resources, security practices, and operational procedures.

- **Proxy**
  A software agent that acts on behalf of a user. Typical proxies accept a connection from a user, make a decision as to whether or not the user or client IP address is permitted to use the proxy, perhaps does additional authentication, and then completes a connection on behalf of the user to a remote destination.

- **Screened Host**
  A host on a network behind a screening router. The degree to which a screened host may be accessed depends on the screening rules in the router.

- **Screened Subnet**
  A subnet behind a screening router. The degree to which the subnet may be accessed depends on the screening rules in the router.

- **Screening Router**
  A router configured to permit or deny traffic based on a set of permission rules installed by the administrator.

- **Session Stealing**
  See IP Splicing.

- **Trojan Horse**
  A software entity that appears to do something normal but which, in fact, contains a trapdoor or attack program.

- **Tunneling Router**
  A router or system capable of routing traffic by encrypting it and encapsulating it for transmission across an un-trusted network, for eventual de-encapsulation and decryption.

- **Social Engineering**
  An attack based on deceiving users or administrators at the target site. Social engineering attacks are typically carried out by telephoning users or operators and pretending to be an authorized user, to attempt to gain illicit access to systems.

- **Virtual Network Perimeter**
  A network that appears to be a single protected network behind firewalls, which actually encompasses encrypted virtual links over untrusted networks.

- **Virus**
  A replicating code segment that attaches itself to a program or data file. Viruses might or might not contain attack programs or trapdoors. Unfortunately, many have taken to calling any malicious code a "virus". If you mean "trojan horse" or "worm", say "trojan horse" or "worm".

- **Worm**
  A standalone program that, when run, copies itself from one host to another, and then runs itself on each newly infected host. The widely reported "Internet Virus" of 1988 was not a virus at all, but actually a worm.

DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

FINAL REPORT
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DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

Content

Volume

1

Non Aligned Movement

Center for South-South Technical Cooperation

Database on Expert

DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

Database on Expert

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Chapter 1

The Need for Database on Expert

Background

The Non Alignment Movement Center for South-South Technical Cooperation (NAM CSSTC) was developed to assist developing countries in technical cooperation for accelerating the development of those countries. It was officially initiated in Belgrade, Yugoslavia in 1961 as an obvious act to institutionalize the Dasa Sila Bandung or the Ten Principal of Bandung, in order that the position of the developing countries will be put forward with the result that their struggle direction is clearer.

Dasa Sila Bandung is an important principal document issued by the Five Countries preceded in Asia-Africa Conference. It is a substantively emphasize the important roles of Human Rights, State Sovereignty, Non-Aggression, Cooperative and Justice must be act as the base of International Cooperation.

The Non Alignment Movement is committed to wage war on poverty, illiteracy and underdevelopment. It is planned to advance broad-based and people centered development, including the quality improvement of the human resources. Based on that, the developing countries, which are member of NAM, can accelerate their development program based on equitable distribution, growth and stability. All programs of NAM CSSTC designed could have immediate as well as longer-term impacts to render the economics of developing countries of NAM member to be more broad-based, efficient and resilient to participate in the globalization process and strengthen cooperation among developing countries.

The mission of NAM CSSTC is to contribute and enhancement of development and collective self-reliance of the developing countries by strengthening and expanding South-South technical cooperation in the context of international development cooperation.

The objective of NAM CSSTC is enhancement of people centered development and capitalization of local resources through constructive interaction among development actors and partnership in development.

The Importance of ICT

Information - Communication Technology (ICT) is recognized by NAM members as an important technology will significantly enhance such development among member countries. The implementation of ICT worldwide has however resulted in a widening digital

divide not only between developed countries and developing countries, but also among NAM members.

ICT has become an indispensable tool in the fight against world poverty. It provides developing countries with an unprecedented opportunity to meet vital development goals such as poverty reduction, basic healthcare and education, which will become more effectively, including illiteracy reduction. Access to information networks will also allows countries using the networks to share information & experience from the others, action coordination, and improve their welfare.

This technology could accelerate development in far more than just the economic sphere. Indeed, connecting the world will transform it beyond recognition. It also could unlock the productivity of developing countries. Greater connectivity will also help fulfill the nearly insatiable human thirst for information and expose geographically isolated communities to wider information and new opportunities, which could create a more advance social and political outlook. Access to ICT networks can help people at all economic levels to meet their basic needs.

Finally, countries that succeed in harnessing the potential of ICT can look forward to greatly expanded economic growth, improved human welfare and stronger forms of democratic system.

In the information age, countries that do not provide access to information networks will not grow, no matter how rich their natural resources. ICT appears to be an essential component of development initiatives and can act as a powerful overall enable of development.

Advances in ICT have driven the last decade's economic boom and the integration of markets around the world. A lot of benefits from ICT and the rapid rise of the Internet have so far accrued to the developed world. Money spent on the digital infrastructure that supports these burgeoning new services that become a major engine of economic growth in some countries.

In the developing countries, ICT connectivity is growing, but the increased productivity and other benefits of the digital revolution are still pretty low. NAM CSSTC want to play the role to assist developing countries in taking advantage of ICT's potential and integrating ICT into the mainstream of their development activities.

Using ICT connectivity, developing countries can take benefits from on-line databases that are giving the important information, the latest discoveries, and also sharing experience with some experts.

The Need of Online Database

The global gap among developed & developing countries is quite real. Almost all of developed countries have no constraint in developing their own research for finding the newest technology & methodology, especially from the financial aspect. Majority of those technology are published through the on-line database developed by some institutional of developed countries.

The existence of database is very needed, especially for developing countries. It becomes an indispensable tool in the fight against world poverty. Majority of developing countries has

some constraints to develop their own research for improving their welfare - even solving their basic problems such as medical treatment & technology, educational method & material, agricultural system, biotechnology, energy exploration etc. With countries in the developing world stretching their budgets to the limit, and with education & research ranking low on some governments' list of spending priorities, the role of on-line database become very important.

The further enhance of the on-line database is a sharing experience and an optional consultancy with the experts. People can get additional information needed that is not available through the database with make a direct contact to the expert. It can be also used by the consultant, who can provide their service such as additional suggestion or analysis.

Access to on-line database can help people at all economic levels to meet their basic needs. Greater connectivity to the experts will help fulfill the nearly insatiable human thirst for the latest information, discovery & method needed for welfare improving. Wiring the planet with on-line database will transform the poverty into the prosperity. It will increase access to the educational materials, basic health information and other critical resources. For example, a single database in English, French, Spanish, Chinese or Hindi could serve a lot of continent and help so many people in the world. It could unlock the productivity level of developing countries, even the poor communities. It also could save human life in the rural areas while the experience manpower & equipped hospital is not available to handle some complicated cases and the patient has to race in time.

Majority of communities in developing countries is depending on agriculture. Agricultural development program will become the highest priority to increase the prosperity of their community. Latest information, new method & technology on agriculture will help them to improve the productivity.

The global economy in the world is relying more than ever on brain power and innovation rather than raw materials and labors only, as a generator of good wealth. A good education has become the key factor determining who will succeed and who will be left behind. The developing countries should pay attention on education program to prepare educated & skilled human resources in facing the high competition of labor market. It could allow them to reduce the gap among developing countries and developed countries. In eliminating the financial constraint, the governments of developing countries could expand the educational opportunities to as many people as possible with keeping down costs through bench mark educational methods & materials of other developed countries. Some cases of successful educational program in on-line database could be used in improving educational system of developing countries.

Connectivity to the on-line database allow developing countries to save their budget & time for getting the latest method or knowledge to meet their basic needs & improve their prosperity. Using the published experiences in the on-line database, developing countries should not allocate special budget for developing their own expensive research.

Cost can be contained by making full use of existing database. The database web sites would also be self-financing when fully developed. To facilitate regular updating information, an automatic prompting system could be set up. Finally, a search mechanism could be developed that will ensure the compatibility and connectivity of the diverse databases.

Database on Expert

The complete on-line database has to offer direct contact to the expert besides the cases published based on experts' experiences. Majority of the on-line database contents is coming from experts' experiences in developed countries. Sometimes, cases happened in developing countries that have a different geographic environment & specific characteristic, is not happened in other developed countries.

Case # 1:

A young and healthy athlete was brought to the hospital in a critical situation. He was suffering from high fever, weakness and serious infection. Laboratory tests confirmed that the infection was *necrotising fasciitis* (commonly know as the "flesh-eating bacteria"). Urgent amputation of the leg seemed the only possible solution to stop the flesh-eating bacteria process and save his life, until one of the physicians recalled seeing an article at the MedLine database - one of the most important medical database on Internet - that referred to new ways of treating limbs infected with *necrotising fasciitis*. After a quick consultant in MedLine, the doctors were able to find and retrieve the article then apply the procedure and treatment recommended. The young man was able to save both his life and his leg, and he can back in athletics. *(source: UNDP)*

Case # 2:

A young child in a poor, rural town, playing football by the side of a busy road, runs out on the street to chase the ball and is hit by a car. The frightened parents take the unconscious child to the nearest medical center for emergency aid. The doctor, a young, eager but inexperienced practitioner fresh out of medical school, takes an X-ray of the child's skull to determine the extent of the injuries. Although the child is stable, the doctor faces the difficult dilemma of either providing treatment locally, based on his or her own diagnosis or sending the child on a long, arduous and perhaps dangerous journey to the capital for treatment at the country's better-equipped hospital. It is a choice, which could have life or death consequence. Then his colleagues - a guess doctor from other city - suggest him for seeing related article to that injury in a med-database.

Chapter 2

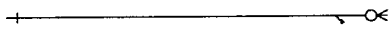
Database Structure

The Data Model

A data model is a collection of conceptual tools for describing data, data relationships, data semantics, and data constraints. The model is needed to describe the structure of database on expert.

The overall logical structure of data relationships of database on expert is visualized below which consist of the following components:

- Rectangles, which represents set record(s) of a table.
- Symbol of :

  which represents "one to many" relationship.

  It means one key record in table A could have any associated records in table B. However, one record in B could only have one associated record in A. For example:

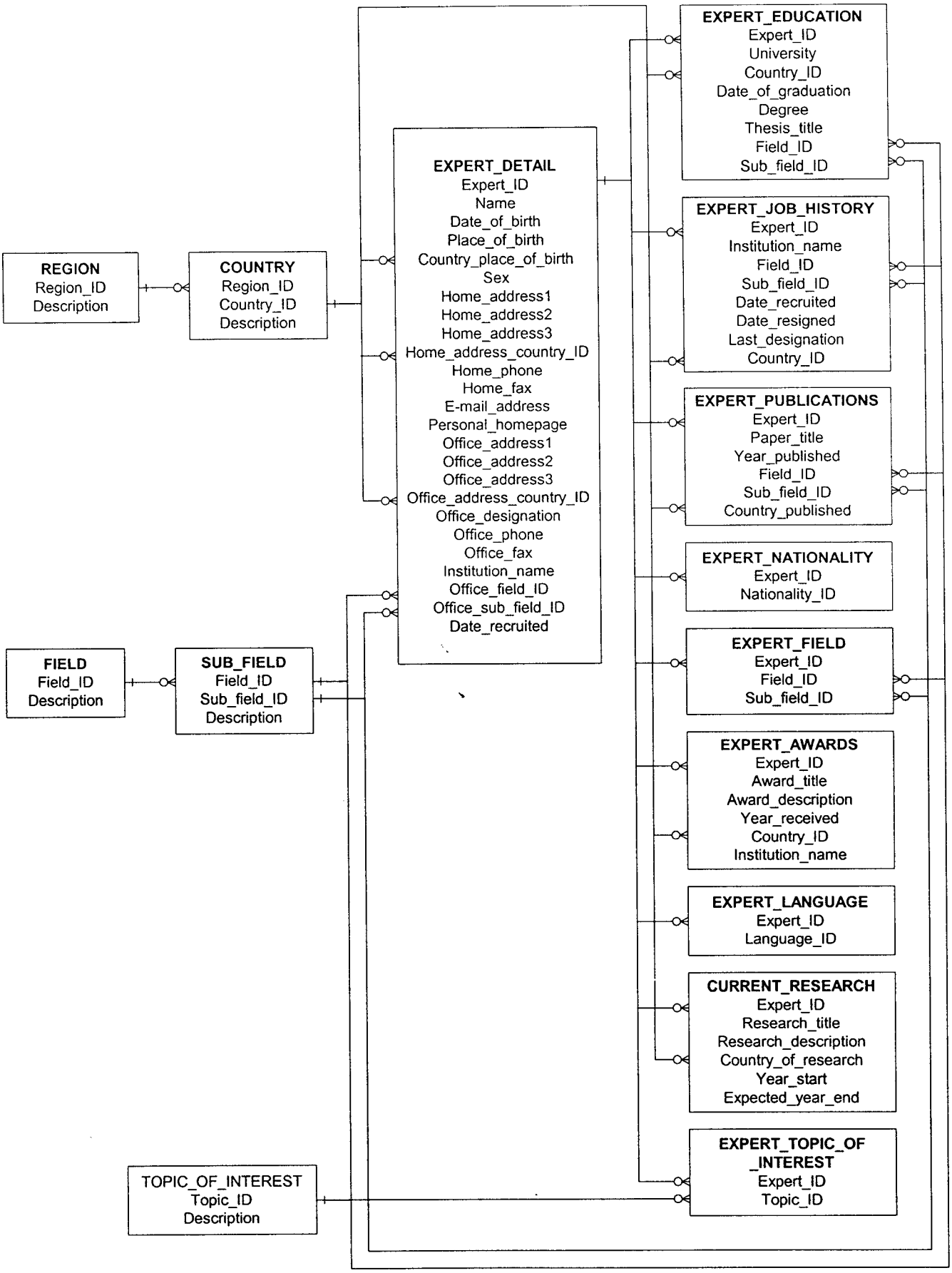
REGION

Region_ID	Description
AP	Asia Pacific
SA	South America

COUNTRY

Region_ID	Country_ID	Description
AP	PH	Philippines
AP	ID	Indonesia
AP	MY	Malaysia
SA	BR	Brazil
SA	GT	Guatemala

The following layout shows how the model is constructed.


REGION
Region_ID
Description
COUNTRY
Region_ID
Country_ID
Description
EXPERT_DETAIL
Expert_ID
Name
Date_of_birth
Place_of_birth
Country_place_of_birth
Sex
Home_address1
Home_address2
Home_address3
Home_address_country_ID
Home_phone
Home_fax
E-mail_address
Personal_homepage
Office_address1
Office_address2
Office_address3
Office_address_country_ID
Office_designation
Office_phone
Office_fax
Institution_name
Office_field_ID
Office_sub_field_ID
Date_recruited
EXPERT_EDUCATION
Expert_ID
University
Country_ID
Date_of_graduation
Degree
Thesis_title
Field_ID
Sub_field_ID
EXPERT_JOB_HISTORY
Expert_ID
Institution_name
Field_ID
Sub_field_ID
Date_recruited
Date_resigned
Last_designation
Country_ID
EXPERT_PUBLICATIONS
Expert_ID
Paper_title
Year_published
Field_ID
Sub_field_ID
Country_published
EXPERT_NATIONALITY
Expert_ID
Nationality_ID
FIELD
Field_ID
Description
SUB_FIELD
Field_ID
Sub_field_ID
Description
EXPERT_FIELD
Expert_ID
Field_ID
Sub_field_ID
EXPERT_AWARDS
Expert_ID
Award_title
Award_description
Year_received
Country_ID
Institution_name
EXPERT_LANGUAGE
Expert_ID
Language_ID
CURRENT_RESEARCH
Expert_ID
Research_title
Research_description
Country_of_research
Year_start
Expected_year_end
EXPERT_TOPIC_OF
_INTEREST
Expert_ID
Topic_ID
TOPIC_OF_INTEREST
Topic_ID
Description

The data model of database on experts pivots around the EXPERT_DETAIL. This is the table where the most common data of experts stored.

Tables and Indexes

Tables

EXPERT_DETAIL

EXPERT_DETAIL is the main table which stores common detail information of experts. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Primary key**
Name	alphanumeric(40)	
Date_of_birth	Date	
Place_of_birth	alphanumeric(20)	
Country_place_of_birth	**alphanumeric(2)**	**Foreign key**
Sex	alphanumeric(1)	
Home_address1	alphanumeric(40)	
Home_address2	alphanumeric(40)	
Home_address3	alphanumeric(40)	
Home_address_country_ID	**alphanumeric(2)**	**Foreign key**
Home_phone	alphanumeric(15)	
Home_fax	alphanumeric(15)	
E-mail_address	alphanumeric(40)	
Personal_homepage	alphanumeric(40)	
Office_address1	alphanumeric(40)	
Office_address2	alphanumeric(40)	
Office_address3	alphanumeric(40)	
Office_address_country_ID	**alphanumeric(2)**	**Foreign key**
Office_designation	alphanumeric(30)	
Office_phone	alphanumeric(15)	
Office_fax	alphanumeric(15)	
Institution_name	alphanumeric(30)	
Office_field_ID	**alphanumeric(2)**	**Foreign key**
Office_sub_field_ID	**alphanumeric(4)**	**Foreign key**
Date_recruited	Date	

EXPERT_EDUCATION

This is the sub-table of EXPERT_DETAIL which stores education history of an expert. The complete format of EXPERT_EDUCATION is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
University	alphanumeric(40)	
Country_ID	**alphanumeric(2)**	**Foreign key**
Date_of_graduation	date	
Degree	alphanumeric(10)	
Thesis_title	alphanumeric(40)	
Field_ID	**alphanumeric(2)**	**Foreign key**
Sub_field_ID	**alphanumeric(4)**	**Foreign key**

EXPERT_JOB_HISTORY

This is the sub-table of EXPERT_DETAIL which stores job history of an expert. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Institution_name	alphanumeric(40)	
Field_ID	**alphanumeric(2)**	**Foreign key**
Sub_field_ID	**alphanumeric(4)**	**Foreign key**
Date_recruited	date	
Date_resigned	date	
Last_designation	alphanumeric(30)	
Country_ID	**alphanumeric(2)**	**Foreign key**

EXPERT_PUBLICATIONS

This is the sub-table of EXPERT_DETAIL which stores information of papers published by experts. The complete structure of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Paper_title	alphanumeric(40)	
Year_published	alphanumeric(4)	
Field_ID	**alphanumeric(2)**	**Foreign key**
Sub_field_ID	**alphanumeric(4)**	**Foreign key**
Country_published	**alphanumeric(2)**	**Foreign key**

EXPERT_NATIONALITY

This is the sub-table of EXPERT_DETAIL which stores nationality(ies) of experts. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Nationality_ID	**alphanumeric(2)**	**Foreign key**

EXPERT_FIELD

This is the sub-table of EXPERT_DETAIL which stores expertise's field(s) and sub_field(s). The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	alphanumeric(4)	Foreign key
Field_ID	alphanumeric(2)	Foreign key
Sub_field_ID	alphanumeric(4)	Foreign key

FIELD

This is the look-up table that stores field ID and its description. The format of the table is as follows:

Field_Name	Data_type	Remarks
Field_ID	Alphanumeric(2)	Primary key
Description	Alphanumeric(40)	

SUB_FIELD

This is the look-up table which stores sub field ID and its descriptions. The format of the table is as follows:

Field_Name	Data_type	Remarks
Field_ID	alphanumeric(2)	Foreign key
Sub_field_ID	alphanumeric(4)	Primary key
Description	alphanumeric(40)	

COUNTRY

This is the look-up table which stores country ID and name. The country ID will be based on ISO-3166 which consists of only 2 character. Please refer to appendix A to see the complete list of ISO-3166 country ID.

The format of country table is as follows:

Field_Name	Data_type	Remarks
Region_ID	Alphanumeric(4)	Foreign key
Country_ID	alphanumeric(2)	Primary key
Description	alphanumeric(30)	

LANGUAGE

This is the look-up table which stores the information of languages exists all over the world. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Language ID	**alphanumeric(2)**	**Primary key**
Description	alphanumeric(30)	

EXPERT_LANGUAGE

This is the sub-table of EXPERT_DETAIL which stores language spoken by experts. The format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Language_ID	**alphanumeric(2)**	**Foreign key**

EXPERT_AWARDS

This is the sub-table of EXPERT_DETAIL which stores information of awards honored to experts. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Award_title	alphanumeric(20)	
Award_description	alphanumeric(80)	
Year_received	alphanumeric(4)	
Country_ID	**alphanumeric(2)**	**Foreign key**
Institution_name	alphanumeric(20)	

CURRENT_RESEARCH

This is the sub table of EXPERT_DETAIL which stores topic of researches being worked out by experts. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	**alphanumeric(4)**	**Foreign key**
Research_title	alphanumeric(40)	
Research_description	alphanumeric(200)	
Country_of_research	**alphanumeric(2)**	**Foreign key**
Year_start	alphanumeric(4)	
Expected_year_end	alphanumeric(4)	

TOPIC_OF_INTEREST

This is the look-up table of topic of interest. The format of the table is as follows:

Field_Name	Data_type	Remarks
Topic_ID	alphanumeric(4)	Primary key
Description	alphanumeric(40)	

EXPERT_TOPIC_OF_INTEREST

This is the sub table of EXPERT_DETAIL which stores topic of interests of experts. The format of the table is as follows:

Field_Name	Data_type	Remarks
Expert_ID	alphanumeric(4)	Foreign key
Topic_ID	alphanumeric(4)	Foreign key

REGION

This is the look-up table which stores regions. The format of the table is as follows:

Field_Name	Data_type	Remarks
Region_ID	alphanumeric(4)	Primary key
Description	alphanumeric(40)	

Indexes

Index is required to increase the performance of searching. Usually index is put on all key fields. The list of index used for database on expert is as follows.

Field Name	Table Name	Index Name
Expert_ID	Expert_Detail	Idx.Expert_Detail.Expert_ID
Country_place_of_birth	Expert_Detail	idx.Expert_Detail.Country_place_of_birth
Home_address_country_ID	Expert_Detail	idx.Expert_Detail.Home_address_country_ID
Office_address_country_ID	Expert_Detail	idx.Expert_Detail.Office_address_country_ID
Office_field_ID	Expert_Detail	idx.Expert_Detail.Office_field_ID
Office_sub_field_ID	Expert_Detail	idx.Expert_Detail.Office_sub_field_ID
Expert_ID	Expert_education	idx.Expert_education.Expert_ID
Country_ID	Expert_education	idx.Expert_education.Country_ID
Field_ID	Expert_education	idx.Expert_education.Field_ID
Sub_field_ID	Expert_education	idx.Expert_education.Sub_field_ID
Expert_ID	Expert_job_history	idx.Expert_job_history.Expert_ID
Field_ID	Expert_job_history	idx.Expert_job_history.Field_ID
Sub_field_ID	Expert_job_history	idx.Expert_job_history.Sub_field_ID
Country_ID	Expert_job_history	idx.Expert_job_history.Country_ID
Expert_ID	Expert_publications	idx.Expert_publications.Expert_ID
Field_ID	Expert_publications	idx.Expert_publications.Field_ID
Sub_field_ID	Expert_publications	idx.Expert_publications.Sub_field_ID
Country_published	Expert_publications	idx.Expert_publications.Country_published
Expert_ID	Expert_nationality	idx.Expert_nationality.Expert_ID
Nationality_ID	Expert_nationality	idx.Expert_nationality.Nationality_ID
Expert_ID	Expert_field	idx.Expert_field.Expert_ID
Field_ID	Expert_field	idx.Expert_field.Field_ID

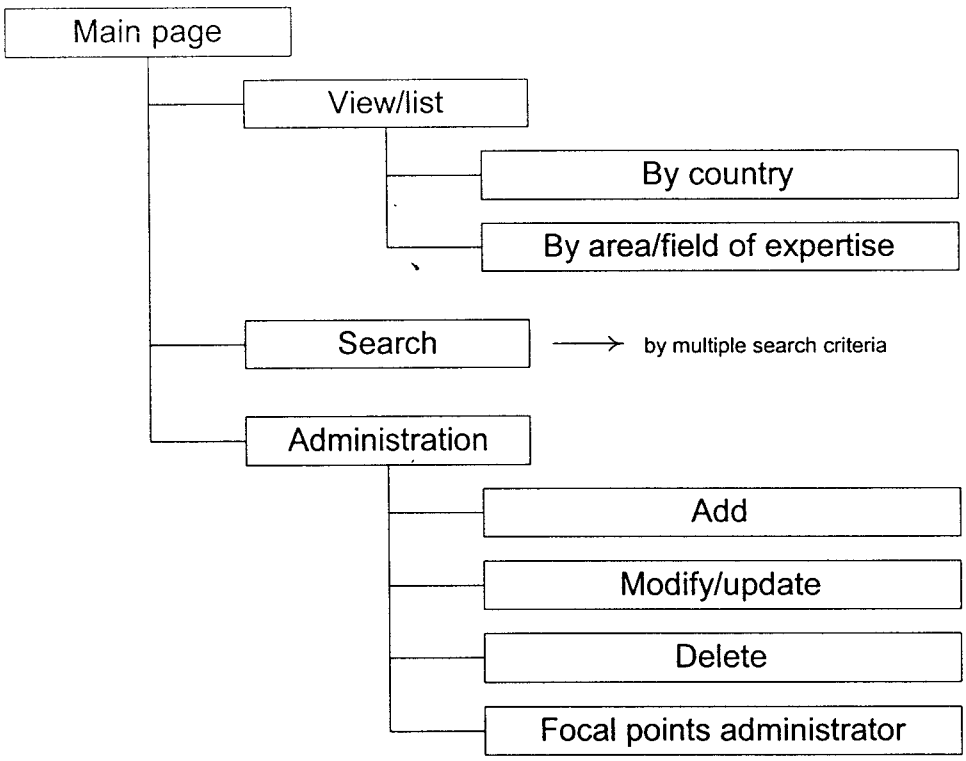
Sub_field_ID	Expert_field	idx.Expert_field.Sub_field_ID
Field_ID	Field	idx.Field.Field_ID
Field_ID	Sub_field	idx.Sub_field.Field_ID
Sub_field_ID	Sub_field	idx.Sub_field.Sub_field_ID
Region_ID	Country	idx.Country.Region_ID
Country_ID	Country	idx.Country.Country_ID
Language ID	Language	idx.Language.Language ID
Expert_ID	Expert_language	idx.Expert_language.Expert_ID
Language_ID	Expert_language	idx.Expert_language.Language_ID
Expert_ID	Expert_awards	idx.Expert_awards.Expert_ID
Country_ID	Expert_awards	idx.Expert_awards.Country_ID
Expert_ID	Current_research	idx.Current_research.Expert_ID
Country_of_research	Current_research	idx.Current_research.Country_of_research
Topic_ID	Topic_of_interest	idx.Topic_of_interest.Topic_ID
Expert_ID	Expert_topic_of_interest	idx.Expert_topic_of_interest.Expert_ID
Topic_ID	Expert_topic_of_interest	idx.Expert_topic_of_interest.Topic_ID
Region_ID	Region	idx.Region.Region_ID

Chapter

System Architecture

Web page structure

The database on expert will be presented through web-based interface. The menu tree of the web presentation is as follow:



Main page

- welcome page and messages whenever the web page of expert opened
- shows three submenus: view/list, search, and administration

View/list menu

- menu to view or list the content of database on expert
- shows two submenus: view by country and view by field of expertise

Search menu

- menu to search expert data based on multiple search criteria
- shows fields of search criteria. At least one criteria must be filled in to start searching. The list of search criteria is as follows:
  - Expert ID
  - Expert Name
  - Sex
  - Country of current address
  - Country of current office
  - Nationality
  - Field of expertise
  - Publication/paper title
  - Region
  - Active language
  - Award title
  - Current research title

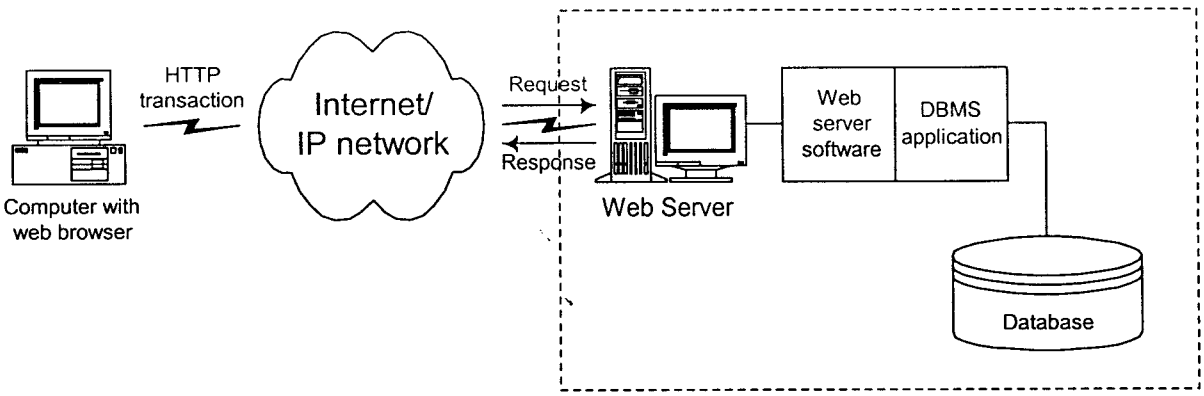
Administration

- menu to administer the content of the database. "Administer" here refers to add, modify/update, and delete data.
- only authorized users have the grant to administer.

- to prevent disturbance from illegal administrator, a login form is shown whenever the module is run.
- rule to administer the data:
  - only focal points administrator can add, modify, and delete data of experts
  - only NAM Centre administrator can maintain data of focal points administrators
  - every change of the data has to be logged

Web System Architecture

In the initial stage, the database on expert will be stored centrally in NAM-CSSTC web server. Tools required in the server to enable people connected to the Internet all over the world to browse the information are web server software and DBMS applications. The complete diagram on how the tools are linkaged each other is as follows.



Web server software

As mentioned in the previous chapter, a web server software is required to handle requests from browsers. It receives requests from the network, interprets, send a system call internally to process the request, receive the result of the system call, and then send the response to the request sender. The system call can run a DBMS application if the request wants to query a particular database to search information in it. Two of the most popular commercial web browsers in the market are Internet Information Server (IIS) and Personal Web Server (PWS).

DBMS Application

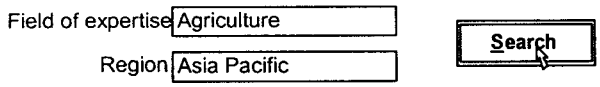
DBMS application is the tool to communicate with the database to search particular information or data in it. Usually a DBMS application is written under a tool which packaged together with its native database. However, nowadays there are a lot of commercial DBMS development tools which comes independently.

Future Improvement and Enhancement

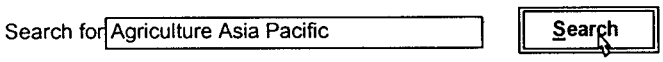
Search Engine

Searching capability can be enhanced by using meta language search. By using this, user will only type word(s) he wants to find, then the search engine will try to find out where the associated word(s) can be found from. There is no need to show which field(s) the user will search from.

For example, if a user wants to find experts in the field of agriculture and live in region of Asia Pacific, he has to fill in two fields: field of expertise and region.



In meta language search, the user will only fill in one blank space, and then the search engine will work the rest:



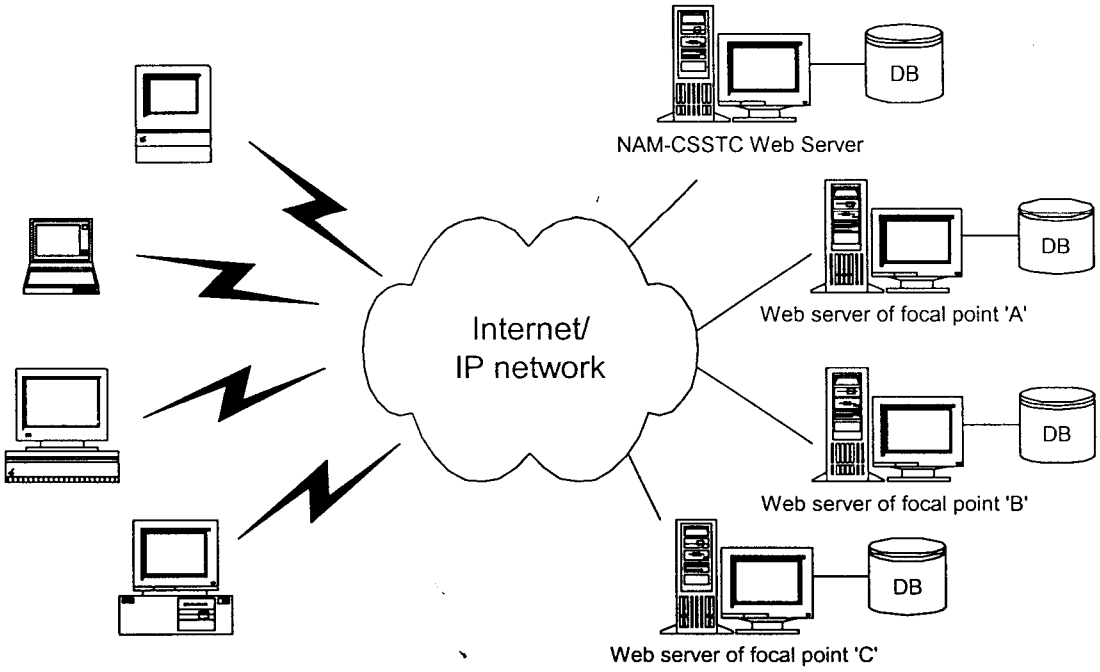
Infrastructure

At the initial stage, database on experts will be placed centrally in NAM-CSSTC web server. This should be adequate to handle small number of access (in Internet term, it is called 'hit'). In the future, when the number of hits grow rapidly, the database on expert should be distributed on every focal point in order to:

- Reduce the workload of NAM-CSSTC web server
- Keeping up the database availability whenever NAM-CSSTC web server shut down for whatever purpose. While NAM-CSSTC web server shut down, the other focal point web server can take over the work.
- Increase the browsing performance. In a single centralized database server configuration, every request to query the information from all over the world will

always be routed to NAM-CSSTC web server. In distributed database configuration, every request to query need to be routed only to its nearest focal point in its region. Only if the nearest focal point web server is down then the request has to be routed to the other available focal points.

However, the distributed database configuration needs more attention and effort to maintain. Data integrity and consistency have to be managed carefully, in order to avoid any data duplication and corruption.



Distributed database

Website

It is important to note that the website is developed upon the concept of gradually building web pages as new content becomes available. Information may be provided as soon as it is known, then updated or changed as time moves on and plans become firm. Anticipating the changes that will come can make this aspect of Web site maintenance a bit easier.

In order to improve the web's content integrity, availability, and ease of navigation, several improvements and advanced technique should be addressed in the near future.

Highlighting new or updated information

Many sites have adopted a means of drawing attention to information, which is *new* or recently *changed*. However, we should be certain to review pages looking for such notations on a regular basis. To make it even easier to locate those that are obsolete, consider adding a comment tag to indicate when the notation was posted or when it should be taken down.

Formatted Web pages for e-mail or print

Although most browsers provide a means for saving or printing the displayed Web page as a formatted text file, it will be helpful to provide such a dedicated, convenient facility. A quick way to do this (rather than wait for a full-function browser to start up) is to use the -dump switch in Lynx and redirect the output to a file. The result is a flat text rendering of the page, which can be included in or attached to your e-mail message and read by the recipient.

Forms and feedback

In the near future, we will provide simple forms to permit readers to send questions and comments to the webmaster in case they had problems reading a particular page. This was soon followed by more advanced forms, such as: the on-line membership form, our "Thank You" form, and a few others. As more involved questions began being submitted, several advanced technique can be introduced. The pull-down menu fields on this form made it easier to identify who could best resolve the question and be certain it could be routed to them more quickly. More recently, a special form was added to allow membership records to be updated easily, without the need to submit a complete new membership form.

All of these forms resulted in a simple e-mail message to the appropriate staff or volunteers. These people would then deal with the e-mail as needed. It is simple, but effective.

Saving data and generating pages

A Web interface can be created to allow webmasters to create a summary of all information or materials submitted to the webpage. This summary listed such items as needed, depend on requirements. Webmaster can select, track, view, edit, and make necessary changes. The summary could then be viewed by stakeholder on-line immediately.

Further extensions to this interface allowed automatic creation and saving of the detailed information and track breakout that has been available on-line. Thus, any of the stakeholder could create a response or reply and post it for readers as it changed -- without the webmaster being a bottle-neck in the process as had happened in past years.

Image maps

Image map can be a very effective way to help readers navigate to the information they need. Most pages on the website contain two image maps:

- the header logo may be used to return to the welcome page, move to the related site, get some general information about the author, or view the site's Table of Contents.

- the footer graphic allows readers to move directly to any of the major portions of the site quickly.

Both were created to provide maximum information using minimum bandwidth. As was recommended above, both client-side and server-side implementations are provided so that the majority of readers can use the maps.

Pages for internal or limited use only

If we have information targeted at a particular group of readers that we would prefer not be seen by others on the same side of the firewall, we can authorize the readers by using the user ID and password feature of the Web.

Special sub-directories are set up with unique access passwords on each. The IDs and passwords are shared with the appropriate committee members so they may access the pages required. A single ID can be a member of multiple groups, so that they only need to remember one access mechanism to get to all the pages they need. More simple way, we can create a single generic ID to pass to all members of the same group or committee if you prefer.

Off-line browsing

Provide off-line browsing, which means readers can view the entire site on their own computer much faster than if they were on-line. And, readers save money on dial-up costs

Provide an index page for each directory

This may be obvious, but it is very important to provide a default page in each subdirectory which is displayed when just the directory name is passed from the browser to the server. This allows visitors to simply erase the file name from their URL and "back up" to what they expect to be our index or pointer into the subject matter.

Use of a default index page also prevents visitors from viewing site's directory listing and selecting a page which may be under construction and not yet ready for public viewing.

Provide a directory for each topic

Proper segmentation into directories of related information makes it easier to locate similar information and it provides a simpler mechanism for granting access to related files either for content editors (via file permissions) or for site visitors (via server authorization files, passwords, etc.) In addition, it facilitates analysis of site metrics if we are using a program which can "roll-up" the counts for all pages beneath each directory.

It is best to keep each directory addressing a single topic. Try not to mix multiple topics together, even if they are relatively small. As soon as they begin to grow (and they usually do), it is likely you will want to have separate directories. However, by then the various page URLs will be know by search engines and be referenced by other sites' pages and contained in visitors' bookmarks. Remember to provide adequate cross-reference links both to other pages within the same topic and to other topics, which may be related.

A directory for Images

While it is possible to intersperse images with the text files, separating them into their own commonly named directories provides a number of benefits. The separate directories "unclutter" our text directories, making maintenance easier. Tools, which manipulate text, check links, and analyze logs can be configured or written to avoid descending into or considering known image directories, saving time and simplifying reporting.

Slash or relative links (vs domain-specific)

If we are mirroring your site, in general we should be careful to use links which do not contain the site's domain name. This keeps all cross-references working on the mirror site

at which the visitor first began reading your pages. If we use a domain-specific link, they will be shuttled to that particular domain (or physical machine) and remain there for all future site-relative links. This may mean that someone trying to use our European mirror suddenly will be making multiple trans-Atlantic accesses to a US based site and suffering the related latency or expense involved with such links.

Places non-domain-specific links hurt

Despite what we just covered above, there *are* times when domain-specific links are not only desired, but required. For example, if we have a CGI application which submits or alters data or pages, such manipulation needs to take place on the "master" site. Otherwise, only that particular mirror will contain the change, and only for a short time at that. Subsequent mirror operations will cover up the change with the original content, causing it to be lost.

Un-mirrored subdirectories

There are some directories and types of data probably we *do not* want to mirror. While we may want to store the analyzed reports of site acccess on all mirrors, it is unlikely we want to mirror the actual raw log files. Private files, certain password protected files, and user-specific files are other categories we should consider when designing mirror.

Each server will normally have its own configuration files. When functional configuration changes are made (e.g. access restriction and page redirection) these changes will need to be made in each mirror's configuration files. This can be facilitated by mirroring the master configuration files, but saving them in a side directory on the mirror, not into the location actually used by the mirror for its own configuration. Then, the changes can be discovered and implemented by hand, or automated in full or in part by a `cron` job.

Permissions

Since the mirror process may not run as the same user or group as the Web server or the site maintainers, particular attention must be paid to file and directory permissions. It is all too easy for a maintainer to make a local copy of a file but leave it with permissions preventing the mirror process from reading it (even if the Web server can). This then results in extraneous error log entries which must be reconciled. Worse yet, the page may later be determined to be something of value and commissioned for public viewing on the master site, but be unavailable on the mirror. (The error was logged, but it became one of those "expected" errors and was ignored when the page "went public".)

Compatible versions of installed programs

Finally, once all required information may be found on each of the mirrors, it is equally important that compatible revisions of system and application software be available. For example, it may not be important whether `perl` 5.003 or 5.004 is available, but it probably must be a version of 5.x.

If we have control of each of the mirrors, it should be a simple matter to upgrade certain programs to be of a compatible version. However, if we are sharing a mirror machine, that may not be possible. In certain circumstances, it may be necessary to modify our web site so that it may be accommodated on all mirrors.

Appendix A

The ISO-3166 Country Code

Code	Country name
AF	Afghanistan (Islamic Republic of)
AL	Albania (Republic of)
DZ	Algeria (People's Democratic Republic of)
AS	American Samoa
AD	Andorra (Principality of)
AO	Angola (People's Republic of)
AI	Anguilla
AQ	Antarctica
AG	Antigua and Barbuda
AR	Argentina (Argentine Republic)
AM	Armenia
AW	Aruba
AU	Australia
A T	Austria (Republic of)
AZ	Azerbaijan
BS	Bahamas (Commonwealth of the)
BH	Bahrain (State of)
BD	Bangladesh (people's Republic of)
BB	Barbados
BY	Belarus
BE	Belgium (Kingdom of)
BZ	Belize
BJ	Benin (people's Republic of)
BM	Bermuda
BT	Bhutan (Kingdom of)
BO	Bolivia (Republic of)
BA	Bosnia-Herzegovina
BW	Botswana (Republic of)
BV	Bouvet Island
BR	Brazil (Federative Republic of)
IO	British Indian Ocean Territory
BN	Brunei Darussalam
BG	Bulgaria (Republic of)
BF	Burkina Faso (Fonnerly Upper Volta)
BI	Burundi (Republic of)

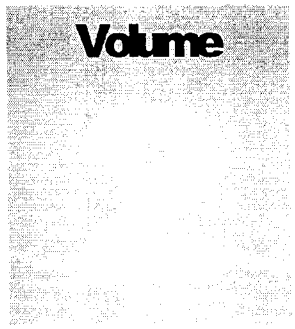
KH	Cambodia
CM	Cameroon (Republic of)
CA	Canada
CV	Cape Verde (Republic of)
KY	Cayman Islands
CF	Central African Republic
TD	Chad (Republic of)
CL	Chile (Republic of)
CN	China (People's Republic of)
CX	Christmas Island (Indian Ocean)
CC	Cocos (Keeling) Islands
CO	Colombia (Republic of)
KM	Comoros (Islamic Federal Republic of the)
CG	Congo (Republic of the)
CK	Cook Islands
CR	Costa Rica (Republic of)
CI	Cote d'Ivoire (Republic of)
HR	Croatia
CU	Cuba (Republic of)
CY	Cyprus (Republic of)
CZ	Czech Republic
DK	Denmark (Kingdom of)
DJ	Djibouti (Republic of)
DM	Dominica (Commonwealth of)
DO	Dominican Republic
EC	Ecuador (Republic of)
EG	Egypt (Arab Republic of)
SV	El Salvador (Republic of)
GQ	Equatorial Guinea (Republic of)
ER	Eritrea
EE	Estonia (Republic of)
ET	Ethiopia (People's Democratic Republic of)
FK	Falkland Islands (Malvinas) .
FO	Faroe Islands
FJ	Fiji (Republic of)
FI	Finland (Republic of)
FR	France (French Republic)
GF	French Guiana
PF	French Polynesia
TF	French Southern Territories
GA	Gabon (Gabonese Republic)
GM	Gambia (Republic of the)
GE	Georgia (Republic of)
DE	Germany (Federal Republic of)
GH	Ghana (Republic of)
GI	Gibraltar
GR	Greece (Hellenic Republic)
GL	Greenland
GD	Grenada

GP	Guadeloupe (French Department of)
GU	Guam
GT	Guatemala (Republic of)
GN	Guinea (Republic of)
GW	Guinea-Bissau (Republic of)
GY	Guyana (Republic of)
HT	Haiti (Republic of)
HM	Heard and McDonald Islands
HN	Honduras (Republic of)
HK	Hong Kong
HU	Hungary (Republic of)
IS	Iceland (Republic of)
IN	India (Republic of)
ID	Indonesia (Republic of)
IR	Iran (Islamic Republic of)
IQ	Iraq (Republic of)
IE	Ireland
IL	Israel (State of)
IT	Italy (Italian Republic)
JM	Jamaica
JP	Japan
JO	Jordan (Hashemite Kingdom of)
KZ	Kazakhstan
KE	Kenya (Republic of)
KI	Kiribati (Republic of)
KP	Korea (Democratic People's Republic of)
KR	Korea (Republic of)
KW	Kuwait (State of)
KG	Kyrgyz Republic
LA	Lao People's Democratic Republic
LV	Latvia (Republic of)
LB	Lebanon (Lebanese Republic)
LS	Lesotho (Kingdom of)
LR	Liberia (Republic of)
LY	Libyan Arab Jamahiriya
LI	Liechtenstein (Principality of)
LT	Lithuania
LU	Luxembourg (Grand Duchy of)
MO	Macau (Ao-me'n)
MK	Macedonia (Former Yugoslav Republic of)
MG	Madagascar (Democratic Republic of)
MW	Malawi (Republic of)
MY	Malaysia
MV	Maldives (Republic of)
ML	Mali (Republic of)
MT	Malta (Republic of)
MH	Marshall Islands (Republic othe)
MQ	Martinique (French Department of)
MR	Mauritania (Islamic Republic of)

MU	Mauritius
YT	Mayotte
MX	Mexico (United Mexican States)
FM	Micronesia (Federated States of)
MD	Moldova (Republic of)
MC	Monaco (Principality of)
MN	Mongolia
MS	Montserrat
MA	Morocco (Kingdom of)
MZ	Mozambique (People's Republic of)
MM	Myanmar (Union of)
NA	Namibia (Republic of)
NR	Nauru (Republic of)
NP	Nepal (Kingdom of)
NL	Netherlands (Kingdom othe)
AN	Netherlands Antilles
NT	Neutral Zone (between Saudi Arabia and Iraq)
NC	New Caledonia
NZ	New Zealand
NI	Nicaragua (Republic of)
NE	Niger (Republic of the)
NO	Nigeria (Federal Republic of)
NU	Niue
NF	Norfolk Island
MP	Northern Mariana Islands (Commonwealth of the)
NO	Norway (Kingdom of)
OM	Oman (Sultanate of)
PK	Pakistan (Islamic Republic of)
PW	Palau (Republic of)
PA	Panama (Republic of)
PO	Papua New Guinea
PY	Paraguay (Republic of)
PE	Peru (Republic of)
PH	Philippines (Republic of the)
PN	Pitcaim
PL	Poland (Republic of)
PT	Portugal (portuguese Republic)
PR	Puerto Rico
QA	Qatar (State of)
RE	Re'union (French Deparbnent of)
RO	Romania
RU	Russian Federation
RW	Rwanda (Rwandese Republic)
SH	Saint Helena
KN	Saint Kitts and Nevis
LC	Saint Lucia
PM	Saint Pierre and Miquelon (French Department of)
VC	Saint Vincent and the Grenadines i
WS	Samoa (Independent State of)

SM	San Marino (Republic of)
ST	Sao Tome and Principe (Democratic Republic of)
SA	Saudi Arabia (Kingdom of)
SN	Senegal (Republic of)
SC	Seychelles (Republic of)
SL	Sierra Leone (Republic of)
SG	Singapore (Republic of)
SK	Slovakia
SI	Slovenia
SB	Solomon Islands
SO	Somalia (Somali Democratic Republic)
ZA	South Africa (Republic of)
ES	Spain (Kingdom of)
LK	Sri Lanka (Democratic Socialist Republic of)
SD	Sudan (Democratic Republic of the)
SR	Suriname (Republic of)
SJ	Svalbard and Jan Mayen Islands
SZ	Swaziland (Kingdom of)
SE	Sweden (Kingdom of)
CH	Switzerland (Swiss Confederation)
SY	Syria (Syrian Arab Republic)
TW	Taiwan, Province of China
TJ	Tajikistan
TZ	Tanzania (United Republic of)
TH	Thailand (Kingdom of)
TG	Togo (Togolese Republic)
TK	Tokelau i
TO	Tonga (Kingdom of)
TT	Trinidad and Tobago (Republic of)
TN	Tunisia
TR	Turkey (Republic of)
TM	Turkmenistan
TC	Turks and Caicos Islands
TV	Tuvalu
UG	Uganda (Republic of)
UA	Ukraine
AE	United Arab Emirates
GB	United Kingdom (United Kingdom of Great Britain and Northern Ireland)
US	United States (United States of America)
UM	United States Minor Outlying Islands
UY	Uruguay (Eastern Republic of)
UZ	Uzbekistan
VU	Vanuatu (Republic of, formerly New Hebrides)
VA	Vatican City State (Holy See)
VE	Venezuela (Republic of)
VN	Vietnam (Socialist Republic of)
VG	Virgin Islands (British)
VI	Virgin Islands (U.S.)
WF	Wallis and Futuna Islands

EH	Western Sahara
YE	Yemen (Republic of)
YU	Yugoslavia (Socialist Federal Republic of)
ZR	Zaire (Republic of)
ZM	Zambia (Republic of)
ZW	Zimbabwe (Republic of)



Non Aligned Movement

Center for South-South Technical Cooperation

Database on Cases

DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

Database on Cases

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Chapter

The Need for Database on Expert

Background

The Non Alignment Movement Center for South-South Technical Cooperation (NAM CSSTC) was developed to assist developing countries in technical cooperation for accelerating the development of those countries. It was officially initiated in Belgrade, Yugoslavia in 1961 as an obvious act to institutionalize the Dasa Sila Bandung or the Ten Principal of Bandung, in order that the position of the developing countries will be put forward with the result that their struggle direction is clearer.

Dasa Sila Bandung is an important principal document issued by the Five Countries preceded in Asia-Africa Conference. It is a substantively emphasize the important roles of Human Rights, State Sovereignty, Non-Aggression, Cooperative and Justice must be act as the base of International Cooperation.

The Non Alignment Movement is committed to wage war on poverty, illiteracy and underdevelopment. It is planned to advance broad-based and people centered development, including the quality improvement of the human resources. Based on that, the developing countries, which are member of NAM, can accelerate their development program based on equitable distribution, growth and stability. All programs of NAM CSSTC designed could have immediate as well as longer-term impacts to render the economics of developing countries of NAM member to be more broad-based, efficient and resilient to participate in the globalization process and strengthen cooperation among developing countries.

The mission of NAM CSSTC is to contribute and enhancement of development and collective self-reliance of the developing countries by strengthening and expanding South-South technical cooperation in the context of international development cooperation.

The objective of NAM CSSTC is enhancement of people centered development and capitalization of local resources through constructive interaction among development actors and partnership in development.

The Importance of ICT

Information - Communication Technology (ICT) is recognized by NAM members as an important technology will significantly enhance such development among member countries. The implementation of ICT worldwide has however resulted in a widening digital

divide not only between developed countries and developing countries, but also among NAM members.

ICT has become an indispensable tool in the fight against world poverty. It provides developing countries with an unprecedented opportunity to meet vital development goals such as poverty reduction, basic healthcare and education, which will become more effectively, including illiteracy reduction. Access to information networks will also allows countries using the networks to share information & experience from the others, action coordination, and improve their welfare.

This technology could accelerate development in far more than just the economic sphere. Indeed, connecting the world will transform it beyond recognition. It also could unlock the productivity of developing countries. Greater connectivity will also help fulfill the nearly insatiable human thirst for information and expose geographically isolated communities to wider information and new opportunities, which could create a more advance social and political outlook. Access to ICT networks can help people at all economic levels to meet their basic needs.

Finally, countries that succeed in harnessing the potential of ICT can look forward to greatly expanded economic growth, improved human welfare and stronger forms of democratic system.

In the information age, countries that do not provide access to information networks will not grow, no matter how rich their natural resources. ICT appears to be an essential component of development initiatives and can act as a powerful overall enable of development.

Advances in ICT have driven the last decade's economic boom and the integration of markets around the world. A lot of benefits from ICT and the rapid rise of the Internet have so far accrued to the developed world. Money spent on the digital infrastructure that supports these burgeoning new services that become a major engine of economic growth in some countries.

In the developing countries, ICT connectivity is growing, but the increased productivity and other benefits of the digital revolution are still pretty low. NAM CSSTC want to play the role to assist developing countries in taking advantage of ICT's potential and integrating ICT into the mainstream of their development activities.

Using ICT connectivity, developing countries can take benefits from on-line databases that are giving the important information, the latest discoveries, and also sharing experience with some experts.

The Need of Online Database

The global gap among developed & developing countries is quite real. Almost all of developed countries have no constraint in developing their own research for finding the newest technology & methodology, especially from the financial aspect. Majority of those technology are published through the on-line database developed by some institutional of developed countries.

The existence of database is very needed, especially for developing countries. It becomes an indispensable tool in the fight against world poverty. Majority of developing countries has

some constraints to develop their own research for improving their welfare - even solving their basic problems such as medical treatment & technology, educational method & material, agricultural system, biotechnology, energy exploration etc. With countries in the developing world stretching their budgets to the limit, and with education & research ranking low on some governments' list of spending priorities, the role of on-line database become very important.

The further enhance of the on-line database is a sharing experience and an optional consultancy with the experts. People can get additional information needed that is not available through the database with make a direct contact to the expert. It can be also used by the consultant, who can provide their service such as additional suggestion or analysis.

Access to on-line database can help people at all economic levels to meet their basic needs. Greater connectivity to the experts will help fulfill the nearly insatiable human thirst for the latest information, discovery & method needed for welfare improving. Wiring the planet with on-line database will transform the poverty into the prosperity. It will increase access to the educational materials, basic health information and other critical resources. For example, a single database in English, French, Spanish, Chinese or Hindi could serve a lot of continent and help so many people in the world. It could unlock the productivity level of developing countries, even the poor communities. It also could save human life in the rural areas while the experience manpower & equipped hospital is not available to handle some complicated cases and the patient has to race in time.

Majority of communities in developing countries is depending on agriculture. Agricultural development program will become the highest priority to increase the prosperity of their community. Latest information, new method & technology on agriculture will help them to improve the productivity.

The global economy in the world is relying more than ever on brain power and innovation rather than raw materials and labors only, as a generator of good wealth. A good education has become the key factor determining who will succeed and who will be left behind. The developing countries should pay attention on education program to prepare educated & skilled human resources in facing the high competition of labor market. It could allow them to reduce the gap among developing countries and developed countries. In eliminating the financial constraint, the governments of developing countries could expand the educational opportunities to as many people as possible with keeping down costs through bench mark educational methods & materials of other developed countries. Some cases of successful educational program in on-line database could be used in improving educational system of developing countries.

Connectivity to the on-line database allow developing countries to save their budget & time for getting the latest method or knowledge to meet their basic needs & improve their prosperity. Using the published experiences in the on-line database, developing countries should not allocate special budget for developing their own expensive research.

Cost can be contained by making full use of existing database. The database web sites would also be self-financing when fully developed. To facilitate regular updating information, an automatic prompting system could be set up. Finally, a search mechanism could be developed that will ensure the compatibility and connectivity of the diverse databases.

Chapter 2

Database Structure

The Data Model

A data model is a collection of conceptual tools for describing data, data relationships, data semantics, and data constraints. The model is needed to describe the structure of database on cases.

The overall logical structure of data relationships of database on cases is visualized below which consist of the following components:

Rectangles, which represents set record(s) of a table.

Symbol of :

which represents "one to many" relationship.

It means one key record in table A could have any associated records in table B. However, one record in B could only have one associated record in A. For example:

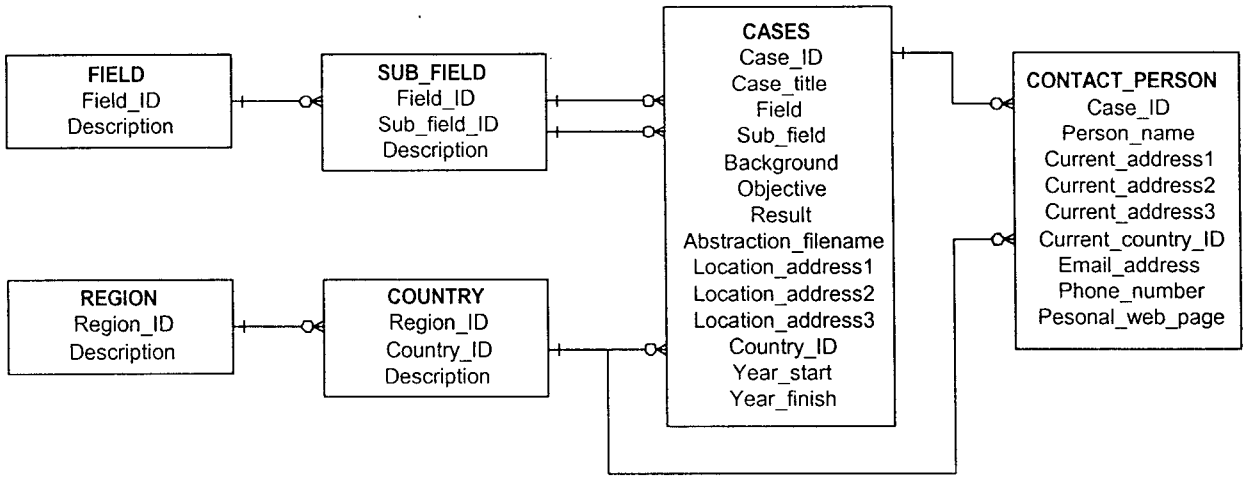
REGION

Region_ID	Description
AP	Asia Pacific
SA	South America

COUNTRY

Region_ID	Country_ID	Description
AP	PH	Philippines
AP	ID	Indonesia
AP	MY	Malaysia
SA	BR	Brazil
SA	GT	Guatemala

The following layout shows how the model is constructed.



The data model of database on cases pivots around the CASES. This is the table where the most common data of cases stored.

Tables and Indexes

Tables

CASES

CASES is the main table which stores common detail information of cases. The complete format of the table is as follows:

Field_Name	Data_type	Remarks
Case_ID	**alphanumeric(4)**	**Primary key**
Case_title	alphanumeric(40)	
Field	alphanumeric(2)	
Sub_field	alphanumeric(4)	
Background	alphanumeric(200)	
Objective	alphanumeric(200)	
Result	alphanumeric(200)	
Abstraction_filename	alphanumeric(20)	
Location_address1	alphanumeric(40)	
Location_address2	alphanumeric(40)	
Location_address3	alphanumeric(40)	
Country_ID	**alphanumeric(2)**	**Foreign key**
Year_start	alphanumeric(4)	
Year_finish	alphanumeric(4)	

CONTACT_PERSON

This is the sub-table of CASES which stores contact person(s) of the particular case(s). The complete format of CONTACT_PERSON is as follows:

Field_Name	Data_type	Remarks
Case_ID	**alphanumeric(4)**	**Foreign key**
Person_name	alphanumeric(40)	
Current_address1	alphanumeric(40)	
Current_address2	alphanumeric(40)	
Current_address3	alphanumeric(40)	
Current_country_ID	**alphanumeric(2)**	**Foreign key**
Email_address	alphanumeric(40)	
Phone_number	alphanumeric(15)	
Pesonal_web_page	alphanumeric(40)	

FIELD

This is the look-up table that stores field ID and its description. The format of the table is as follows:

Field_Name	Data_type	Remarks
Field_ID	**Alphanumeric(2)**	**Primary key**
Description	Alphanumeric(40)	

SUB_FIELD

This is the look-up table which stores sub field ID and its descriptions. The format of the table is as follows:

Field_Name	Data_type	Remarks
Field_ID	**alphanumeric(2)**	**Foreign key**
Sub_field_ID	**alphanumeric(4)**	**Primary key**
Description	alphanumeric(40)	

COUNTRY

This is the look-up table which stores country ID and name. The country ID will be based on ISO-3166 which consists of only 2 character. Please refer to appendix A to see the complete list of ISO-3166 country ID.

The format of country table is as follows:

Field_Name	Data_type	Remarks
Region_ID	**Alphanumeric(4)**	**Foreign key**
Country_ID	**alphanumeric(2)**	**Primary key**
Description	alphanumeric(30)	

REGION

This is the look-up table which stores regions. The format of the table is as follows:

Field_Name	Data_type	Remarks
Region_ID	**alphanumeric(4)**	**Primary key**
Description	alphanumeric(40)	

Indexes

Index is required to increase the performance of searching. Usually index is put on all key fields. The list of index used for database on cases is as follows.

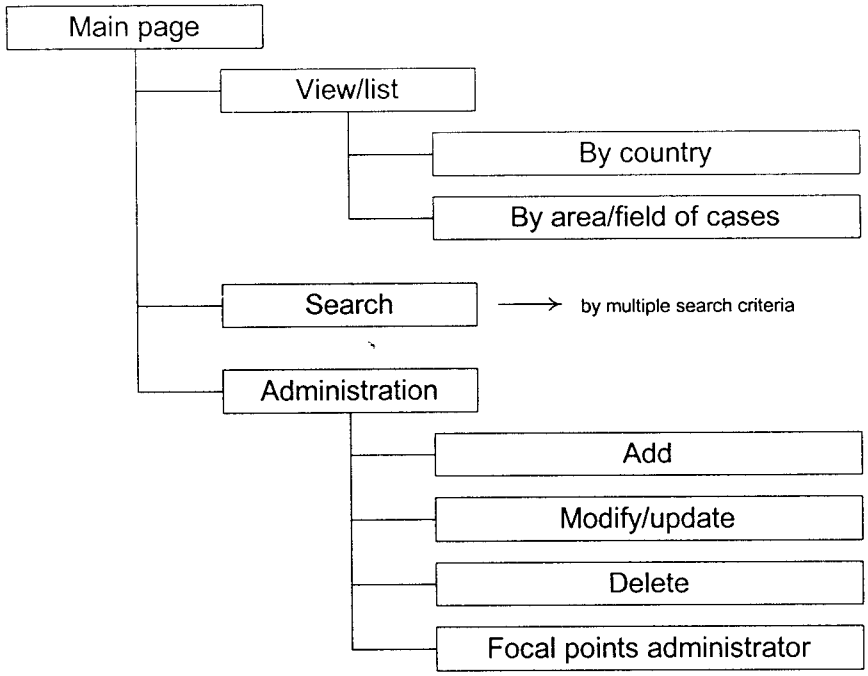
Field Name	Table Name	Index Name
Case_ID	Cases	Idx.Cases.Case_ID
Country_ID	Cases	Idx.Cases.Case_ID
Case_ID	Contact_Person	Idx.Cases.Case_ID
Current_country_ID	Contact_Person	Idx.Cases.Case_ID
Field_ID	Field	Idx.Cases.Case_ID
Field_ID	Sub_Field	Idx.Cases.Case_ID
Sub_field_ID	Sub_Field	Idx.Cases.Case_ID
Region_ID	Country	Idx.Cases.Case_ID
Country_ID	Country	Idx.Cases.Case_ID
Region_ID	Region	Idx.Cases.Case_ID

Chapter

System Architecture

Web page structure

The database on cases will be presented through web-based interface. The menu tree of the web presentation is as follows:



Main page

welcome page and messages whenever the web page of cases opened

shows three submenus: view/list, search, and administration

View/list menu

menu to view or list the content of database on cases

shows two submenus: view by country and view by field of cases

Search menu

menu to search cases data based on multiple search criteria

shows fields of search criteria. At least one criteria must be filled in to start searching. The list of search criteria is as follows:

- Case ID
- Case Name
- Field/Sub field of cases
- Region/Country
- Objective of the cases
- Contact person

Administration

menu to administer the content of the database. "Administer" here refers to add, modify/update, and delete data.

only authorized users have the grant to administer.

to prevent disturbance from illegal administrator, a login form is shown whenever the module is run.

rule to administer the data:

- only focal points administrator can add, modify, and delete data of cases
- only NAM Centre administrator can maintain data of focal points administrators
- every change of the data has to be logged

Web System Architecture

The database on expert will be stored in NAM-CSSTC web server. Tools required in the server to enable people connected to the Internet all over the world to browse the information are web server software and DBMS applications. The complete diagram on how the tools are linkaged each other is as follows.

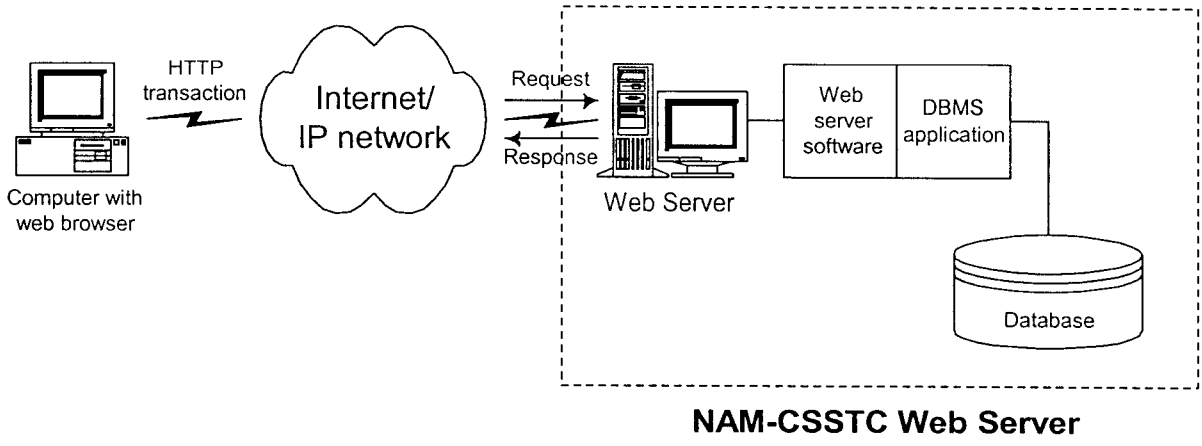
Web server software

As mentioned in the previous chapter, a web server software is required to handle requests from browsers. It receives requests from the network, interprets, send a system call internally to process the request, receive the result of the system call, and then send the response to the request sender. The system call can run a DBMS application if the request

wants to query a particular database to search information in it. Two of the most popular commercial web browsers in the market are Internet Information Server (IIS) and Personal Web Server (PWS).

DBMS Application

DBMS application is the tool to query a database to search particular information or data in the database. Usually a DBMS application is written under a tool which packaged together with its native database. However, nowadays there are a lot of commercial DBMS development tools which comes independently.

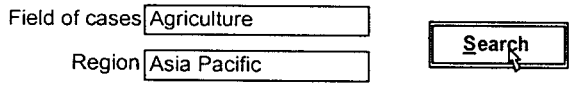


Future Improvement and Enhancement

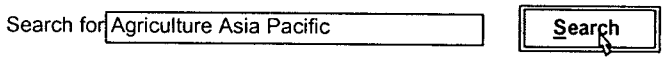
Search Engine

Searching capability can be enhanced by using meta language search. By using this, user will only type word(s) he wants to find, then the search engine will try to find out where the associated word(s) can be found from. There is no need to show which field(s) the user will search from.

For example, if a user wants to find case(s) in the field of agriculture and the occurred in Asia Pacific region, he has to fill in two fields: field of cases and region.



In meta language search, the user will only fill in one blank space, and then the search engine will work the rest:



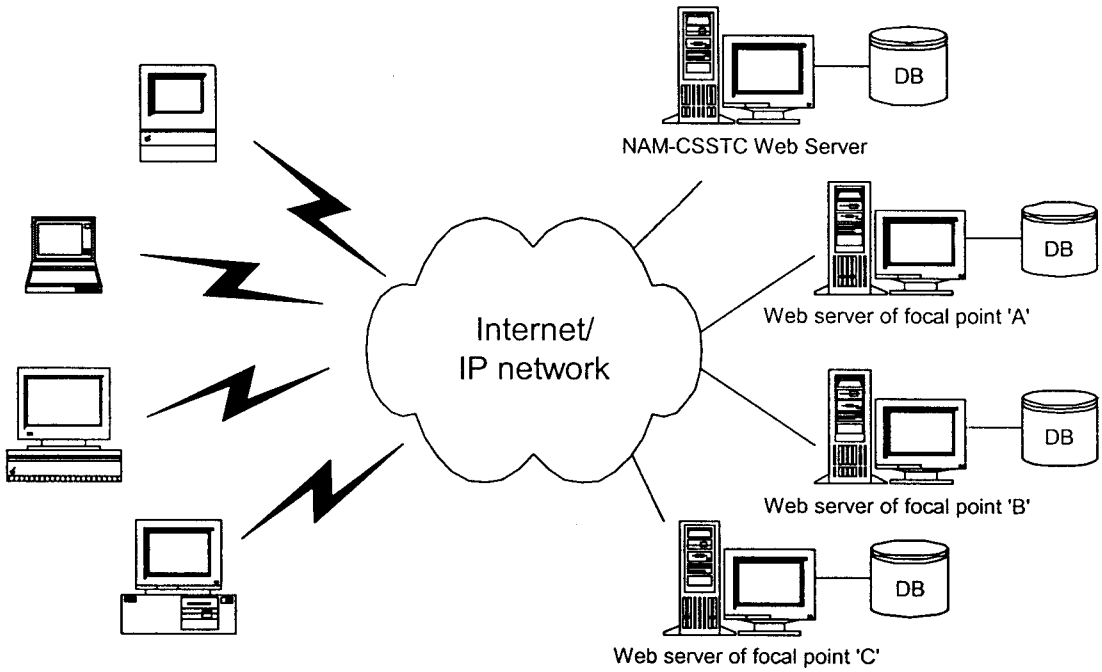
Infrastructure

At the initial stage, database on experts will be placed centrally in NAM-CSSTC web server. This should be adequate to handle small number of access (in Internet term, it is called 'hit'). In the future, when the number of hits grow rapidly, the database on expert should be distributed on every focal point in order to:

- Reduce the workload of NAM-CSSTC web server
- Keep up the database availability whenever NAM-CSSTC web server be shut down for whatever purpose. While NAM-CSSTC web server shut down, the other focal point web server can take over the work.
- Increase the browsing performance. In single centralized database server configuration, every request to query the information from all over the world will always be routed to

NAM-CSSTC web server. In distributed database configuration, every request to query need to be routed only to its nearest focal point in its region. Only if the nearest focal point web server is down then the request has to be routed to the other available focal points.

However, the distributed database configuration needs more attention and effort to maintain. Data integrity and consistency have to be managed carefully, therefore there is no duplicated and corrupted data anywhere.



Distributed database

Website

It is important to note that the website is developed upon the concept of gradually building web pages as new content becomes available. Information may be provided as soon as it is known, then updated or changed as time moves on and plans become firm. Anticipating the changes that will come can make this aspect of Web site maintenance a bit easier.

In order to improve the web's content integrity, availability, and ease of navigation, several improvements and advanced technique should be addressed in the near future.

Highlighting new or updated information

Many sites have adopted a means of drawing attention to information, which is *new* or recently *changed*. However, we should be certain to review pages looking for such notations on a regular basis. To make it even easier to locate those that are obsolete, consider adding a comment tag to indicate when the notation was posted or when it should be taken down.

Formatted Web pages for e-mail or print

Although most browsers provide a means for saving or printing the displayed Web page as a formatted text file, it will be helpful to provide such a dedicated, convenient facility. A quick way to do this (rather than wait for a full-function browser to start up) is to use the -dump switch in Lynx and redirect the output to a file. The result is a flat text rendering of the page, which can be included in or attached to your e-mail message and read by the recipient.

Forms and feedback

In the near future, we will provide simple forms to permit readers to send questions and comments to the webmaster in case they had problems reading a particular page. This was soon followed by more advanced forms, such as: the on-line membership form, our "Thank You" form, and a few others. As more involved questions began being submitted, several advanced technique can be introduced. The pull-down menu fields on this form made it easier to identify who could best resolve the question and be certain it could be routed to them more quickly. More recently, a special form was added to allow membership records to be updated easily, without the need to submit a complete new membership form.

All of these forms resulted in a simple e-mail message to the appropriate staff or volunteers. These people would then deal with the e-mail as needed. It is simple, but effective.

Saving data and generating pages

A Web interface can be created to allow webmasters to create a summary of all information or materials submitted to the webpage. This summary listed such items as needed, depend on requirements. Webmaster can select, track, view, edit, and make necessary changes. The summary could then be viewed by stakeholder on-line immediately.

Further extensions to this interface allowed automatic creation and saving of the detailed information and track breakout that has been available on-line. Thus, any of the stakeholder could create a response or reply and post it for readers as it changed -- without the webmaster being a bottle-neck in the process as had happened in past years.

Image maps

Image map can be a very effective way to help readers navigate to the information they need. Most pages on the website contain two image maps:

- the header logo may be used to return to the welcome page, move to the related site, get some general information about the author, or view the site's Table of Contents.

- the footer graphic allows readers to move directly to any of the major portions of the site quickly.

Both were created to provide maximum information using minimum bandwidth. As was recommended above, both client-side and server-side implementations are provided so that the majority of readers can use the maps.

Pages for internal or limited use only

If we have information targeted at a particular group of readers that we would prefer not be seen by others on the same side of the firewall, we can authorize the readers by using the user ID and password feature of the Web.

Special sub-directories are set up with unique access passwords on each. The IDs and passwords are shared with the appropriate committee members so they may access the pages required. A single ID can be a member of multiple groups, so that they only need to remember one access mechanism to get to all the pages they need. More simple way, we can create a single generic ID to pass to all members of the same group or committee if you prefer.

Off-line browsing

Provide off-line browsing, which means readers can view the entire site on their own computer much faster than if they were on-line. And, readers save money on dial-up costs

Provide an index page for each directory

This may be obvious, but it is very important to provide a default page in each subdirectory which is displayed when just the directory name is passed from the browser to the server. This allows visitors to simply erase the file name from their URL and "back up" to what they expect to be our index or pointer into the subject matter.

Use of a default index page also prevents visitors from viewing site's directory listing and selecting a page which may be under construction and not yet ready for public viewing.

Provide a directory for each topic

Proper segmentation into directories of related information makes it easier to locate similar information and it provides a simpler mechanism for granting access to related files either for content editors (via file permissions) or for site visitors (via server authorization files, passwords, etc.) In addition, it facilitates analysis of site metrics if we are using a program which can "roll-up" the counts for all pages beneath each directory.

It is best to keep each directory addressing a single topic. Try not to mix multiple topics together, even if they are relatively small. As soon as they begin to grow (and they usually do), it is likely you will want to have separate directories. However, by then the various page URLs will be know by search engines and be referenced by other sites' pages and contained in visitors' bookmarks. Remember to provide adequate cross-reference links both to other pages within the same topic and to other topics, which may be related.

A directory for Images

While it is possible to intersperse images with the text files, separating them into their own commonly named directories provides a number of benefits. The separate directories "unclutter" our text directories, making maintenance easier. Tools, which manipulate text, check links, and analyze logs can be configured or written to avoid descending into or considering known image directories, saving time and simplifying reporting.

Slash or relative links (vs domain-specific)

If we are mirroring your site, in general we should be careful to use links which do not contain the site's domain name. This keeps all cross-references working on the mirror site

at which the visitor first began reading your pages. If we use a domain-specific link, they will be shuttled to that particular domain (or physical machine) and remain there for all future site-relative links. This may mean that someone trying to use our European mirror suddenly will be making multiple trans-Atlantic accesses to a US based site and suffering the related latency or expense involved with such links.

Places non-domain-specific links hurt

Despite what we just covered above, there *are* times when domain-specific links are not only desired, but required. For example, if we have a CGI application which submits or alters data or pages, such manipulation needs to take place on the "master" site. Otherwise, only that particular mirror will contain the change, and only for a short time at that. Subsequent mirror operations will cover up the change with the original content, causing it to be lost.

Un-mirrored subdirectories

There are some directories and types of data probably we *do not* want to mirror. While we may want to store the analyzed reports of site acccess on all mirrors, it is unlikely we want to mirror the actual raw log files. Private files, certain password protected files, and user-specific files are other categories we should consider when designing mirror.

Each server will normally have its own configuration files. When functional configuration changes are made (e.g. access restriction and page redirection) these changes will need to be made in each mirror's configuration files. This can be facilitated by mirroring the master configuration files, but saving them in a side directory on the mirror, not into the location actually used by the mirror for its own configuration. Then, the changes can be discovered and implemented by hand, or automated in full or in part by a `cron` job.

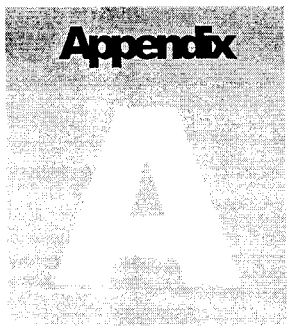
Permissions

Since the mirror process may not run as the same user or group as the Web server or the site maintainers, particular attention must be paid to file and directory permissions. It is all too easy for a maintainer to make a local copy of a file but leave it with permissions preventing the mirror process from reading it (even if the Web server can). This then results in extraneous error log entries which must be reconciled. Worse yet, the page may later be determined to be something of value and commissioned for public viewing on the master site, but be unavailable on the mirror. (The error was logged, but it became one of those "expected" errors and was ignored when the page "went public".)

Compatible versions of installed programs

Finally, once all required information may be found on each of the mirrors, it is equally important that compatible revisions of system and application software be available. For example, it may not be important whether `perl` 5.003 or 5.004 is available, but it probably must be a version of 5.x.

If we have control of each of the mirrors, it should be a simple matter to upgrade certain programs to be of a compatible version. However, if we are sharing a mirror machine, that may not be possible. In certain circumstances, it may be necessary to modify our web site so that it may be accommodated on all mirrors.



The ISO-3166 Country Code

Code	Country name
AF	Afghanistan (Islamic Republic of)
AL	Albania (Republic of)
DZ	Algeria (People's Democratic Republic of)
AS	American Samoa
AD	Andorra (Principality of)
AO	Angola (People's Republic of)
AI	Anguilla
AQ	Antarctica
AG	Antigua and Barbuda
AR	Argentina (Argentine Republic)
AM	Armenia
AW	Aruba
AU	Australia
A T	Austria (Republic of)
AZ	Azerbaijan
BS	Bahamas (Commonwealth of the)
BH	Bahrain (State of)
BD	Bangladesh (people's Republic of)
BB	Barbados
BY	Belarus
BE	Belgium (Kingdom of)
BZ	Belize
BJ	Benin (people's Republic of)
BM	Bermuda
BT	Bhutan (Kingdom of)
BO	Bolivia (Republic of)
BA	Bosnia-Herzegovina
BW	Botswana (Republic of)
BV	Bouvet Island
BR	Brazil (Federative Republic of)
IO	British Indian Ocean Territory
BN	Brunei Darussalam
BG	Bulgaria (Republic of)
BF	Burkina Faso (Fonnerly Upper Volta)
BI	Burundi (Republic of)

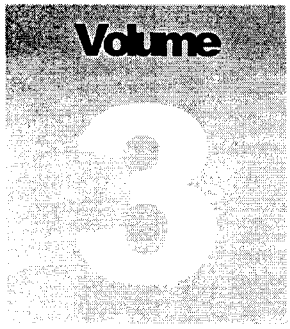
KH	Cambodia
CM	Cameroon (Republic of)
CA	Canada
CV	Cape Verde (Republic of)
KY	Cayman Islands
CF	Central African Republic
TD	Chad (Republic of)
CL	Chile (Republic of)
CN	China (People's Republic of)
CX	Christmas Island (Indian Ocean)
CC	Cocos (Keeling) Islands
CO	Colombia (Republic of)
KM	Comoros (Islamic Federal Republic of the)
CG	Congo (Republic of the)
CK	Cook Islands
CR	Costa Rica (Republic of)
CI	Cote d'Ivoire (Republic of)
HR	Croatia
CU	Cuba (Republic of)
CY	Cyprus (Republic of)
CZ	Czech Republic
DK	Denmark (Kingdom of)
DJ	Djibouti (Republic of)
DM	Dominica (Commonwealth of)
DO	Dominican Republic
EC	Ecuador (Republic of)
EG	Egypt (Arab Republic of)
SV	El Salvador (Republic of)
GQ	Equatorial Guinea (Republic of)
ER	Eritrea
EE	Estonia (Republic of)
ET	Ethiopia (People's Democratic Republic of)
FK	Falkland Islands (Malvinas) .
FO	Faroe Islands
FJ	Fiji (Republic of)
FI	Finland (Republic of)
FR	France (French Republic)
GF	French Guiana
PF	French Polynesia
TF	French Southern Territories
GA	Gabon (Gabonese Republic)
GM	Gambia (Republic of the)
GE	Georgia (Republic of)
DE	Germany (Federal Republic of)
GH	Ghana (Republic of)
GI	Gibraltar
GR	Greece (Hellenic Republic)
GL	Greenland
GD	Grenada

GP	Guadeloupe (French Department of)
GU	Guam
GT	Guatemala (Republic of)
GN	Guinea (Republic of)
GW	Guinea-Bissau (Republic of)
GY	Guyana (Republic of)
HT	Haiti (Republic of)
HM	Heard and McDonald Islands
HN	Honduras (Republic of)
HK	Hong Kong
HU	Hungary (Republic of)
IS	Iceland (Republic of)
IN	India (Republic of)
ID	Indonesia (Republic of)
IR	Iran (Islamic Republic of)
IQ	Iraq (Republic of)
IE	Ireland
IL	Israel (State of)
IT	Italy (Italian Republic)
JM	Jamaica
JP	Japan
JO	Jordan (Hashemite Kingdom of)
KZ	Kazakhstan
KE	Kenya (Republic of)
KI	Kiribati (Republic of)
KP	Korea (Democratic People's Republic of)
KR	Korea (Republic of)
KW	Kuwait (State of)
KG	Kyrgyz Republic
LA	Lao People's Democratic Republic
LV	Latvia (Republic of)
LB	Lebanon (Lebanese Republic)
LS	Lesotho (Kingdom of)
LR	Liberia (Republic of)
LY	Libyan Arab Jamahiriya
LI	Liechtenstein (Principality of)
LT	Lithuania
LU	Luxembourg (Grand Duchy of)
MO	Macau (Ao-me'n)
MK	Macedonia (Former Yugoslav Republic of)
MG	Madagascar (Democratic Republic of)
MW	Malawi (Republic of)
MY	Malaysia
MV	Maldives (Republic of)
ML	Mali (Republic of)
MT	Malta (Republic of)
MH	Marshall Islands (Republic othe)
MQ	Martinique (French Department of)
MR	Mauritania (Islamic Republic of)

MU	Mauritius
YT	Mayotte
MX	Mexico (United Mexican States)
FM	Micronesia (Federated States of)
MD	Moldova (Republic of)
MC	Monaco (Principality of)
MN	Mongolia
MS	Montserrat
MA	Morocco (Kingdom of)
MZ	Mozambique (People's Republic of)
MM	Myanmar (Union of)
NA	Namibia (Republic of)
NR	Nauru (Republic of)
NP	Nepal (Kingdom of)
NL	Netherlands (Kingdom othe)
AN	Netherlands Antilles
NT	Neutral Zone (between Saudi Arabia and Iraq)
NC	New Caledonia
NZ	New Zealand
NI	Nicaragua (Republic of)
NE	Niger (Republic of the)
NO	Nigeria (Federal Republic of)
NU	Niue
NF	Norfolk Island
MP	Northern Mariana Islands (Commonwealth of the)
NO	Norway (Kingdom of)
OM	Oman (Sultanate of)
PK	Pakistan (Islamic Republic of)
PW	Palau (Republic of)
PA	Panama (Republic of)
PO	Papua New Guinea
PY	Paraguay (Republic of)
PE	Peru (Republic of)
PH	Philippines (Republic of the)
PN	Pitcaim
PL	Poland (Republic of)
PT	Portugal (portuguese Republic)
PR	Puerto Rico
QA	Qatar (State of)
RE	Re'union (French Deparbnent of)
RO	Romania
RU	Russian Federation
RW	Rwanda (Rwandese Republic)
SH	Saint Helena
KN	Saint Kitts and Nevis
LC	Saint Lucia
PM	Saint Pierre and Miquelon (French Department of)
VC	Saint Vincent and the Grenadines i
WS	Samoa (Independent State of)

SM	San Marino (Republic of)
ST	Sao Tome and Principe (Democratic Republic of)
SA	Saudi Arabia (Kingdom of)
SN	Senegal (Republic of)
SC	Seychelles (Republic of)
SL	Sierra Leone (Republic of)
SG	Singapore (Republic of)
SK	Slovakia
SI	Slovenia
SB	Solomon Islands
SO	Somalia (Somali Democratic Republic)
ZA	South Africa (Republic of)
ES	Spain (Kingdom of)
LK	Sri Lanka (Democratic Socialist Republic of)
SD	Sudan (Democratic Republic of the)
SR	Suriname (Republic of)
SJ	Svalbard and Jan Mayen Islands
SZ	Swaziland (Kingdom of)
SE	Sweden (Kingdom of)
CH	Switzerland (Swiss Confederation)
SY	Syria (Syrian Arab Republic)
TW	Taiwan, Province of China
TJ	Tajikistan
TZ	Tanzania (United Republic of)
TH	Thailand (Kingdom of)
TG	Togo (Togolese Republic)
TK	Tokelau i
TO	Tonga (Kingdom of)
TT	Trinidad and Tobago (Republic of)
TN	Tunisia
TR	Turkey (Republic of)
TM	Turkmenistan
TC	Turks and Caicos Islands
TV	Tuvalu
UG	Uganda (Republic of)
UA	Ukraine
AE	United Arab Emirates
GB	United Kingdom (United Kingdom of Great Britain and Northern Ireland)
US	United States (United States of America)
UM	United States Minor Outlying Islands
UY	Uruguay (Eastern Republic of)
UZ	Uzbekistan
VU	Vanuatu (Republic of, formerly New Hebrides)
VA	Vatican City State (Holy See)
VE	Venezuela (Republic of)
VN	Vietnam (Socialist Republic of)
VG	Virgin Islands (British)
VI	Virgin Islands (U.S.)
WF	Wallis and Futuna Islands

EH	Western Sahara
YE	Yemen (Republic of)
YU	Yugoslavia (Socialist Federal Republic of)
ZR	Zaire (Republic of)
ZM	Zambia (Republic of)
ZW	Zimbabwe (Republic of)



Non Aligned Movement

Center for South-South Technical Cooperation

Database and The Internet

DEVELOPMENT OF THE INFORMATION NETWORK AND DATABASE FOR NAM CSSTC

Database and The Internet

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Table of Contents

Chapter 1

Introduction

A *database management system* (DBMS) consists of a collection of interrelated data and set of programs to access that data. The collection of data is usually referred to as the database. The database contains information about one particular enterprise.

The primary goal of a DBMS is to provide an environment that is both convenient and efficient to use in retrieving information from and storing information into the database.

Database system are designed to manage large bodies of information. The management of data involves both the definition of structures for the storage of information and the provision of mechanism for the manipulation of information. In addition, the database system must provide safety of information stored in the database, despite system crashes or attempts at unauthorized access. If data is to be shared among several users, the system must avoid possible anomalous results.

Purpose of Database System

Consider part of a savings bank enterprise that keeps information about all customers and savings accounts maintained at the bank. The savings account and customer records are kept in permanent system files. In addition to these files, the system has a number of application programs that allow one to manipulate the files, including:

- A program to debit or credit an account
- A program to add a new account
- A program to find the balance of an account
- A program to generate monthly statements

These application programs have been written by system programmers in response to the needs of the bank organization.

New application programs are added to the system as the need arises. As a result, new permanent files are created that contain information about all the checking accounts maintained in the bank, and new application programs may need to be written. Thus, as time goes by, more files and more application programs are added to the system. Since these files and programs have been created over a long period of time, presumably by different programmers, the files are likely to have different formats and the programs may be written in several programming languages.

The environment described above is a typical *file-processing system*, which is supported by a conventional operating system. Permanent records are stored in various files, and a number of different application programs are written to extract records from and add records to the appropriate files. This scheme has a number of major disadvantages:

- **Data redundancy and consistency.** Since the files and application programs are created by different programmers over a long period of time, the same piece of information may be duplicated in several places (files). This leads to higher storage and access cost as well as potential data inconsistency. By data inconsistency means that the various copies of the same data no longer agree.

- **Difficulty in accessing data.** Suppose that one of the officers in the bank needs to find out the names of all the customers who live in the area of the city with zip code 78733. The officers calls the data processing department and asks them to generate such a list. As this is an unusual request that was not anticipated when the original system was designed, there is no application program on hand to generate such a list. There is, however, an application program to generate the list of *all* customers. The bank officer has two choices now: either he can get the list of customers and ask one of his secretaries to extract manually the needed information, or he can ask the data-processing department to have one of the system programmers write such a program. Both alternatives are obviously unsatisfactory.

  What pointed out us is that this environment does not allow one to retrieve needed data in a convenient and efficient manner. Better data retrieval systems must be developed for general use.

- **Data isolation.** Since data is scattered in various files, and files may be in different formats, it is difficult to write new application programs to retrieve the appropriate data.

- **Multiple users.** In order to improve the overall performance of the system and obtain a faster response time, many systems allows multiple users to update the data simultaneously. In such an environment, interaction of concurrent updates may result in inconsistent data. In order to prevent any inconsistency, some form of supervision must be maintained in the system. Since data may be accessed by many different application programs which have not been previously coordinated, such a supervisor is very difficult to obtain.

- **Security problems.** Not every user of the database system should be able to access all data. Since applications programs are added to the system in an ad hoc manner, it is difficult to enforce such security constraint.

- **Integrity problems.** The data values stored in the database must satisfy certain types of *consistency constraints*. For example, the balance of a bank account may never fall below a prespecified amount (for example, $25). These constraints must be enforced in the system. This enforcement can be carried out by adding appropriate code in the various application programs. However, when new constraints are added, it is difficult to change the programs to enforce them. This is compounded in the case where constraints involve several data items from different files.

These difficulties, among others, have prompted the development of database management systems.

Data Abstraction

A database management system is a collection of interrelated files and a set of programs that allow several users to access and modify these files. A major purpose of a database system is to provide users with an *abstract* view of the data. That is, the system hides certain details of how the data is stored and maintained. However, in order for the system to be usable, data must be retrieved efficiently.

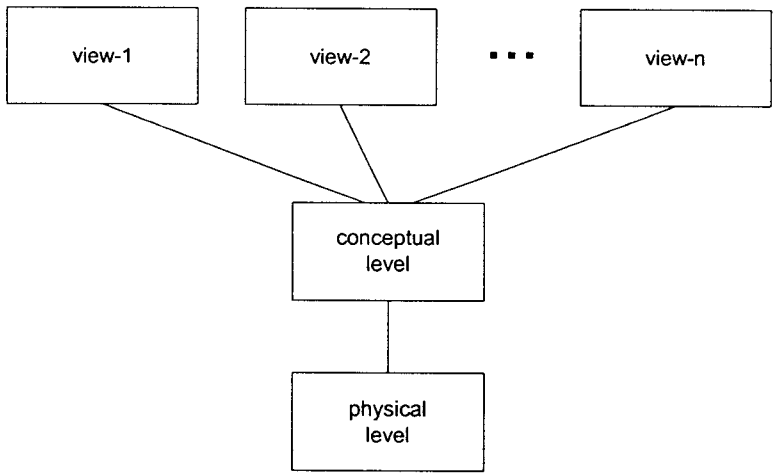
The concern for efficiency leads to the design of complex data structures for the representation of data in the database. However, since database system are often used by non-computer-trained personnel, this complexity must be hidden from database system users. This is accomplished by defining several levels of abstraction at which the database may be viewed.

- **Physical level.** This is the lowest level of abstraction, at which one describes *how* the data are actually stored. At this level, complex, low-level data structures are described in detail.

- **Conceptual level.** This is the next higher level of abstraction at which one describes *what* data are actually stored in the database, and the relationships that exist among data. This level describes the entire database in terms of a small number of relatively simple structures. Although the implementation of the simple structures of the conceptual level may involve complex physical-level structures, the user of the conceptual level need not be aware of this.

- **View level.** This is the highest level of abstraction at which one describes only part of the entire database. Despite the use of simpler structures at the conceptual level, there remains a form of complexity resulting from the large size of the database. Many users of the database system will not be concerned with all of this information. Instead, such users need only a part of the database. To simplify the interaction of such users with the system, the view level of abstraction is defined. There may be many views provided by the system for the same database.

The interrelationship among these three levels of abstraction is illustrated below.



Here is an analogy to illustrate the distinction among levels of abstraction. Most high-level programming languages support the notion of record type. For example, in a Pascal-like language, a record may be declared as follows:

```
type   customer = record
                    name : string;
                    address : string;
                    city : string;
                  end;
```

This defines a new record called customer with three fields. Each field has a name and a type associated with it. In a banking enterprise, the is a possibility to have several such record types, including among others:

- account, with fields *number* and *balance*.
- employee, with fields *name* and *salary*.

At physical level, a *customer*, *account*, or *employee* record can be described as a block of consecutive storage locations (for example, bytes or words). A the conceptual level, each such record is described by a type definition, illustrated above, and the interrelation among these record types is defined. Finally, at the view level, several views of the database are defined. For example, people needing to prepare the payroll checks can only see that part of the database that has information about the employees of the bank. The cannot access information about customer accounts. Similarly, tellers can access only account information. They cannot access information concerning salaries of employees.

Chapter

Data Models

A data model is a collection of conceptual tools for describing data, data relationships, data semantics, and data constraints. There are a number of different data models. These are partitioned into three different groups: object-based logical models, record-based logical models, and physical data models.

Object-Based Logical Models

Object-based logical models are used in describing data at the conceptual and view levels. They are characterized by the fact that they provide fairly flexible structuring capabilities and allow one to specify data constraints explicitly. One of the widely known object-based logical models is the *entity-relationship* model.

The entity-relationship (E-R) data model is based on a perception of a real world which consists of a collection of basic objects called *entities*, and *relationships* among these objects. An entity is an object that exists and is distinguishable from other objects. The distinction is accomplished by associating with each entity a set of attributes which describes the objects. For example, the attributes *number* and *balance* describe one particular account in a bank. A *relationship* is an association among several entities. For example, a *CustAcct* relationship associates a customer with each account that the customer has. The set of all entities of the same type and relationships of the same type are termed an *entity set* and *relationship set*, respectively.

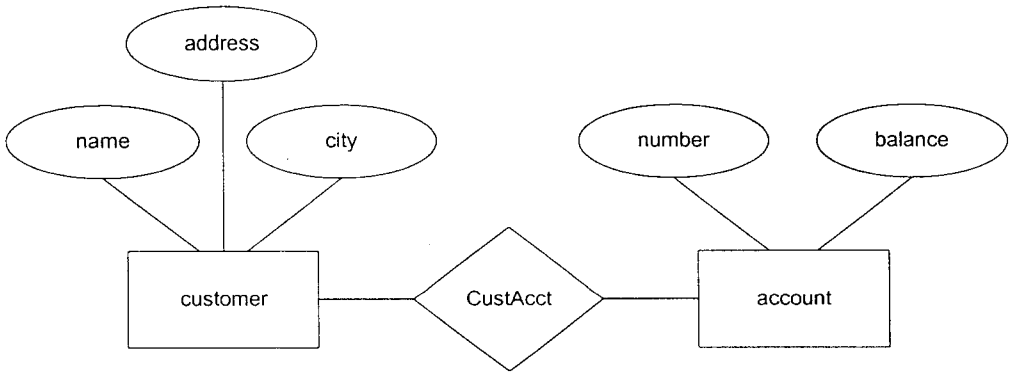
In addition to entities and relationships, the E-R model represents certain constraints to which the contents of a database must conform. One such important constraint is *mapping cardinalities* which express the number of entities to which another entity can be associated via a relationship set.

The overall logical structure of a database can be expressed graphically by an *E-R diagram* which consists of the following components:

- **rectangles**, which represents entity sets
- **ellipses**, which represents attributes
- **diamonds**, which represents relationships among entity sets
- **lines**, which link attributes to entity sets and entity sets to relationships

Each components is labeled with its corresponding name.

To illustrate, consider part of a database banking system consisting of customers and the accounts they have. The E-R diagram corresponding to this scheme is shown below. The E-R model is covered in detail in chapter 3.



Record-Based Logical Models

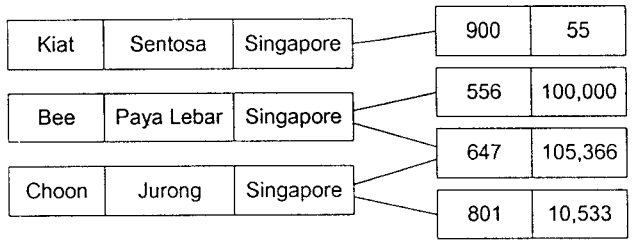
Record-based logical models are used in describing data at the conceptual and view levels. In contrast to object-based data models, these models are used to specify both the overall logical structure of the database and a higher-level description of the implementation. They do not, however, provide facilities for specifying data constraints explicitly. The three most widely accepted data models are:

- **Relational model.** The data and the relationships among data are represented by a collection of tables each of which has a number of columns with unique names. To illustrate this, consider a database consisting of customers and the accounts they have. A sample of relational model is shown below. It shows, for example, that customer Choon lives in Jurong, Singapore, that he has two accounts, one numbered 647 with a balance of $105,366 and the other 801 with a balance of $10,533. Note that customers Bee and Choon share account number 647 (they may share a business venture).

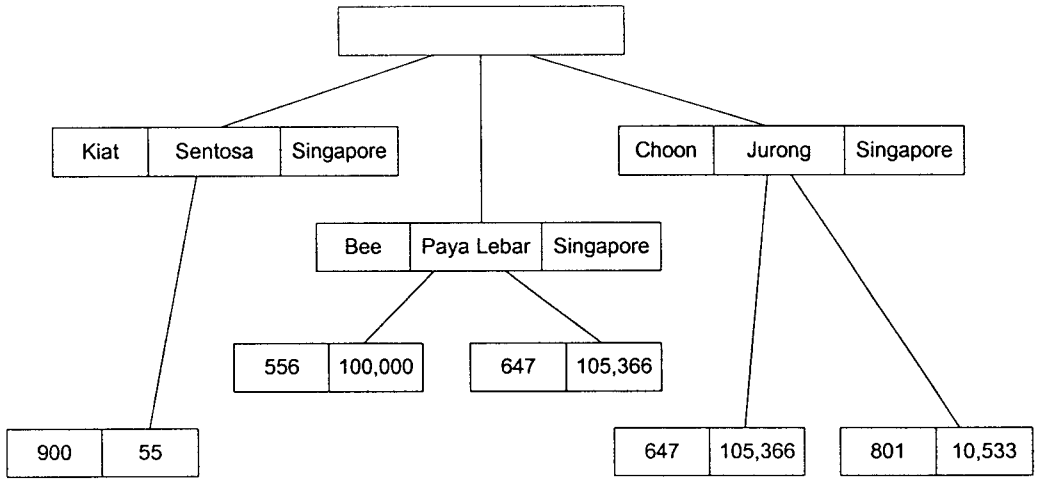
name	*address*	*city*	*number*
Kiat	Sentosa	Singapore	900
Bee	Paya Lebar	Singapore	556
Bee	Paya Lebar	Singapore	647
Choong	Jurong	Singapore	801
Choong	Jurong	Singapore	647

number	*balance*
900	55
556	100,000
647	105,366
801	10,533

- **Network model**. Data in network model are represented by collections of *records*, and relationships among data are represented by *links*, which can be viewed as pointers. The records in the database are organized as collections of arbitrary graphs. A sample of network model that has the same information as in figure relational model above is as shown below.



- **Hierarchical Model**. The hierarchical model is similar to the network model in sense that data and relationships among data are represented by records and links respectively. The hierarchical model differs from the network model in that the records are organized as collection of trees rather than arbitrary graphs. A sample of hierarchical model that has the same information as in figure relational model above is as shown below.



Chapter 2

Entity-Relationship Model

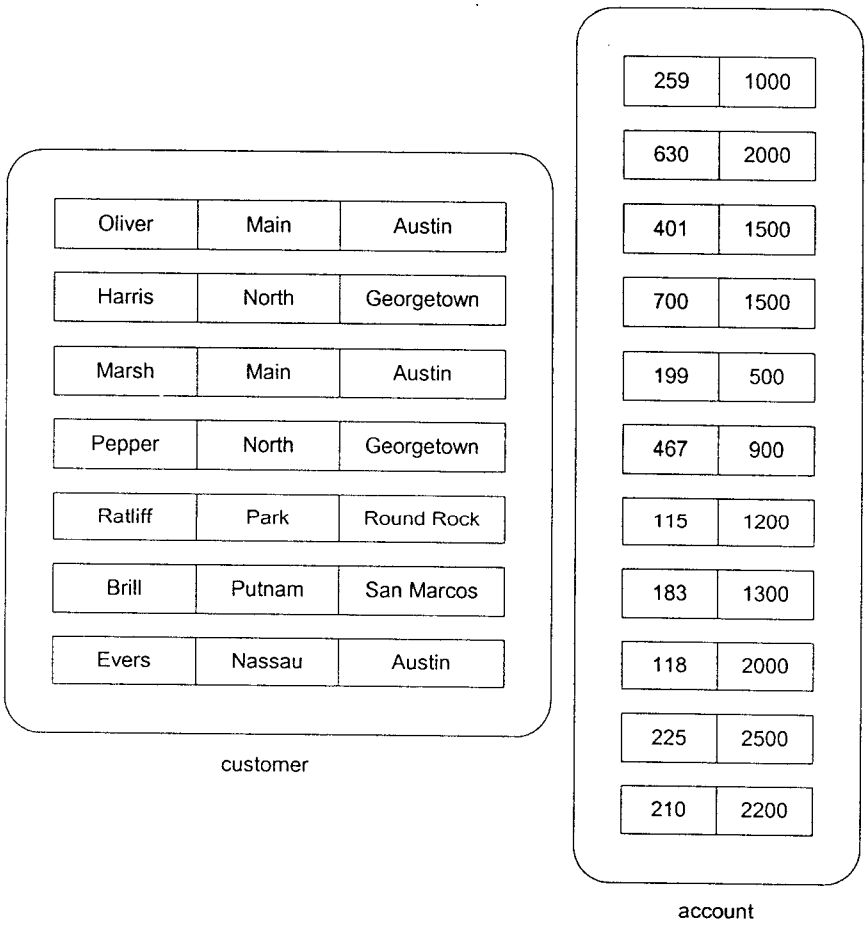
The entity-relationship (E-R) data model is based on a perception of a real world which consists of a set of basic objects called *entities* and *relationships* among these objects. In was developed in order to facilitate database design by allowing the specification of an *enterprise scheme*. Such a scheme represents the overall logical structure of the database.

Entities and Entity Sets

An *entity* is an object that exists and is distinguishable from other objects. An *entity set* is a set of entities of the same type. The set of all persons having an account at a bank, for example, can be defined as the entity set *customer*. Similarly, the entity set *account* might represent the set of all accounts in a particular bank.

Entity sets need not be disjoint. For example, it is possible to define the entity set of all employees of a bank (*employee*) and the entity set of all customers of the bank (*customer*). A *person* entity may be an *employee* entity, a *customer* entity, both, or neither.

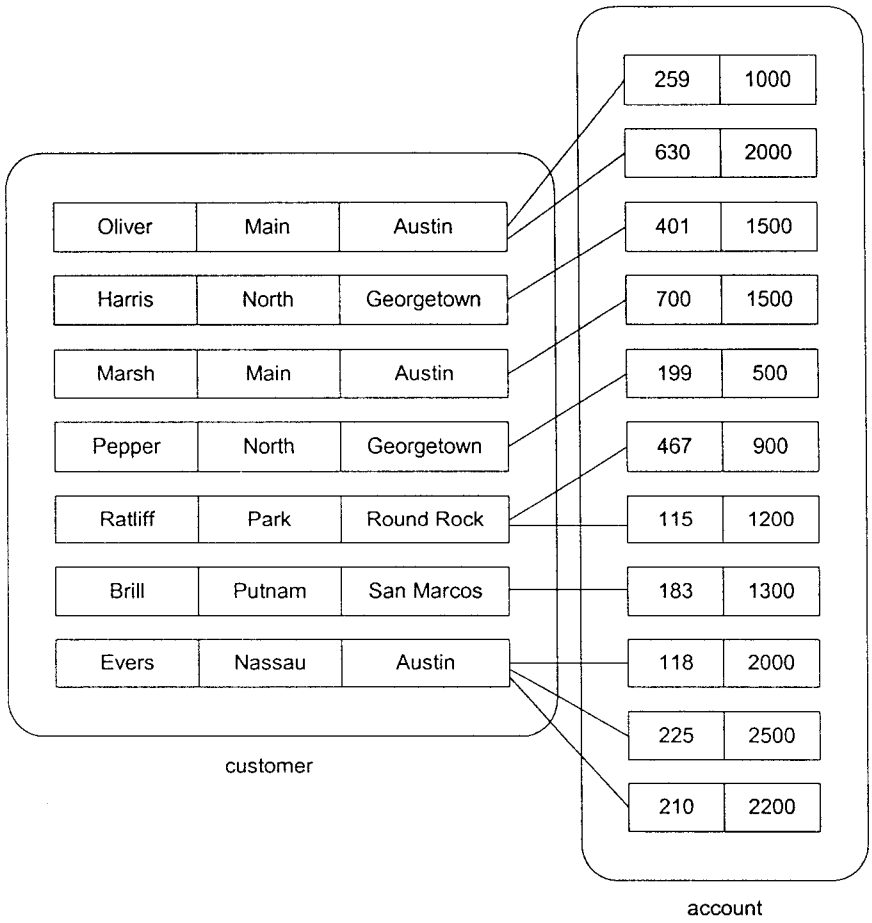
An entity is represented by a set of *attributes*. Possible attributes of the *customer* entity set are *name*, *address*, and *city*. Possible attributes of the *account* entity set are *number* and *balance*. For each attribute there is a set of permitted values, called the *domain* of that attribute. The domain of attribute *name* might be the set of all text strings of a certain length. Similarly, the domain of attribute *number* might be the set of all positive integers.



Relationships and Relationship Sets

A *relationship* is an association among several entities. For example, relationship of a customer named 'Choong' with account 401. This specifies that Choong is a customer with bank account number 401.

To illustrate this, consider the two entity sets *customer* and *account* of the figure below. A relationship set *CustAcct* is defined to denote the association between customer and bank account that they have.



The relationship *CustAcct* is an example of a binary relationship set, that is, one which involves two entity sets. Most of the relationship sets in a database system are binary. Occasionally, however, there are relationship sets with involve more than two entity sets.

The function that an entity plays in a relationship is called its *role*. Roles are normally implicit and are not usually specified. However, they are useful when the meaning of a relationship needs clarification. Such is the case when the entity sets of a relationship set are not distinct. For instance, the relationship *works-for* might be modeled by ordered pairs of *employee* entities. The first employee of a pair takes the role of manager, while the second takes the role of worker. In this way, all relationship of *works-for* are characterized by (manager, worker) pairs.

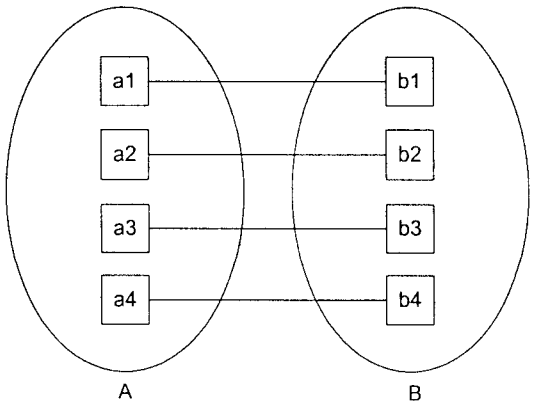
Mapping Constraints

An E-R enterprise scheme may define certain constraints to which the contents of a database must conform. One important constraints is *mapping cardinalities* which express the number of entities to which another entity can be associated via a relationship.

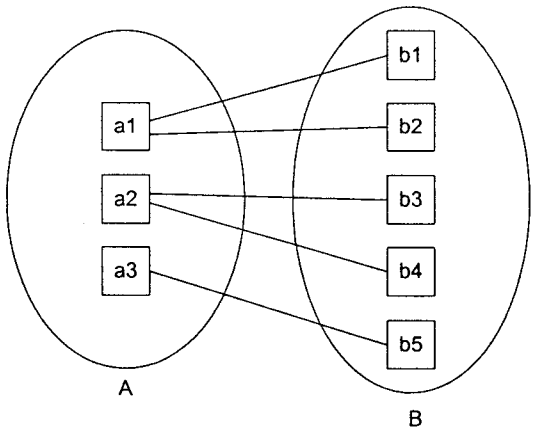
Mapping cardinalities are most useful in describing binary relationship sets, although occasionally they contribute to the description of relationship sets that involve more than

two entity sets. For a binary relationship set between entity sets *A* and *B*, the mapping cardinality must be one of the following:

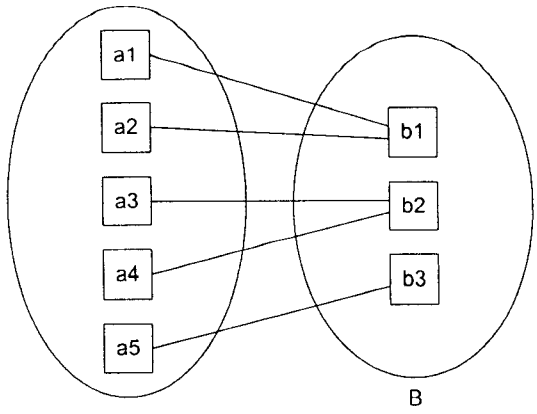
- **One-to-one.** An entity in A is associated with at most one entity in B, and an entity in B is associated with at most one entity in A. The figure of one-to-one relationship is visualized below.



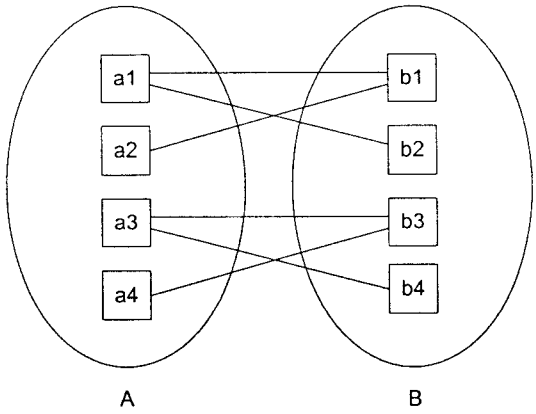
- **One-to-many.** An entity in A is associated with any number of entities in B, and an entity in B is associated with at most one entity in A. The figure of one-to-many relationship is visualized below.



- **Many-to-one.** An entity in A is associated with at most one entity in B. An entity in B, however, can be associated with any number of entities in A. The figure of many-to-one relationship is visualized below.



- **Many-to-many**. An entity in A is associated with any number of entities in B, and an entity in B is associated with any number of entities in A. The figure of many-to-many relationship is visualized below.



Primary Keys

An important task in database modeling is to specify how entities and relationships are distinguished. Conceptually, individual entities and relationships are distinct, but from a database perspective, the difference among them must be expressed in terms of their attributes. To make such distinctions, a *superkey* is assigned to each entity set. The superkey is a set of one or more attributes, which, taken collectively, allow us to identify uniquely an entity in the entity set. For example, the *Customer_ID* attribute of the entity set *customer* is sufficient to distinguish one *customer* entity from another. The term of primary key is used to denote a candidate key that is chosen by a database designer as the principal means of identifying entities within an entity set.

It is possible that an entity set does not have sufficient attributes to form a primary key. For example, consider the entity set *transaction* which has three attributes: *transaction_number*, *date*, and *amount*. Although each *transaction* entity is distinct, transaction on different accounts may share the same transaction number. Thus, this entity set does not have a primary key. Such an entity set is termed a *weak entity*. An entity which has a primary key is termed a *strong entity*.

Relationship sets also have primary keys. Their primary keys are formed by taking all the attributes that comprise the primary keys of the entity sets that define the relationship set. For example, *Customer_ID* is the primary key of *customer* and *Account_Number* is the primary key of *account*. Thus, the primary key of the relationship set *CustAcct* is (*Customer_ID*, *Account_Number*).

Entity-Relationship Diagram

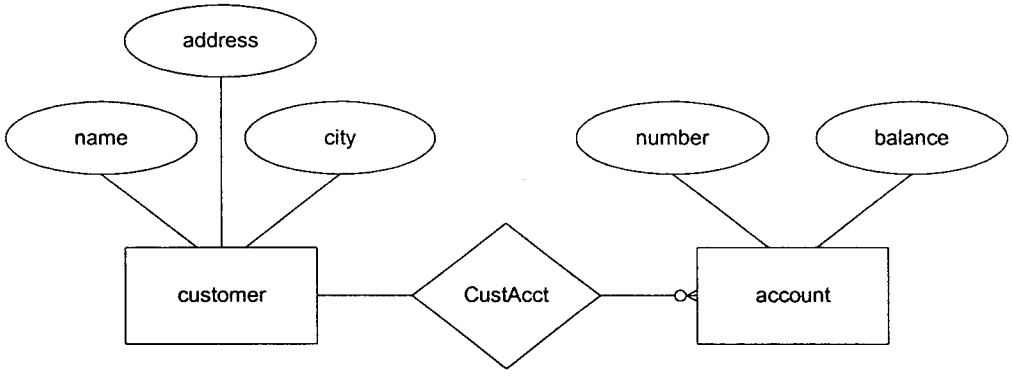
The overall logical structure of a database can be expressed graphically by an *E-R diagram* which consists of the following components:

- **Rectangles**, which represents entity sets.
- **Ellipses**, which represents attributes.
- **Diamonds**, which represents relationship sets.
- **Lines**, which link attributes to entity sets and entity sets to relationship sets.

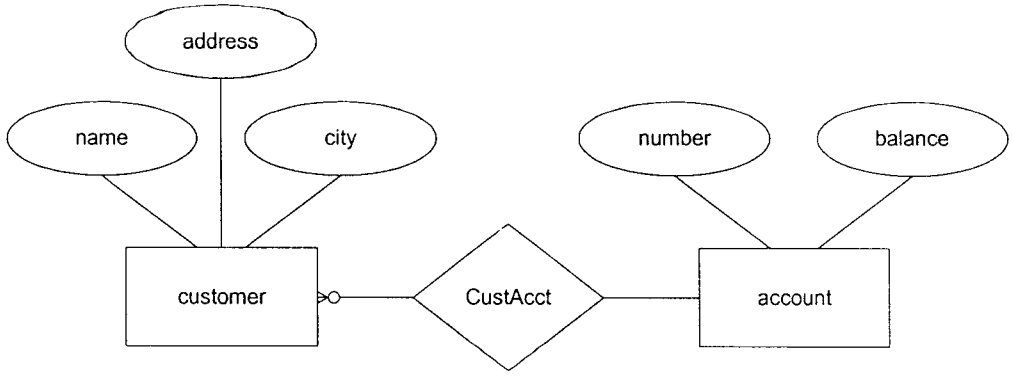
Each component is labeled with its corresponding name. A weak entity set is indicated in E-R diagrams by a doubly outlined box.

The relationship may be many-to-many, one-to-many, many-to-one, or one-to-one. To distinguish among these, a special end-up line is drawn on each 'many' relationship:

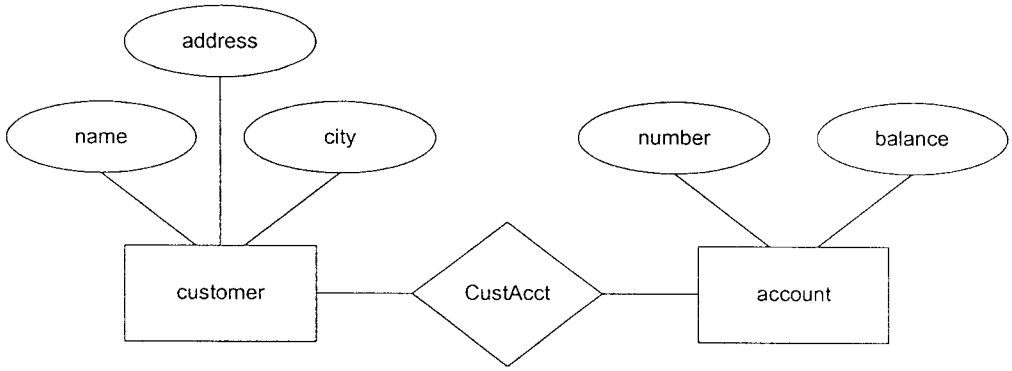
Illustration of all possibilities of E-R diagram is as shown below:



example of one-to-many relationship



example of many-to-one relationship

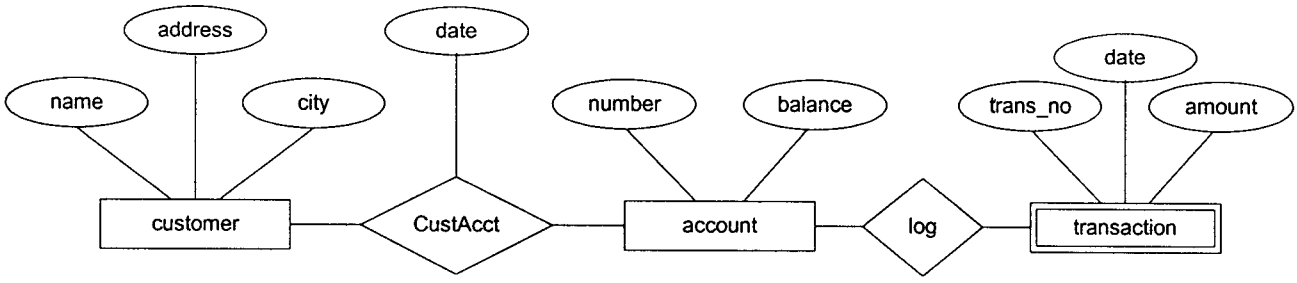


example of one-to-one relationship

Reducing E-R Diagram to Tables

A database which conforms to an E-R diagram can be represented by a collection of tables. For each entity set and for each relationship set in the database, there is a unique table which is assigned the name of the corresponding entity set or relationship set. Each table has a number of columns which, again, have unique names.

Figures below show how an E-R diagram can be reduced into tables:



E-R diagram

customer-name	*address*	*city*
Oliver	Main street	Austin
Harris	North street	Georgetown
Marsh	Main street	Austin
Pepper	North street	Georgetown
Ratliff	Parkway	Round Rock
Brill	Putnam drive	San Marcos
Evers	Nassau	Austin

The customer table

account-number	*balance*
259	1,000
630	2,000
401	1,500
700	1,500
199	500
467	900
115	1,200
183	1,300
118	2,000
225	2,500
210	2,200

The account table

account-number	*transaction-number*	*date*	*amount*
29	5	17-May-95	50
630	11	17-May-95	70
401	22	23-May-95	-300
700	69	28-May-95	-500
199	103	03-Jun-95	900
259	6	07-Jun-95	-44
115	53	07-Jun-95	120
299	104	16-Jun-95	-200
259	7	17-Jun-95	-79

The transaction table

account-number	*date*
259	17-Jun-95
630	17-May-95
401	23-May-95
700	28-May-95
199	13-Jun-95
467	07-Jun-95
115	07-Jun-95
183	13-Jun-95
118	17-Jun-95
225	19-Jun-95
210	27-Jun-95

The CustAcct table

Chapter

The Internet

Connecting to the Worldwide Internet

The worldwide Internet grows from original ARPANET, an early research computer networks belongs to the US Dept. of Defense. ARPANET then evolves, connecting more computer networks, until today, form a worldwide Internet, which interconnects thousands of networks containing millions of computers in universities, laboratories, and commercial organizations. The Internet has seen staggering growth due to two factors – the ease which TCP/IP networks can be interconnected with and the open-door policy that allowed organizations of all types to gain easy access to the Internet.

The benefits of Internet

- Cross-platform

  Many corporate computing environments use different computing platforms. The capability to exchange information across platforms is crucial. The Intranet enables companies to unify communication within a multi-platform environment. Hence, companies can mix and match platforms as needed with no adverse effect on the overall environment.

  Within an Intranet, universal browsers such as Netscape Navigator and Microsoft Internet Explorer enable the users to perform the following tasks independent of the platforms used.

- Breaking down the barriers

  Intranets dissolve the barriers of communication that are created by department walls, geographical location and decentralized resources. Intranets create global accessibility by bringing together individuals and resources from a distributed environment. Employees, customers and vendors are able to access information stored in multiple locations simultaneously.

- Reducing distribution cost

  By combining computing and communication in the same system, Intranets reduce distribution costs by eliminating the traditional paper-based internal corporate communication media, such as printed pages, pamphlets, booklets and flyers. Instead, they are published electronically on the company's Intranet, saving the resources needed to print, distribute and update them.

- Immediate delivery

  Information delivered using an Intranet becomes available almost instantaneously throughout the entire organization. With HTML form-support, users may even fill out forms, post sign-up sheets and schedules on the Intranet. Information can move much more quickly and effectively by removing the need for human intervention.

- Open standards

  Internet technologies follow a set of open standards, which facilitate software developers to develop cost effective and easy-to-implement Intranet solutions. Users can choose from a number of vendors for software products.

  The growth of Internet technologies provides companies with a greater pool of resources to develop their own Intranets. Conversely, traditional GroupWare products have a more limited range of compatible products and fewer specially trained consultants to install and administer them.

- Scalability

  Since Intranets are based on Internet technologies, size is not a limitation with Intranets.

Reason for Connection to the Internet

In the early years of the operation of the Internet, only academic and research organizations could gain access to the network. Current days, any organizations can apply to the NIC for name and address assignment, and can connect their own private network to the Internet. An individual or commercial organization, as well, can gain access to the Internet via a dial-up or dedicated connection.

There are three reasons that organization or person might want to consider connecting to the Internet :

- **Accessing Internet resources.** The Internet provides access to a wide variety of different types of information resources that may be useful/valuable to them

- **Communicating with other organizations.** The organizations may need to communicate one another via computers already connects to the Internet. Connecting to the Internet allows them to communicate without having to install separate communication links to those organizations.

- **Interconnecting among internal-private networks.** The organizations may want to use the Internet as a high-speed backbone for communication within their own private internet. They don't want to communicate with other organizations on the Internet. They simply use the Internet as a means of interconnecting their own set of private internets.

Component in Computer Internetworking

TCP/IP Architecture and Network Components

Host

In TCP/IP, host is referred to any computing device/system that is attached to an internet and communicates using the TCP/IP protocols. Host runs application programs that communicate with one another. A host can be a large mainframe, a minicomputer, a midrange departmental processor, a workstation or a personal computer.

Router

A router or gateway is a computing device that provides connectivity between the various individual networks making up the internet. The function of a router is to move network traffic from one physical network to another when a program running in a host attached to one physical network has to communicate with a host attached to some other physical networks. The routing function can be performed by an ordinary host that runs routing software, or by a specialized device that is dedicated to the routing function. In large internets, routing is generally performed by dedicated routers.

Network and Cabling System

Networks tie TCP/IP hosts. An individual network is a collection of two or more hosts that are interconnected using a particular form of data link technology via cabling system. Several individual networks can be interconnected using routers. Many data-link technologies are available nowadays for LAN and WAN topography. However, The TCP/IP architecture is independent of any particular form of networking technology.

Client and Server

Other terminologies that are very close related to the computer networks are client and server. These terminologies do not refer to specific hardware components; instead they represent different role in process on a computing model. *Client* is a host or an application component that makes a request for a service of some other application components operating in a role of a server. While *server* is a computing component running in the remote host that process the request and provides a well-defined service required by the client. The client is responsible for establishing communication with the server. The client then makes a request for a service by transmitting data to the server. The server then carries out the service and replies by sending data back to the client. There can be multiple clients sharing the services of a single server, and the client applications need not to be aware that processing is not being performed locally.

General speaking assumes that clients are generally small and desktop hosts, like workstations or PCs, while servers mean bigger and more powerful hosts like mainframes or minicomputers. TCP/IP topology allows several specific servers

provide specific functions. The following are a few type of server systems that is popular in the client-server environment nowadays :

- **File Server**, provides file access and file management services
- **Print Server**, provides printing services
- **Database Server**, provides database access and database management services
- **Communication Server**, provides access to modem or other specialized communication facilities
- **Application Server**, provide access to application logic, allowing an application to be distributed among more than one host computer.

Network Software

Networking Operating System → NOS

NOS is a software product, typically used in the personal computer environment, that provides high-level networking functions to users and application programs. This TCP/IP networking software allows user to communicate over an internet with other users. It is a unified interface and independent of the underlying networking technology. Most of computer system in the world can run TCP/IP networking software.

A network operating system controls how different hardware and software in a network function together properly. The Internet consists of various hardware platforms running various network operating systems. Theoretically, one company may not stay with one network operating system, however, using only one network operating system will simplify network installation, maintenance and administration.

The primary choices of network operating systems are Unix, Windows NT and Novell's NetWare.

Many large organizations are using Unix-based machines since Unix is well suited for the Internet's open system model and its Web server can be set up with little cost. However, most users find Unix difficult to set up and maintain. Using a Unix-based machine also precludes access to various low-priced software applications to enhance the Intranet.

Many companies choose Windows NT due to its ease of installation, maintenance and administration. Windows NT can support various workstation operating systems, such as Windows 3.1, Windows 95, Windows NT, Unix and Mac. It also supports popular network protocols, like TCP/IP and IPX/SPX. Novell's NetWare is a popular local area network solution based on the IPX/SPX protocol. Since it is only designed to operate file and print servers, NetWare may constrain the types of applications provided and the number of Intranet users.

Workstation operating systems

Client computers can run a number of operating systems, such as Windows, Macintosh, OS/2 and Unix operating systems. To let the workstation operating system use the network, special drivers must be installed on the client computer's network-interface card in order to communicate with the network.

Web Server Software

To establish an Internet, server software is required to handle requests from browsers. Currently, a number of free Web servers are available in the market. Apart from the cost of a Web server, how the server software supports the Web developers must also be considered. For small operations, an Intranet can be first built with servers that are easy to use and maintain and then moves to higher performance servers as the Intranet's use increases. The performance of the Intranet depends more on the performance of the server machine than on the server software.

Web Browsers

Currently, the most popular browsers are Netscape's Navigator and Internet Explorer. In a few years, Microsoft will integrate the browser's functionality into all of its business application software and may make the browser part of the operating system.

On the Unix side, the markets will probably continue to be dominated by Netscape. Therefore, for a network that includes Unix, Macintosh and Windows clients, and must standardize on one browser, Netscape's Navigator is the only choice at this time.

Hypertext markup language (HTML)

The Web (or more properly, the World Wide Web) is a highly used tool by Internet users. It was developed at CERN in Switzerland as a new form of communicating text and graphics across the Internet making use of the hypertext markup language (HTML) as a way to describe the attributes of the text and the placement of graphics, sounds, or even movie clips. HTML is a programming language used to create documents (pages) on the WWW. HTML allows the user to insert formatting directives into the text, much like some of the first word processors for home computers. Until now, the number of users has blossomed and the number of sites containing information and searchable archives has been growing at an unprecedented rate. The web is collections of "Web pages" contain anything from personal information to broad topics of interest.

The Web requires a client program (such as Netscape, Internet Explorer, or Lynx) and a server (http) to send information to the client. There are two important aspects in the Web: first, in order to use the Web, someone needs to be running a Web server on a machine for which such a server exists. Second, the local user needs to run an application program to connect to the server; this application is known as a client program. Server programs are available for UNIX machines, Windows and Macintosh. Client programs are available from NCSA for UNIX, Windows, and the Macintosh, which provide a graphical interface for the Web and allow the user to view pictures. On UNIX an application called Lynx is also available which allows the user to just view the text off of a server.

Security and Firewall System

Security Functions in the Network

Security mechanism should provide facilities for implementing secure communication in a networked environment and allows access to resources in the computing environment to be controlled. Security system should cover following security functions that are useful in a large network such as the Internet :

- **Data Protection.** Data protection is to ensure that the messages can be sent over the network privately, so they cannot be read by unauthorized parties. One popular example of this function is a cryptographic technique, in which messages are enciphered before transmission and deciphered after receipt. A channel using a cryptographic technique is called a secure channel. Cryptography also protects data integrity because an intruder cannot modify, relay or suppress data in transit without the receiver detecting it.

- **Authentication.** Authentication is to verify the identity of an end-user or an application component that is making a request for a service. The end-user should acquire the credentials required, called ticket, in order to be authenticated by a server. This procedure could be in form of login-and-password mechanism.

- **Authorization.** Authorization is to provide facilities for specifying which users or application components can have access to individual resources in the computing environment. In the beginning of a session, an end-user conducting an authentication process, and if he is successful, then authorization function determines what operations are valid for him during his session. Authorization describes the resources he is authorized to access and the type of accesses he can perform to each resource, until end of the session.

Planning the Network Security Policy

Securing a site involves evaluating an organization's information assets, its vulnerabilities, and defenses. A security policy reflects the management's outlook on security. The policy is enforced using both technical and non-technical means. A firewall policy is a set of rules that determine what types of connections are or are not allowed across a firewall. An Internet firewall is a technical mechanism used to enforce a firewall security policy. Based on a security policy, a firewall architecture can be evaluated and selected. An overall security policy and a firewall security policy are prerequisites to proper firewall implementation.

A network security policy is a set of rules applied to a network for restricting user access to the network resources and Internet services. It is designed based on a site security policy.

Regardless of the size of the network to be protected, we have to identify the resources we have to protect, the Internet services to be accepted and rejected, the network topology and the post-attack policy. A network security policy is designed for a particular computer network. Although there are generic network security policies available to help the security policy designer, the appropriateness of these policies for a particular network needs to be evaluated.

A security policy should address the following issues:

1. Selecting the Internet services and resources

Resources such as hardware, software, data, documents, and manpower need to be identified. Whether or not these resources should be shared depend on several factors:

1. *requirements for sharing these resources*. Some resources may have special requirements for being shared. For example, setting up an FTP server to share files may require a dedicated machine to host an FTP server as well as a leased line for communication.

2. *whether resources should be shared*. The reason for sharing resources needs to be clearly identified. For example, if an FTP server is to be used internally, the files it stores should not be made publicly available.

3. *potential risks*. The risks involved with sharing a resource needs to be identified. For example, if access control is not enforced, it may be possible for an Internet-based attacker to launch a denial-of-service attack on the internal FTP server.

A firewall can be designed to allow or deny access to the shared resources across a network.

2. Determining the authorized and unauthorized accesses

Companies and organizations enforce access control to limit user access to resources. Information may be made available only to specific groups or individual users. Changes in access control policies can be made once for an entire group rather than for individual users. File access permissions are commonly used to enforce the information access policy.

3. Restricting access locations

The locations from which services can be accessed should be controlled. Typical policies restrict access to internal network services from external users, but allow internal users to access external network services. Problems may arise if an internal user accesses an un-trusted external host. These hosts could be set up by a hacker and could, for example, contain malicious executable code in the form of a rouge Java applet or a program containing a virus. Some policies restrict internal users from accessing untrusted hosts.

Network administrators may also need to define a list of external servers for which access by internal clients is to be denied based on the criteria of their organizations. Based on these security criteria, a list of external servers to be derived can be defined.

Another problem is unauthorized external hosts attempting to access internal network. For example, multiple unsuccessful login attempts from a particular host may indicate the host is attempting to get unauthorized access to the system. All network access from this host should therefore be denied. A host probing Internet server ports may also indicate a system under the control of a hacker. Some information services such as finger and DNS (external DNS) should be made accessible only to trusted external hosts.

4. Publicizing internal documents

- Many organizations would like to publicize their products or services on the Internet using the Web or make software or documents available via FTP. Many organizations set up web servers that provide several functions: **Intranet** - internal users accessing internally available documents, **Extranet** - a closed group of external users accessing information, **Internet** - information available publicly to all Internet users.

  Access to Internet information services can be restricted based on network address and/or on user authentication (username/passwords). Strong authentication such as tokens can also be used.

5. Reconstructing Network topology

Since smaller networks are easier to manage than larger ones, it sometimes makes sense to subdivide a network into several parts based on the resources they share. Separating the network and using dedicated services can simplify the enforcement of network security policies.

Critical network components, including the firewall and Internet servers, need to be physically secured. An attacker using a pair of wire cutters on the web server communication line can launch a very effective, albeit crude, denial-of-service attack.

6. Managing user accounts

Attackers frequently gain unauthorized access by sniffing user passwords from the network or cracking a user password file. Networks with fewer user accounts tend to be more reliable and more resistant to attacks. User accounts are a source of vulnerability and need to be carefully managed. User accounts should be used only on the local network, or used on Internet servers -- with only limited access, and not used for external access using telnet

Remote file system access may be provided via anonymous ftp to avoid passwords from being sent in clear text over the Internet. Secure Internet servers and firewall hosts should not have user accounts, but can have an administrator account.

Administrator accounts are popular to attack since they typically use a fixed and well-known user name and have the greatest privilege in the machine. In order to prevent the administrator accounts from being hacked, they should use very secure passwords. Changing the name of the administrator account regularly also adds security.

7. Controlling the remote sites

Many organizations today use the Internet to connect their offices all over the world, to transfer sensitive information and data between offices, and to communicate with partners. These data transfer may be vulnerable to eavesdropping since the Internet is an insecure communication channel.

To protect against eavesdropping, documents can be encrypted before they are sent using a package such as PGP. There are several drawbacks to encrypting individual files, including requiring the users to decide which files to encrypt, the time to encrypt the file, and keeping track of the encryption keys.

Virtual Private Networks (VPNs) can be set up to provide secure communication between offices. They set up a 'tunnel' between firewalls that encrypts all network traffic sent through them. They move the responsibility of encrypting interoffice messages from the users to the network administrator and allow centralized control and administration.

Firewall System

A firewall system is a collection of hardware and software that interconnects two or more networks and provides a central location for managing security. Firewall system can also employ routers to filters out data packets based on criteria specified. By properly configuring a firewall using a combination of routers, reasonable security against Internet intruders and proper protection on various servers on the Intranet can be achieved.

The firewall enforces rules, which are derived from the security policy. A rule might specify that access to a particular port on a particular host be accepted from a particular host, but denied from all other hosts. Firewalls accept or reject connection based on the rule sets. Complex rule sets degrade firewall performance for both packet-filtering firewalls as well as application-gateway firewalls.

Application-gateway firewalls are not as directly affected by complex rule sets; however, overloading a dual-homed host with too many proxy servers can degrade firewall performance. The rule sets to be implemented by the firewall should be chosen to efficiently implement a security policy. This includes simplifying the rule set by removing redundant rules. Some vendors have estimated that adding one rule to a router degrades the throughput by 5 - 15%. Individual rules should be combined if possible.

Some general policies are commonly applied for both packet-filtering and application-gateway firewall architecture are:

- all packets flowing into the local network MUST pass through the firewall.
- source routing packets and routing table modification protocols must be denied. If hackers can alter the route they travel into the network, they could bypass the firewall host as well as the bastion host. Therefore, all *incoming network management protocols* including *Simple Network Management Protocol* (*SNMP*) and *Routing Information Protocol* (*RIP*) should be denied. Furthermore, all packets with source routing should be rejected.
- Even though TCP/IP, UDP/IP and other IP protocols communication ports are theoretically protected by application-gateway firewalls, they should still be protected by the same scheme as in packet-filtering firewall.

Three types of firewalls

- **Network-level firewall.** A network-level firewall is typically a router or special computer that examines packet addresses and then decides whether to pass the packet through or to block the packet from entering the Intranet based on the source and/or destination addresses.
- **Application-level firewall.** An application-level firewall is normally a host computer running software known as a proxy server. A proxy server is an application that

controls traffic by restricting and regulating the connections depending on the nature of the services at the application layer. The job of the proxy server is to transfer a copy of the packet from one network to another network. It masks the origin of the initiating connection and protects the Intranet from other Internet users. A proxy server can be configured to control which services are allowed on the network. However, users are required to use client programs that can support proxy operations.

- **Circuit-level firewall.** With the application gateway firewall, the proxy server intercepts the packets between client and server. The firewall is not transparent to user. With circuit-level firewall, the packets are not intercepted. All packets will be relayed through the firewall into the internal network in a transparent manner. A circuit-level firewall does not need to use a special proxy client application by creating a circuit between a client and a server without the need to know anything about the service. The advantage is that it provides service for a wide variety of protocols and there is much less overhead involved. The disadvantage is protection and control are coarse-grained, and not as flexible as that provided by application gateway firewalls.

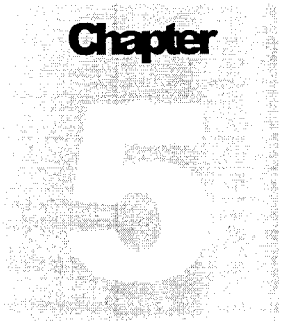
Firewall architecture

The three most popular firewall architectures are the dual-homes host, the screened host and the screened subnet firewall. The last two firewalls use a combination of routers and proxy servers.

- **A Dual-homed Host firewall.** A dual-homed host firewall is a simple and secure configuration in which a host computer is dedicated as the dividing line between the Intranet and the Internet. The host computer uses two separate network cards to connect to each network. The dual-homed host firewall works by running either an application-level or a circuit-level proxy.

- **A Screened host firewall.** This kind of firewall adds a router and places the host computer away from the Internet. The router can be configured so that it sees only one host computer on the Intranet network. Users on the Intranet have to connect to the Internet through this host computer and external users cannot directly access other computers on the Intranet

- **A Screened subnet firewall.** A screened subnet firewall further isolates an Intranet from the Internet by incorporating an intermediate perimeter network. The host computer is placed on the perimeter network which users can access through two separate routers, one controls access to the Intranet and the second connects to the Internet.



Future Development in Computer Network

Current and Future Trends in Software Development

Object-oriented Computing

Object-oriented Programming (OOP) is new methodology of software engineering. A complex piece of software is breakdown into components according to their functionality. Therefore, writing a software is like building a car. One will first build nuts and bolts, gears and bearings. They are put together to make the engine, transmission and wheels. Then, these parts are put together to make a car. In object-oriented design, an application is an integration of objects, each providing specific function.

Java, Applet and ActiveX

Sun Microsystems' development of a new software product named Java has also made a significant impact on the WWW. Java is commonly viewed as a new way to make web pages more dynamic - incorporating sound, animation, or even stock tickers into web page. However, it is becoming known as a new computing platform - the base upon which software developers can build applications.

Java is different from ordinary software in that Java applications, or applets, reside on centralized network servers. The network delivers the applet to your system upon user request. The applet runs inside a "container" such as a Web browser on the client system. This alleviates the user (client) from having to store applications on his/her computer, thus allowing cross-platform operability. Since the application resides on the server, and only the required components are temporarily transferred to the user when requested, client side software needs only be minimal.

The possible ramifications of this are unlimited. Applets could potentially replace most of client-resident software due to its flexibility and open-endedness. Users could download applications on an as-needed basis instead of having to purchase bulky, expensive software packages that most users never fully exploit anyway.

Microsoft has realized the importance of Java and has developed a similar product, ActiveX, Java has been accepted as the industry standard. Both Netscape and Microsoft

have incorporated Java capabilities into their web-browsers, and many companies have begun to develop Internet applications based upon the Java platform.

According to a recent InfoWorld survey, one out of every three Web sites is Java-enabled with more than 20 million people using Java-enabled browsers.

Hardware Convergence

Client/Server Technology

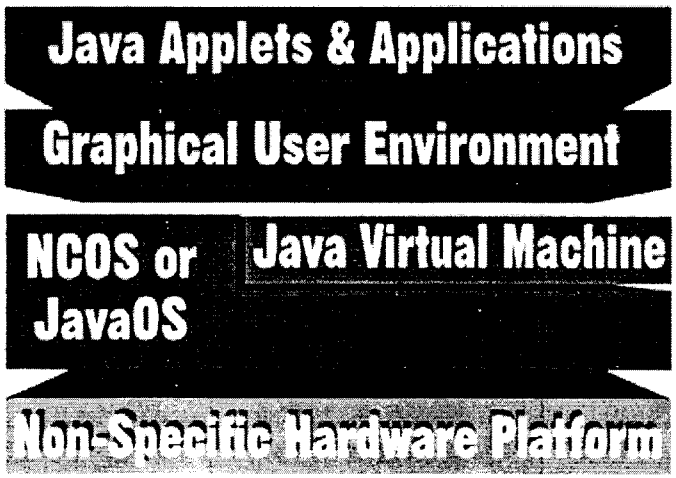
Client/Server (C/S) technology refers to a distributed network of software and hardware components. Applications, such as MS Word, reside on the client computer, while data is stored on the server computer. Each time that a user wishes to alter or retrieve data, he/she must send a request to the server, which in turn returns the requested information to the client. This technology enables users in many different locations to have access to the same data, while freeing up local (user) resources.

Network Computer

Oracle introduced the concept of the Network Computer (NC). The NC is a "new generation of affordable, easy-to-use information devices, optimized for electronic communications, information access, entertainment, and a host of applications."

In simple terms, the NC is a stripped-down version of a PC or PDA (personal digital assistant) which does not have a large local disk to store softwares and data files. Instead, the vast majority of the softwares and data will reside on the server (host) computer, and will only be retrieved as needed, via Java (or similar) software.

The idea of NCs in its current incarnation emerged in late December 1995. Many vendors had been working on prototypes and references and many felt there was a need for coherency in the infant market. With the future in mind, representatives from Apple Computer, IBM, Netscape, Oracle, and Sun Microsystems came together to create NCRef1. The preliminary specification was released on May 20, 1996 called "NC Reference Profile 1", the set of guidelines is designed to make multimedia Internet computing as ubiquitous as telephone and television services. It promotes competition in a new class of communications and commerce devices for use in homes, schools, businesses and institutions and will ensure compatibility of models from different manufacturers.



The Network Computer Reference Profile

The Reference provides a common set of standard features and functions across a broad range of scalable NCs. It is architecturally neutral and intended to facilitate the growth of the network computing industry while protecting investments made by customers, content providers, system providers, service providers and application providers through industry-wide

compatibility. The most important decision -- to make NCRef1 platform-independent -- was a given since the lead vendors needed to maintain their marketshare. NCs complying with the planned NC Reference may take many forms -- from desktops to laptops to video phones, pagers and even conventional PCs. All these devices may be linked to the Internet or Intranet and run basic applications such as Web browsers, e-mail applications, word processors, spreadsheets and presentation packages. In addition, NCs may function as multimedia machines by supporting video e-mail, 16-bit CD-quality sound and digital videos. To allow the flexibility and usability of the NC, network computer would operate on industry standards and protocols, such as TCP/IP, FTP, SNMP, HTML, HTTP, Java, SMTP, IMAP4, POP3, JPEG, GIF, WAV, and AU. This is an attempt to alleviate the problems caused by proprietary (closed) systems which has added to the complexity of PCs.

Network computer supports a variety of client/server models, ranging from the ultra-thin client to the fat client. The thin client is typified by a desktop system which stores applications and data on a network server, but performs all or most of the application processing within itself. Thin-client the preferred model for network computer. The ultra-thin client does not store any applications or data locally, and all actual application processing is performed on a network server. The only local processing is that of graphical display. All the data that transpires between the client and the server consists of graphical updates to the screen. This is close to X-terminal. The fat client stores most of its data locally, as well as processes applications locally.

The promise of the NC lies in it's low cost, ease-of-use, flexibility, and reduced maintenance costs. The first generation of NCs are expected to costs approximately $500, with lower prices for NCs which substitute a monitor with a TV.

Several NCs Hardware Products are :

1. The Desktop Client Station, these devices exist only in a networked computing environment with a core focus on Java applications
2. Minimal or Sealed-Unit PCs, devices to be created according to the NetPC and Odin standards, as well as others made independently, such as the AcerBasic.
3. Hand-Held Devices, like PDAs, but actually rely on a wireless or wired network environment, such as the WebBook and the Acorn PDA.
4. Internet Access Devices (IADs) and Set-Top Boxes (STBs), these boxes connect to television systems and provide access to the Internet through built-in Web browsers. They may or may not have Java support.
5. Java-based X Terminals, with local operating systems have been improved to include a Java Virtual machine, such as those from HDS, NCD, Boundless Technologies, and IBM.
6. Internet appliances, an array of other Internet appliances, such as network-televisions are also in development.
7. Intelligent Telephones, provide executive telephones combined with network access, such as the Acorn ExecuPhone.

NetPc

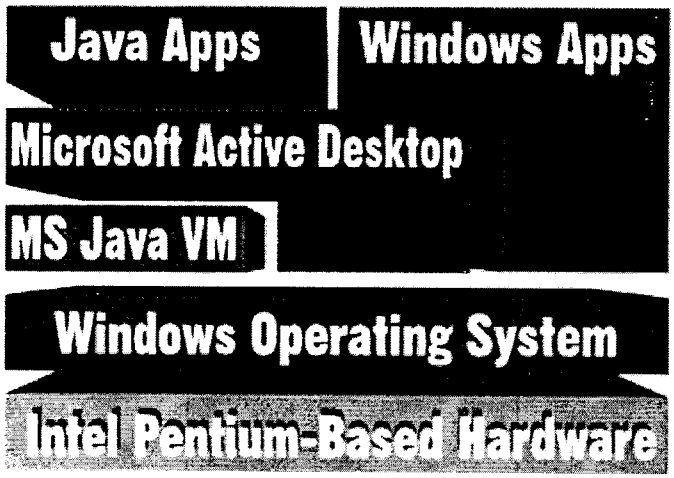
The NetPC is based on Microsoft-only standards for operating systems and device drivers. On October 28th, 1996, Microsoft and Intel, the leaders of the desktop computer industry, announced the joint NetPC initiative. The NetPC standard builds on existing, successful,

hardware and system architecture while improving management and componentization of the overall unit. Microsoft and Intel identified a few of the most powerful issues at the core of the appeal of network computing. The NetPC reference profile is a specification for a low-maintenance PC system that was designed with the network in mind. At the very basic level, it is a Windows-based environment that runs on an Intel/PC-based architecture.

The NetPC is a hardware specification first, and practically defines the desktop platform found in many corporations today. The hardware section of the standard also leaves room for the addition of interesting new technologies into the PC form factor.

Basic hardware components of the NetPC are :

- CPU: Pentium 100MHz or equivalent;
- Memory: 16MB RAM minimum;
- Disk: Internal hard disk as cache;
- Video: 640x480 pixels at 8 bits/pixel (VGA);
- Audio device (type unspecified);
- Plug-and-play BIOS support;
- No expansion slots;
- Network interface (Ethernet, Token Ring, V.34 modem, ISDN, ATM, T-1);
- Keyboard, pointing device/mouse; and
- Locked/sealed case.



Microsoft NetPC Architecture

Optional hardware additions include :

- IDE floppy drive,
- CD-ROM,
- PC (PCMCIA) card slots,
- Universal Serial Bus (USB), and
- 1394 high-speed peripheral bus.

The Universal Serial Bus (USB) provides a generic desktop bus for components ranging from a simple mouse to complex digital video camera systems. The concept for the USB is

to simplify the number of connectors and cables in and out of the PC box. If this sounds familiar to you, think back to the older Macintosh desktop bus. The concept is the same, but the implementation is different. The USB allows you to hook a mouse to a keyboard, a keyboard to a monitor, speakers to the monitor, the monitor to the PC, and so on. Essentially, redundant cables and connectors are reduced, and not all of the cables have to be directly plugged into the PC system unit.

The IEEE 1394 bus (also known as FireWire) is a next-generation serial bus for external devices; it adds increased speed and more data paths. It was designed to suit a large variety of peripheral devices such as keyboards, mice, microphones, digital video cameras, and even common household electronics (of the future), such as stereos and VCRs. Systems based on the USB and 1394 architectures will be appearing on the market this year from vendors such as Sony PC, HP, Gateway, and Dell. Because of the new architecture, however, they will take time to reach a wide audience and even longer to be incorporated into a wide range of non-PC components.

The NetPC defines a specific operating system environment. Based on Windows 95 (and probably Windows 97), the operating system environment will be compatible with current Windows software and will not require any rewrites, recompiles, etc. It is unknown whether the Windows NT environment will also be available for the NetPC design. Technically, this shouldn't be a problem, since the hardware design is not too far from current PC designs. However, the NetPC calls for some features that are still missing from NT 4.0, such as the plug-and-play support. The NetPC design will also not support the lightweight Microsoft Windows CE (Pegasus) environment for portable devices because of core differences in OS architecture.
The filesystem for the NetPC has yet to be specified. One possibility for a future version of the spec is FAT-32, a filesystem Microsoft is developing as a replacement in future Windows system for the age-old DOS FAT (FAT-16) filesystem. This new filesystem provides significant improvements in storage capacity, file names, performance, file information, etc. -- basically, filesystem technologies developed over the last 20 years in other operating systems. It is not, however, the same as the NT's NTFS file system, which is a step beyond even FAT-32 in some respects. The local storage specified for the NetPC is to be used as a cache drive and probably the system disk. User data storage might be specifically moved to the network file server system.

Virtual Network Computing (VNC)

VNC or Virtual Network Computing is, in essence, a remote display system which allows user to view a computing 'desktop' environment not only on the machine where it is running, but from anywhere on the Internet and from a wide variety of machine architectures. The VNC is a development of very-thin-client ATM network computers.

The characteristics of VNC which distinguish it from other remote display systems are as follows:

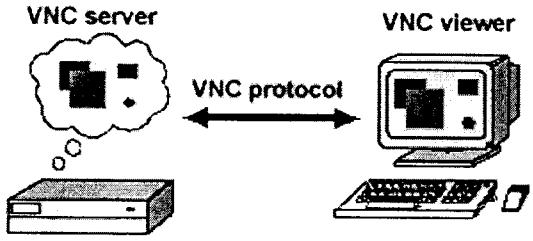
- No state is stored at the viewer. This means you can leave your desk, go to another machine, whether next door or several hundred miles away, reconnect to your desktop from there and finish the sentence you were typing. Even the cursor will be in the same place. With a PC X server, if your PC crashes or is restarted, all the remote applications will die. With VNC they go on running.

- It is small and simple. The Win32 viewer, for example, is about 150K in size and can be run directly from a floppy. There is no installation needed.

- It is truly platform-independent. A desktop running on a Linux machine may be displayed on a PC, or a Solaris machine, or any number of other architectures. The simplicity of the protocol makes it easy to port to new platforms. We have a Java viewer, which will run in any Java-capable browser. We have a Windows NT server, allowing you to view the desktop of a remote NT machine on any of these platforms using exactly the same viewer. And other people have ported VNC to a wide variety of other platforms.

- It is sharable. One desktop can be displayed and used by several viewers at once, allowing CSCW-style applications.

The VNC Protocol. The VNC protocol is a simple protocol for remote access to graphical user interfaces. It is based on the concept of a *remote framebuffer* or *RFB*. The protocol simply allows a server to update the framebuffer displayed on a viewer. Because it works at the framebuffer level it is potentially applicable to all operating systems, windowing systems and applications. This includes X/Unix, Windows 3.1/95/NT and Macintosh, but might also include PDAs, and indeed any device with some form of communications link. The protocol will operate over any reliable transport such as TCP/IP. The VNC protocol is truly a "thin-client" protocol: it has been designed to make very few requirements of the viewer. In this way, clients can run on the widest range of hardware, and the task of implementing a client is made as simple as possible.



VNC Clients. Writing a VNC viewer is a simple task, as it should be for any thin-client system. It requires only a reliable transport (usually TCP/IP), and a way of displaying pixels (either directly writing to the framebuffer, or going through a windowing system). There are several clients available for the networked display devices. This includes the Videotile (the original RFB client), an X-based client (which runs on Solaris, Linux and Digital Unix workstations), a Win32 client which runs on Windows NT and 95, a Macintosh client, and a Java client which runs on any Java-capable browser (including Sun's JavaStation).

VNC Servers. Writing a VNC server is slightly harder than writing a client for a number of reasons. The protocol is designed to make the client as simple as possible, so it is usually up to the server to perform any necessary translations. For example, the server must provide pixel data in the format the client wants. We have servers for our two main platforms, X (i.e. Unix) and Windows NT/95. A Unix machine can run a number of Xvnc servers for different users, each of which represents a distinct VNC desktop. Each VNC desktop is like a virtual X display, with a root window on which several X applications can be displayed. The Windows server (WinVNC) is a little more difficult to create, because there are fewer places to insert hooks into the system to monitor display updates, and a less clearly-defined model of multiuser operation. Our current server simply mirrors the real

display to a remote client, which means that the server is not 'multiuser'. It does, however, provide the primary user of a PC with remote access to their desktop.

Input protocol. The input side of the protocol is based on a standard workstation model of a keyboard and multi-button pointing device. Input events are sent to the server by the client whenever the user presses a key or pointer button, or whenever the pointing device is moved. These input events can also be synthesized from other non-standard I/O devices.

Connection Setup and Shutdown. When the connection between a client and a server is first established, the server begins, by requesting authentication from the client, using a challenge-response scheme, which typically results in the user being prompted for a password at the client end. The server and client then exchange messages to negotiate desktop size, pixel format, and the encoding schemes to be used. The client then requests an update for the entire screen, and the session begins. Because of the stateless nature of the client, either side can close the connection at any time without adverse consequences.

Telecommunication Technology

Telecommunications technology continues to improve. Digital phone lines (ISDN), fiber optics, modem technology, and other communications means allows users to transfer and receive data more efficiently. Big telecom manufacturers are working on ways to improve wireless communications technologies. One recent development in wireless technology (wireless) involves the utilization of radio frequency (RF) waves to transfer data. Radio stations may someday offer Internet access with extremely high bandwidth capacity and fast transfer times.

Glossary of Firewall

- **Abuse of Privilege**
  When a user performs an action that they should not have, according to organizational policy or law.

- **Access Control Lists**
  Rules for packet filters (typically routers) that define which packets to pass and which to block.

- **Access Router**
  A router that connects your network to the external Internet. Typically, this is your first line of defense against attackers from the outside Internet. By enabling access control lists on this router, you'll be able to provide a level of protection for all of the hosts "behind" that router, effectively making that network a DMZ instead of an unprotected external LAN.

- **Application-Layer Firewall**
  A firewall system in which service is provided by processes that maintain complete TCP connection state and sequencing. Application layer firewalls often re-address traffic so that outgoing traffic appears to have originated from the firewall, rather than the internal host.

- **Authentication**
  The process of determining the identity of a user that is attempting to access a system.

- **Authentication Token**
  A portable device used for authenticating a user. Authentication tokens operate by challenge/response, time-based code sequences, or other techniques. This may include paper-based lists of one-time passwords.

- **Authorization**
  The process of determining what types of activities are permitted. Usually, authorization is in the context of authentication: once you have authenticated a user, they may be authorized different types of access or activity.

- **Bastion Host**
  A system that has been hardened to resist attack, and which is installed on a network in such a way that it is expected to potentially come under attack. Bastion hosts are often components of firewalls, or may be "outside" web servers or public access systems. Generally, a bastion host is running some form of general-purpose operating system (e.g., Unix, VMS, NT, etc.) rather than a ROM-based or firmware operating system.

- **Challenge/Response**
  An authentication technique whereby a server sends an unpredictable challenge to the user, who computes a response using some form of authentication token.

- **Chroot**
  A technique under Unix whereby a process is permanently restricted to an isolated subset of the filesystem.

- **Cryptographic Checksum**
  A one-way function applied to a file to produce a unique "fingerprint" of the file for later reference. Checksum systems are a primary means of detecting filesystem tampering on Unix.

- **Data Driven Attack**
  A form of attack in which the attack is encoded in innocuous-seeming data which is executed by a user or other software to implement an attack. In the case of firewalls, a data driven attack is a concern since it may get through the firewall in data form and launch an attack against a system behind the firewall.

- **Defense in Depth**
  The security approach whereby each system on the network is secured to the greatest possible degree. May be used in conjunction with firewalls.

- **DNS spoofing**
  Assuming the DNS name of another system by either corrupting the name service cache of a victim system, or by compromising a domain name server for a valid domain.

- **Dual Homed Gateway**
  A dual homed gateway is a system that has two or more network interfaces, each of which is connected to a different network. In firewall configurations, a dual homed gateway usually acts to block or filter some or all of the traffic trying to pass between the networks.

- **Encrypting Router**
  see Tunneling Router and Virtual Network Perimeter.

- **Firewall**
  A system or combination of systems that enforces a boundary between two or more networks.

- **Host-based Security**
  The technique of securing an individual system from attack. Host based security is operating system and version dependent.

- **Insider Attack**
  An attack originating from inside a protected network.

- **Intrusion Detection**
  Detection of break-ins or break-in attempts either manually or via software expert systems that operate on logs or other information available on the network.

- **IP Spoofing**
  An attack whereby a system attempts to illicitly impersonate another system by using its IP network address.

- **IP Splicing / Hijacking**
  An attack whereby an active, established, session is intercepted and co-opted by the attacker. IP Splicing attacks may occur after an authentication has been made, permitting the attacker to assume the role of an already authorized user. Primary protections against IP Splicing rely on encryption at the session or network layer.

- **Least Privilege**
  Designing operational aspects of a system to operate with a minimum amount of system privilege. This reduces the authorization level at which various actions are performed and decreases the chance that a process or user with high privileges may be caused to perform unauthorized activity resulting in a security breach.

- **Logging**
  The process of storing information about events that occurred on the firewall or network.

- **Log Retention**
  How long audit logs are retained and maintained.

- **Log Processing**
  How audit logs are processed, searched for key events, or summarized.

- **Network-Layer Firewall**
  A firewall in which traffic is examined at the network protocol packet layer.

- **Perimeter-based Security**
  The technique of securing a network by controlling access to all entry and exit points of the network.

- **Policy**
  Organization-level rules governing acceptable use of computing resources, security practices, and operational procedures.

- **Proxy**
  A software agent that acts on behalf of a user. Typical proxies accept a connection from a user, make a decision as to whether or not the user or client IP address is permitted to use the proxy, perhaps does additional authentication, and then completes a connection on behalf of the user to a remote destination.

- **Screened Host**
  A host on a network behind a screening router. The degree to which a screened host may be accessed depends on the screening rules in the router.

- **Screened Subnet**
  A subnet behind a screening router. The degree to which the subnet may be accessed depends on the screening rules in the router.

- **Screening Router**
  A router configured to permit or deny traffic based on a set of permission rules installed by the administrator.

- **Session Stealing**
  See IP Splicing.

- **Trojan Horse**
  A software entity that appears to do something normal but which, in fact, contains a trapdoor or attack program.

- **Tunneling Router**
  A router or system capable of routing traffic by encrypting it and encapsulating it for transmission across an un-trusted network, for eventual de-encapsulation and decryption.

- **Social Engineering**
  An attack based on deceiving users or administrators at the target site. Social engineering attacks are typically carried out by telephoning users or operators and pretending to be an authorized user, to attempt to gain illicit access to systems.

- **Virtual Network Perimeter**
  A network that appears to be a single protected network behind firewalls, which actually encompasses encrypted virtual links over untrusted networks.

- **Virus**
  A replicating code segment that attaches itself to a program or data file. Viruses might or might not contain attack programs or trapdoors. Unfortunately, many have taken to calling any malicious code a "virus". If you mean "trojan horse" or "worm", say "trojan horse" or "worm".

- **Worm**
  A standalone program that, when run, copies itself from one host to another, and then runs itself on each newly infected host. The widely reported "Internet Virus" of 1988 was not a virus at all, but actually a worm.