WIRELESS TRAVEL MAP OVER WAP ON MOBILE DEVICES

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Submitted in Partial Fulfillment of the
Requirements for the Degree of

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By

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ABSTRACT

Nowadays, information and technologies have become the most important part in our daily life. The fastest growing direction of the information and technology industry is the mobile Internet. Putting the Internet in the mobile devices is one technology step that can change our life style. By personal devices, the Internet users can get to the worldwide information from anywhere, anytime and anyhow. New wireless networks provide many services and applications for mobile users.

The mobile digital map is one of the service types on mobile network. It has the ability to search the map (such as the travel map) although the users are on the way or in the car. By combining digital map information and WAP technology we can offer travel map service on the mobile phone. However, wireless network presents information with strong restrictions because of the limitations of mobile phones and low bandwidth of the wireless network.

In this thesis, I will present the travel map service on the mobile devices, the technique to solve the limitation of WAP and how can the server generate vector map and present the output map a on low memory browser.

The conclusion was the main advantages that I got from combining vector digital map, travel information and WAP. The result of this thesis may open up the creation of geographic information system for the tourism industry in the future.

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CHAPTER 1: INTRODUCTION

The Internet has opened up many exciting possibilities for organizing and running a business that are transforming organizations and the use of information systems in everyday life.[1] It is creating a universal platform for transforming information inside the firm.

1.1 Background of Online Mapping Service

Developments in Internet Technologies in recent years have enabled advances in several services such as digital libraries, search engines, distance learning and mapping service. Online Mapping Services have experienced an explosion due to the convergence of these technological developments, the merging of the telecommunications and computing industries and geographic information system. Online Mapping Service is a digital mapping service for routing and providing driving direction, that is applied for many tasks, as following below:

- Tourist Map
- Express Way Map
- City Map
- Traffic Map

1.2 What is Digital Mapping?

Digital mapping is the collection of information in computer systems (often called Geographical Information Systems, or GIS for short) that represent, in digital form, information that can be shown on a map.[2] The information in a GIS relates to the characteristics for geographic locations or areas. In other words, a GIS answers questions about where things are or about what is located at a given location. The information that goes to make up the maps has to be represented in terms that computers can understand.

For objects' description, GIS uses information that consists of two components: location information, which reflects geographic features of the object, and descriptive information, which describe another object's features. Thus, a hybrid data model, which combines location data and descriptive attribute data, is used for managing such features. The spatial and attribute data are linked in such a way that both of the components are available in a combination.

The information that goes to make up the maps has to be represented in terms that computers can understand. There are basically two types of digital map data models: raster data models and vector data models.

1.2.1 Raster data models

Raster data models represent spatial features in grid-cells or dots known as pixels, that can represent discrete point, line and polygon features. A point feature is represented as a value in a single cell, a linear feature as a series of connected cells portraying shape. Location of each spatial object is represented as the cell or pixel as the homogeneous unit. These pixels are the basic units for which information is explicitly recorded. Each pixel is only assigned as one value. The simplest way of storing spatial data is through the raster model. In this model, the spatial data are organized in cells or pixels. These pixels are the basic units for which information is explicitly recorded. Each pixel is only assigned one value. Raster digital map data is created by scanning paper map or aerial photography into a computer file.

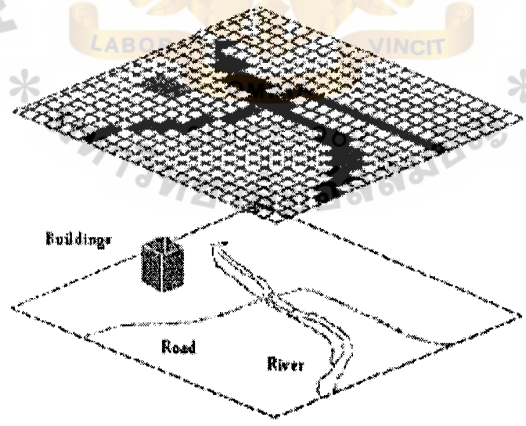

Figure1: Raster Representation

1.2.2 Vector data model

The vector data model represents geographic features similar to the way maps do. A coordinate system refers to real-world locations. The used coordinate system is usually a fixed two-dimensional system, where a location is recorded as an (x,y) coordinate. Vector data models represent spatial features in three ways, known as entities or features:

- **Points**, which are the basic building block and, depending on the map, may represent individual features such as trees or lampposts. The location of a point is described by an X and Y coordinate, which fix the object to some reference system such as the Ordnance Survey's National Grid. Map data often does not include a Z coordinate (or height);
- **Lines**, which are sets of points that represent linear features such as roads and rivers;
- **Polygons** or **areas**, which are sets of lines used to represent closed areas such as woodland, bodies of water or cities, and also administrative areas such as parliamentary constituencies.

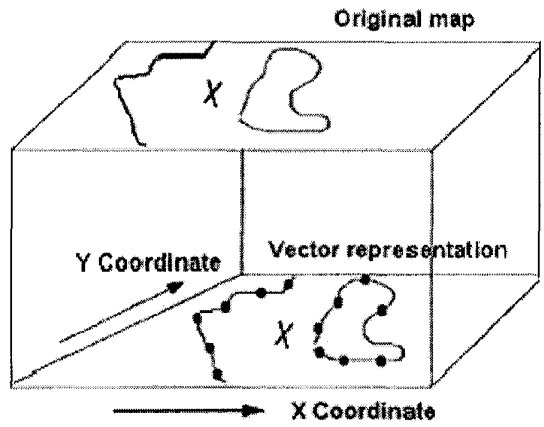

Figure 2: Vector Representation

A line is the basic unit in the vector data model. A line is represented in computers by a descriptive header and an ordered set of co-ordinate pairs representing the X and Y locations of points making up the line, as illustrated in Table 3.1 below. A point is a special case of a line with only one pair of X and Y co-ordinates. A closed polygon is a special case of a line in which the first and last pair of X and Y co-ordinates have the same values. Table 1 illustrates how these are represented using the vector data model.

Point		Line		Polygon	
X	**Y**	**X**	**Y**	**X**	**Y**
2	4	5	2	6	4
		4	4	5	7
		3	6	7	9
		2	7	9	7
				8	5

Table 1: Co-ordinates for Figure 3

Features on the Earth's surface are mapped on flat, two-dimensional maps as points, lines and areas or polygons. A Cartesian co-ordinate system is used as a reference map locations to ground locations. Co-ordinates can be held either in the units of a map system or in the units of the ground system, together with the scale.

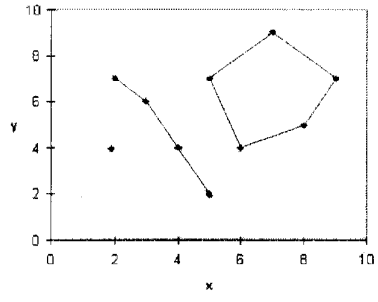

Figure 3: Graph for coordinate in table1

Figure 3 shows a graph with examples of point, line and closed polygons. From this example it is easy to see how a single feature is stored. Maps often have many features, so some method of accessing them is essential. Two methods are often used:

- by giving each feature on a map a unique identification label.
- by assigning map features to separate classes or categories and storing these in different map layers.

Commonly, one map layer may contain points, another lines, and another polygons. To organize layers in different map, layers store different types or classes of map data.

1.3 Comparison of graphic format

The purpose of this topic is to compare vector graphic with raster graphic. This table compares the characteristics of two types of graphic format.

Vector Graphic	Raster Graphic
Keep as entities – points, lines, polygons with topological relationships and real X,Y coordinates for all features	Keep as grid cell, Rows/Columns of equal-size grid cells, each of which has real X, Y coordinates
Resolution depends on source data	Resolution depends on cell size
Object-Oriented spatial analysis easy	Surface-Oriented spatial analysis

Table 2: Comparison of graphic format

In summary, the vector is quite an attractive solution for mapping systems. It is closer to map encoding than bitmap format, but it requires more power from a mobile device for processing and visualization.

CHAPTER 2: LITERATURE SURVEY

2.1 The Telecommunications Revolution

Telecommunications can be defined as the communication of information by electronic means, usually over some distance. Previously, telecommunications meant voice transmission over telephone lines. Today, a great deal of telecommunications transmission is through digital data transmission, using computers to transmit data from one location to another. We are currently in the middle of a telecommunications revolution that is spreading communications technology and telecommunications services throughout the globe.[3]

2.2 Introduction Mobile Environment

The term "Mobile Environment" is very closely associated with the term of "mobile computing". Mobile computing is a new emerging computing paradigm, which has become very popular lately, due to the growth of incredibly faster telecommunication technologies. Cellular communication systems, wireless LAN (Local Area Network), and wireless data network give to mobile users the capability of accessing information anytime, anywhere, and anyhow. As a result of that, people can manage their information, which is located at the servers in wired networks, with their mobile devices. The users can characterise mobile computing as follows: mobile computing consists of travelling people using wireless information devices connected to the computer network infrastructure to find out the information they want.

2.3 Mobile Devices

Nowadays, a mobile market provides wide range of mobile terminals from usual cellular mobile phones to laptop computer. Physics characteristics, functionality, and the customer target can distinguish all these devices from each other. The mobile phone will be able to be determined as the following basic groups,

- **Normal cellular mobile phones,** the users are able to send and receive text messages with SMS (Short Messages Service);
- **WAP – phones** have built-in micro-browser, which the users can travel to World Wide WAP content. (e.g Ericsson R380, Nokia 7110, Motorola V8088);
- **PDA –** A type of equipment integrated with or attached to a mobile phone for data and voice transfer, usually having a small text keyboard, can run simple applications and connect to Internet.
- **Laptop PC** includes all the sub-notebook size equipment

2.4 Digital Mapping Service

In twenty first century, the most rapidly growing direction of information technology industry is the mobile Internet. On the one hand, Internet technologies have become widely used and penetrate almost every possible area of our life. There are a lot of services for any requirements of common users. People can communicate with their friends, colleagues or business communication, videoconferencing with them even, receive latest news every hour, manage their bank accounts, do shopping, and information searching via the mobile Internet. Everyday people need to go from

one place to other places such as home to office or restaurant. At the same time they still need good information to help them to make the best decision. Online mapping services have become the tools that can help them to choose the best way. There are many companies providing the location information.

2.5 Wireless Map Survey

The number of mobile phones in the world is increasing every day at an astonishing speed, with analysts forecasting that there will be more than a billion mobile phones in use within the next five years and that over half of the Internet access will be through non-PCs . The mobile phone has become a part of daily life for many people, and together with a watch is the only electronic device that many people carry around everywhere with them, all day long.

One of the service types on mobile network is the mobile digital map. It has the ability to search the map (such as the travel map) although the users are on the way or in the vehicle. By combining digital map information and WAP technology we can offer travel map service on the mobile phone.

When you on the travelling to anyplace, you can use your mobile phone to search information about sightseeing, also the route in both, the text and the graphic format. Nowadays, there are sites that provide information about the route or traffic of many places, that information is in the form of text and graphic (or digital map).

Thaimapguide

This site provides Thai Map information. Only textual information is provided, including the ability to perform search operations. The working step is as the following screen.

Figure 4: The Search Card

The users can search the requested place by selecting category such as hotel, post office and bank from dropdown list and input keyword of the place name, such as Silom City Inn to the input box then click search.

Figure 5: The Result Card

The application will use your input keyword to search the place name from the database and return the match result as name of place.

Figure 6: The Information Card

Then the users will use the place name and link to see the information card, that provides the address and other information for the searching place.

Thai Navigator Pro

This application works as navigation systems for vehicles, advanced GPS receivers (Geographical Positioning System) which are able to display geographical maps. Thai Navigator Pro provides mobile location service technologies include location identification, navigation, vehicle tracking, location based information, and services. The users can view the map and perform operations like zooming and panning.

Hardware available on

Notebook System : 12 channel GPS, Power supply by PS/2 connector and Magnetic Mount.

MAP Point Asia

Products and Services on WAP phone

This company provides WAP engine enabled mobile phone users to search nearby services and to generate customized driving directions from their location to their destination. WAP near-by service provides a text-only search capability for a mobile phone user. A GSM phone will soon be able to self-locate its position within GSM network using cellular network based position. Specific functions can then be introduced to help the user to find destinations such as banks, automatic teller machines, gas stations and restaurants. [4]

Avantgo

It is an application server vector map for palm users. The users can search, view the map and perform operations like zooming. "Zooming in" means changing of map scale in order to see more details or "zooming out" means see the map outline. "Panning" is scrolling of the map on a screen of map on a screen in order to look at hidden parts of a map, which could not fit on a screen.

System Requirement

Palm: Palm OS Version 3.x or later running on the following devices: Palm III, Palm IIIx, Palm IIIe, Palm IIIc, Palm V, Palm Vx, Palm VII, Palm m100; Memory Requirements: At least 428KB of free memory, plus additional space for data.

2.6 Problem Statement

We apply the analysis of used cases in order to design the data model of our system. To perform a vector image, it requires more power from a mobile device for processing and visualization, such as a notebook or a palm. In the mobile environment, wireless networks provide a more complex environment compared to wired networks because of the limitations of power and narrow bandwidth. A mobile phone device should always have a small size in order to be mobile. Therefore, the small size leads towards the small screen and limited processing power. User input devices for mobile terminals are also differ from a conventional computer keyboard and mouse. Developers have to keep in mind these factors as well as the environment in which people use mobiles.

This thesis will apply the analysis of use cases in order to propose the data model of WAP system. These strategies would be taking into consider the geographical nature of problem domain. Therefore, approaches from the conventional MAP could be used. The result of the proposed model will be applied to use methods from coverage database design, which is used for development of a data structure for MAP applications. The analysis part will define all entities that refer to the problem domain and the relationship between them. Following steps are necessary to achieve a complete and effective data model for WAP application via the mobile phone.

- Create the model of the work performed by the user for "searching the location"
- Define entities, geographic and related non-geographic features, Identifying their attributes and relationships.

- Match the representation of each geographic feature to one of the coverage feature classes point, line or polygon

Major problem is to transfer data to a mobile user. The output of MAP application should make it as effective as possible and take into regard all limitations of the mobile environment.

CHAPTER 3: TECHNOLOGIES USED

This thesis will implement the vector MAP system that provides for mobile phone users. In this system, the map data is kept as vector graphic and send the information and output map in WBMP format to users over Internet via WAP. For this system development, it will be concerned with technologies as follows:

3.1 WIRELESS APPLICATION PROTOCOL

3.1.1 What is WAP/WML?

At present, the trend of information technology is towards smaller and faster devices, together with the need to access information from anywhere, which has paved the way for a new technology that brings together web and the mobile devices. The Wireless Application Protocol [WAP] is an industry-wide standard, defining a communications protocol and application environment that allows us to access Internet content and services from mobile phones, designed from the ground up for low-power, small-screen devices with limited input capabilities and low bandwidth.

WML (Wireless Markup Language) is a markup language based on [XML] and is intended for use in specifying content and user interface for narrowband devices, including cellular phones and pagers.

3.1.2 Why is WAP needed?

WAP (Wireless Application Protocol) gives mobile access to information and services for small wireless devices i.e. mobile phones and PDAs. WAP takes care of the limitations those kinds of devices have and the demand of flexibility they need.

The Limitations that WAP handles

- **Display size** - Small display screens with low resolution. A small mobile device such as a phone may only have a few lines of textual display, each line containing 8-12 characters.
- **The input device** - a limited or special-purpose input device. A phone typically has a numeric keypad and a few additional function-specific keys. A more sophisticated device may have software-programmable buttons, but may not have a mouse or other pointing device.
- **Computational resource** - Low power CPU, small memories size and less reliable power supply.
- **Narrowband network connectivity** - Low bandwidth and high latency.

3.1.3 How does a Wap device connect to the Internet?

The normal implementation of a WAP scenario looks pretty much like this:

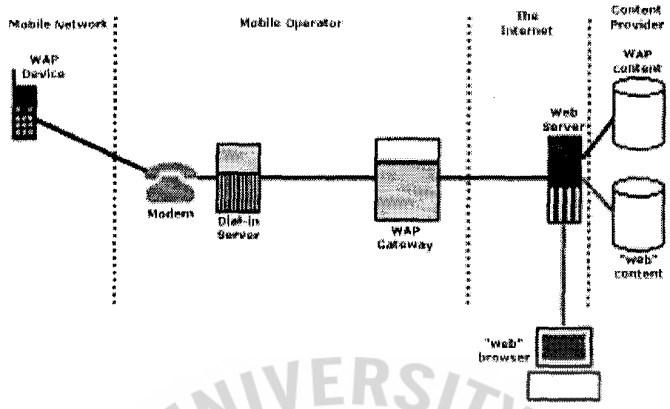

Figure 7: How does a Wap device connect to the Internet?

In the figure above, starting from the left, you'll find the mobile WAP device attached to the mobile network (GSM) which dials the modem attached to a dial-in server (RAS, or Remote Access Service). This server gives the WAP device access to the protocols it needs. These are the same lower level protocols, as a normal Internet Service Provider will give you. This is known as PPP or Point-to-Point Protocol.[5]

These protocols are used to access the next step in the chain, the WAP gateway, in this figure hosted by the mobile operator. The WAP gateway is the link between the wireless and the "web" world, basically giving the WAP device access to the common Internet.

When you type in the URL for a site on your WAP device for instance, the WAP device first checks if it already has an open connection, if not, it dials up the PPP provider as described above. After the PPP provider has given the WAP device

the required protocols and assigned it an IP address, the request for the URL is sent to the gateway. The WAP gateway, now under "control" of the WAP device requests the URL with a normal HTTP request, such as GET http://wap.telenor.no/.

On the internet, there is a normal "web" server which in this case holds both “WAP” and "WEB" contents, which now receives the request to send out the contents located at the http://wap.telenor.no/ URL. Also note the normal "web" browser at the lower part of the figure. The web server, depending on which type of browser it is talking to (“WAP” or "WEB"), sends out WAP.

Following the requested content back to the WAP device, the contents, if they are in so called textual WML code (the human readable type), the WAP gateway compiles the textual WML into so called tokenized WML, or WMLC, where basically the code is "compressed" down into binary data (the machine readable type). This tokenized WML is then passed back to the WAP device. If the contents from the web server is already in tokenized WML format, the WAP gateway skips this operation. The reason for the conversion from textual WML to tokenized WML is to reduce bandwidth usage. A WAP device's WML browser can only read tokenized WML.

Finally, back at the WAP device that requested the URL, the WML browser, when receiving the tokenized WML code renders the contents on the WAP device's display to present a card for the user.

3.1.4 WAP Protocol Stack

WAP Protocol Stack or WAP Internal Structure, its structure has five different layers.

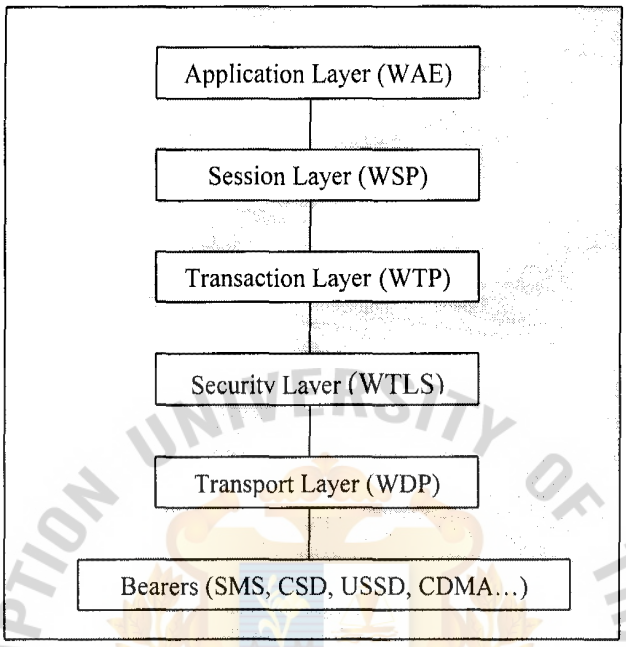

Figure 8: WAP Protocol Stack Diagram

Wireless Application Environment (WAE)

The WAE defines the user interface on the phone. The application development environment helps to facilitate the development of services that support multiple bearers. To achieve this, the WAE contains the Wireless Markup Language (WML), WMLScript - a scripting micro-language similar to JavaScript - and the Wireless Telephony Application (WTA). These are the tools that allow WAP-based applications to be developed.

Wireless Session Protocol (WSP)

A sandwich layer that links the WAE to two session services - one connection oriented operating above the Wireless Transaction Protocol and a connectionless service operating above the Wireless Datagram Protocol.

Wireless Transaction Protocol (WTP)

Runs on top of a datagram service such as User Datagram Protocol (UDP); part of the standard suite of TCP/IP protocols, to provide a simplified protocol suitable for low bandwidth mobile stations. WTP offers three classes of transaction service: unreliable one way request, reliable one way request and reliable two way request respond. Interestingly, WTP supports Protocol Data Unit concatenation and delayed acknowledgement to help reduce the number of messages sent. This protocol therefore tries to optimize the user experience by providing the information that is needed when it is needed - it can be confusing to receive confirmation of delivery messages when you are expecting the information itself. By stringing several messages together, the end user may well be able to get a better feel more quickly for what information is being communicated.

Wireless Transport Layer Security (WTLS)

WTLS incorporates security features that are based upon the established Transport Layer Security (TLS) protocol standard. Includes data integrity checks, privacy on the WAP Gateway to client leg and authentication.

Wireless Datagram Protocol (WDP)

This allows WAP to be bearer independent by adapting the transport layer of the underlying bearer. WDP presents a consistent data format to the higher layers of the WAP protocol stack thereby conferring the advantage of bearer independence to application developers.

3.1.5 What is WAP Gateway?

A WAP gateway forms a bridge between two distinct worlds, the Internet (or other IP packet network) and the wireless phone data network, which are fundamentally different in their underlying technologies. [6]

Work is currently being done into the convergence of varies technologies that will make life simpler for people who access information. Eventually we may see a day when a single predominant technology will be used for all types of networks, supporting voice, data and video services. However, until then, we need solution specific technologies, like WAP, to enable information flow towards users who are using different access mechanisms.

A WAP gateway is basically software that is placed between a network that supports WAP and an IP packet network such as the Internet. It acts as an intermediary that converts between the protocols of the packet network and the protocols on the WAP network (WSP, WTP, WTLS, and WDP). When cellular packet networks, such as GPRS, that can use TCP/IP directly are prevalent, it may still make more sense to use the WAP protocol as it's nature is to reduce the data

transfer size required. In addition, WAP for the moment, presumes the use of WML, which is geared towards small screens and low processing power. If on the other hand you use a GPRS mobile connected to a laptop, you can access HTTP and TCP/IP directly to access information on the Internet. Among other things, the gateway converts WSP requests from wireless devices into HTTP requests, and vice versa for the HTTP responses.

A WAP gateway can be implemented as a single host or a cluster of servers for load balancing. However, regardless of the implementation, it can still be considered as a single box from a mobile user's perspective.

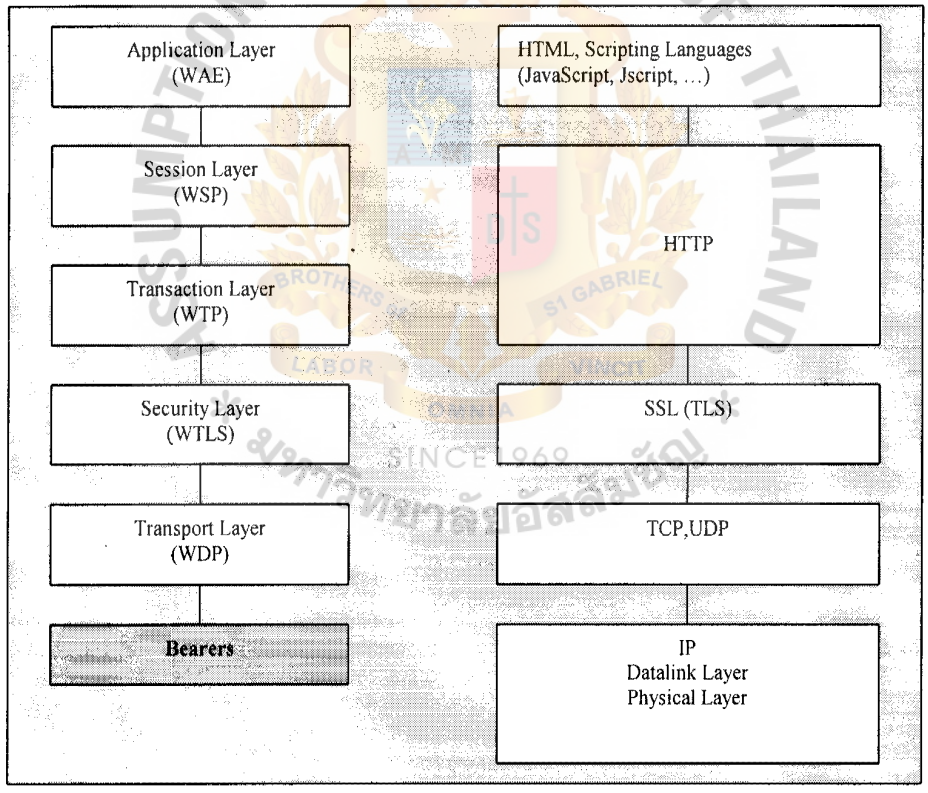

Figure 9: WAP Layer Compare with Internet Layer

The Internet is based on the TCP/IP protocol stack, which is suited to wired networks and quite unsuitable for most types of wireless networks. This is because:

- TCP is a heavyweight transport layer protocol that has high overheads (or control data as a percentage of the total data transferred), especially during connection establishment. This is due to the three-way-handshake mechanism. It also transmits large amounts of data to handle the possibility of packets arriving in a different order to which they were sent. This could happen if the packets take different routes in an IP network.

Here is a simple illustration of the three-way-handshake mechanism in TCP:

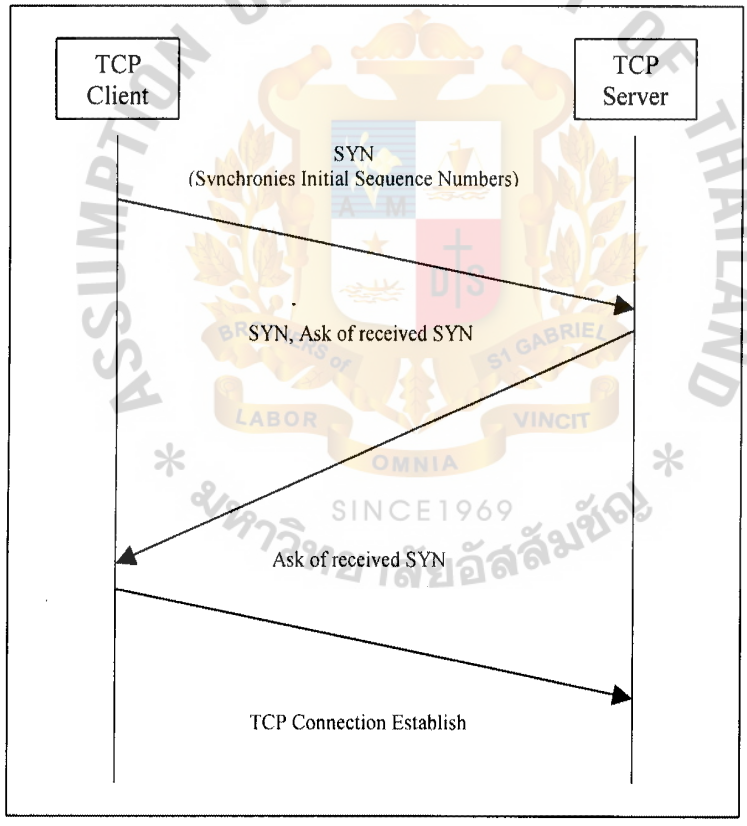

Figure 10: Three-way-handshake mechanism in TCP

A connection is only considered as established when all three messages have been exchanged, a large overhead in wireless networks.

The round-trip delays (or latency) incurred are very high in wireless networks, which would mean that timer values used for retransmission of data in wired networks would cause unnecessary network congestion. When packets transmission are not acknowledged by the remote entity within a fixed period, known as a retransmission timer value, the TCP layer at the sending end resends these packets.

3.2 Vector Map Data storage Technique

Digital Map data storage techniques actually format graphic and nongraphic data in a variety of different formats to facilitate processing and retrieval.

Digital Map database are stored in either vector or raster form. Map data structures adhering to a "vector" format store the position of map features as sequences of x, y (and sometimes z) coordinates. A vector format represents the location and shape of features and boundaries precisely. Only the accuracy and scale of the map compilation process; the resolution of input devices; and the skill of the operator inputting data limit the precision. In contrast, the "raster" or "grid-based" format generalizes map features as cells or pixels in a grid matrix. The fineness of the grid or, in other words, the size of the cells in the grid matrix, will determine the level of detail at which map features are represented.

CHAPTER 4: GOAL AND TECHNOLOGY PLATFORM

WAP (Wireless Application Protocol) is a big technology that brings together the two worlds of the web and the mobile phone. Putting the Internet in the device of a hand is one technology step that can change our life style. We will get universal access with personal devices to information anytime, anywhere and anyhow. New emerging telecommunication technologies offer an opportunity for providing new generation services and applications for mobiles users. Even the term "mobile commerce" (M-Commerce) has appeared it is a subset of "Electronic Commerce" (E-Commerce) that is conducted via a mobile telecommunications network. Wireless data networks represent a new application environment with strong restrictions because of limitations of mobile devices and wireless communication environment. WAP (Wireless Application Protocol) Forum defines standard architecture, programming model and a set of protocols intended to implement wireless Internet access.

4.1 Wireless Travel Map over Wap on mobile devices.

Nowadays, many web site providers are also offering a new service to mobile users. You can access a WAP Website to search and view much information such as weather forecasts, news, airlines schedule and many more, but most of WAP websites also provide information in textual form.

One of the service types on a mobile network is the mobile digital map. It has the ability to search the map (such as the travel map) although the users are on the way or in the car. By combining digital map information and WAP technology we can offer travel map service on the mobile phone. However, wireless network presents information with strong restrictions because of the limitations of mobile phones and low bandwidth of the wireless network.

4.2 The Goal of structured development

For Wireless Travel Map, the service of this WAP Website is to provide information about driving direction in digital map system over WAP on your mobile devices. The users can find the direction and view digital map from anywhere as they want on their mobile devices. Tourists can access and use online digital map service from their mobile devices, instead of, working on desktop PC and plug to modem and dial to Internet. The map is kept and processed as vector graphic, so it can bring the advantage function of vector graphic to use. It is a multi-scale map, the user can zoom in/out to see the deep detail and has panning function to see the information that not fit in the screen and kept the graphic as layers. On a different scale it will show the different data such as when the user zoom in at large scale, the layer that kept restaurant on and will include the clearly step design, that makes the users receive correct and clear location data. The information that the users will get from the service are address, nearest place, and the graphic map. Although the mobile phone has a limitation in screen size, but this application design will bring the symbol and abbreviation to use in the map, therefore in equal one screen size, the users will receive more information.

4.3 Why wireless bitmap?

At present, the WAP only supports black and white images with no compression. These are called type 0 WBMPs. The WBMP-format (wireless bitmap image) is the only image format, which has been specified by the WAP Forum. The WBMP format supports the definition of compact image formats suitable for encoding a wide variety of image formats and provides the means for optimization steps such as stripping of superfluous headers and special purpose compression schemes. This leads to efficient communication to and from the client and for efficient presentation in the client display.

A WBMP image has the following characteristics:

- Compact binary encoding
- Extensibility (unlimited type definition space)
- Optimized for low computational costs in the client.

Specification of well-defined WBMP Types: WBMP Type 0: B/W, Uncompressed Bitmap. WBMP type 0 has the following characteristics:

- No compression
- Color: one bit with white=1, black=0
- Depth: 1 bit deep (monochrome)
- The high bit of each byte is the left-most pixel of the byte
- The first row in the data is the upper row of the image.

4.4 Scale of the Map Data.

Map scale describes the relationship between mapped size and actual size. It is expressed as a relationship between linear distances on the map and corresponding ground distances. Two methods of notating scale are commonly used:

• Inch-Foot Equivalent—The scale relationship is expressed as "1 inch = x feet" where the map distance of 1 inch is compared to its corresponding ground distance.

• Representative Fraction (RF)—This is a pure fraction that represents the ratio of map distance to ground distance without specifying any measurement unit. The inch-foot equivalent of 1" = 100' is represented in RF form as 1:1,200 or 1/1,200.

Large-scale maps cover small areas, but can include a higher level of detail than small-scale maps, which depict larger areas at a lower detail. There are no precise definitions of large- or small-scale, the following scale categories apply:

• Large-scale: (1:50,000)

• Medium-scale: (1:100,000)

• Small-scale: (1:200,000)

4.5 Working with Layers

My map uses layers to organize drawings into groups of objects as well as to identify different objects with varying line types, and symbol style. In my design, I create a Layer_map for map line object and text label of each place. Layer_more_detail for more detail such symbol for restaurant and convenient shop, so,

these places are not important places, but they are observable points, for the users when they zoom in at large scale.

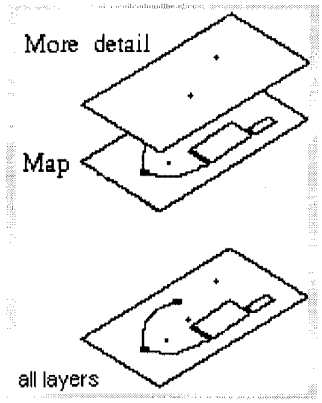

Figure11: Working with Layer

To perform map layer with scale

If scale > 50000

Layer_map on

Else

Layer_ map on

Layer_more_detail on

End;

4.6 Viewing

Viewing a digital map on a (limited sized) display would benefit some possible operations. The most basic one is panning. This would allow maps larger than the actual display to be used. In addition to panning, a zooming facility is essential is essential for useful digital map inspection. Actually, zooming means changing the scale of the map. This is a problem for a raster image, because the raster

cell size is fixed to scale, thus, the vector graphics are more useable for zooming. The vector format introduces another desired feature from the digital map: a layered structure could be supported. Because the presentation of the maps content and form is highly dependent on the scale of the map, which is partially in relation to the resolution of the displaying device, the map "simplicity", i.e. amount of graphical elements, should be able to be modified with respect to the scale.

4.7 Potential of Application Design

When the purpose system is implemented, it is able to serve the map on mobile devices, so that the users can search the map from their mobile phone and the processes are as the following steps:

1. Dial-Up to WAP Service or Wireless ISP.

2. Connect to WAP Site then the application will send the first card "Welcome Screen". This card has a set timing of 10 seconds and then the application will load the "Menu Card".

Figure 12: Welcome Screen

3. In this "Menu Card", is showing the place categories. The user selects the Category from the list.

Figure 13: Category Screen

4. After the users select the place categories, for example, the users select hotel categories the application will show the list of hotel in the card and then the users will select "hotel name" from the list.

Figure 14: Hotel Name Screen

5. After the users select the place, the application will send the address information to the users. This is the map detail screen; it has the details of the place such as address and telephone number. There are a links to see map and back to home page.

Figure 15: Map Detail Screen

7. When the users want to see the map graphic and select "See Map" function, the server responds with the digital map in a WBMP format. On the Output Map screen the user can scroll down, it has a viewing function. Users can view the map and perform operations like zooming. "Zoom in" means changing of the map scale in order to see more details or "zoom out" to see the map outline. "Panning" is scrolling of the map on a screen in order to look at hidden parts of a map, which could not fit on a screen.

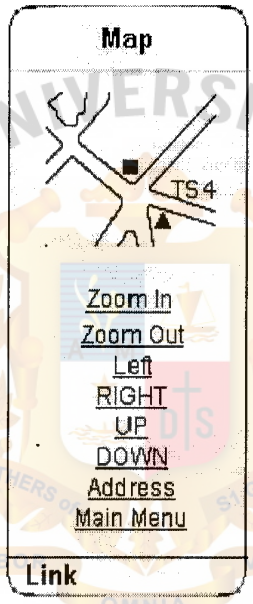

Figure 16: Output Map

8. In application design, each symbol is used to represent a particular place. Each symbol will show the meaning of each symbol.

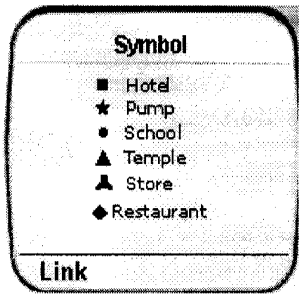

Figure 17: Symbol Screen

4.8 Technology Platform

For Wireless Travel Map, when the user accesses Wap Website and searches for direction of the place that they want by selecting from a list, such as the user select, "Wat Mai" from a list, the application will send the request back to the server, then the server will use this sightseeing name "Wat Mai" to find out the co-ordinate from database. Then, the geocoding application will use this co-ordinate zoom into location in the map and capture image. After that the converting applications will convert the image into wireless bitmap format and the server will respond the map image to your browser, where all processes will run at server side, the browser will only view the output image.

The Server consists of two elements

- The Cartographic and Output Generation Server
- Web Server

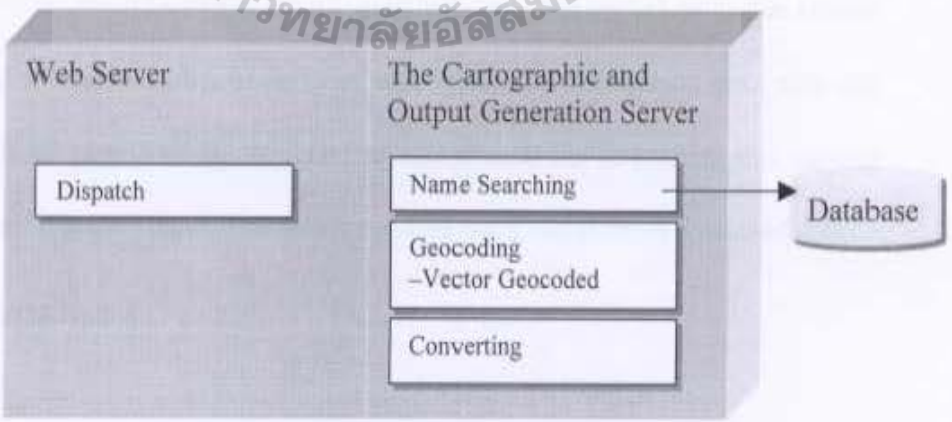

Figure 18: Technology Platform

The Cartographic and Output Generation Server

There are three applications in application layer:

Searching -This application receives the place name that is selected by user and searches the database, to find out co-ordinate.

Geocoding - This application zooms in location on the vector digital map by using co-ordinate.

Converting - Converting output from the geocoding into a WBMP (Wireless Bitmap) format that supports for output terminals.

The Web Server

Dispatch the data packages over protocol.

4.9 Bearer

The WAP protocols are designed to operate over a variety of different bearer services, including short message, circuit-switched data, and packet data. The bearers offer differing levels of quality of services with respect to throughput, error rate, and delays. The WAP protocols are designed to compensate for or tolerate this varying level of service. For the output application services use CSD (Circuit Switched data) as the underlying bearer.

Circuit Switched Data Network

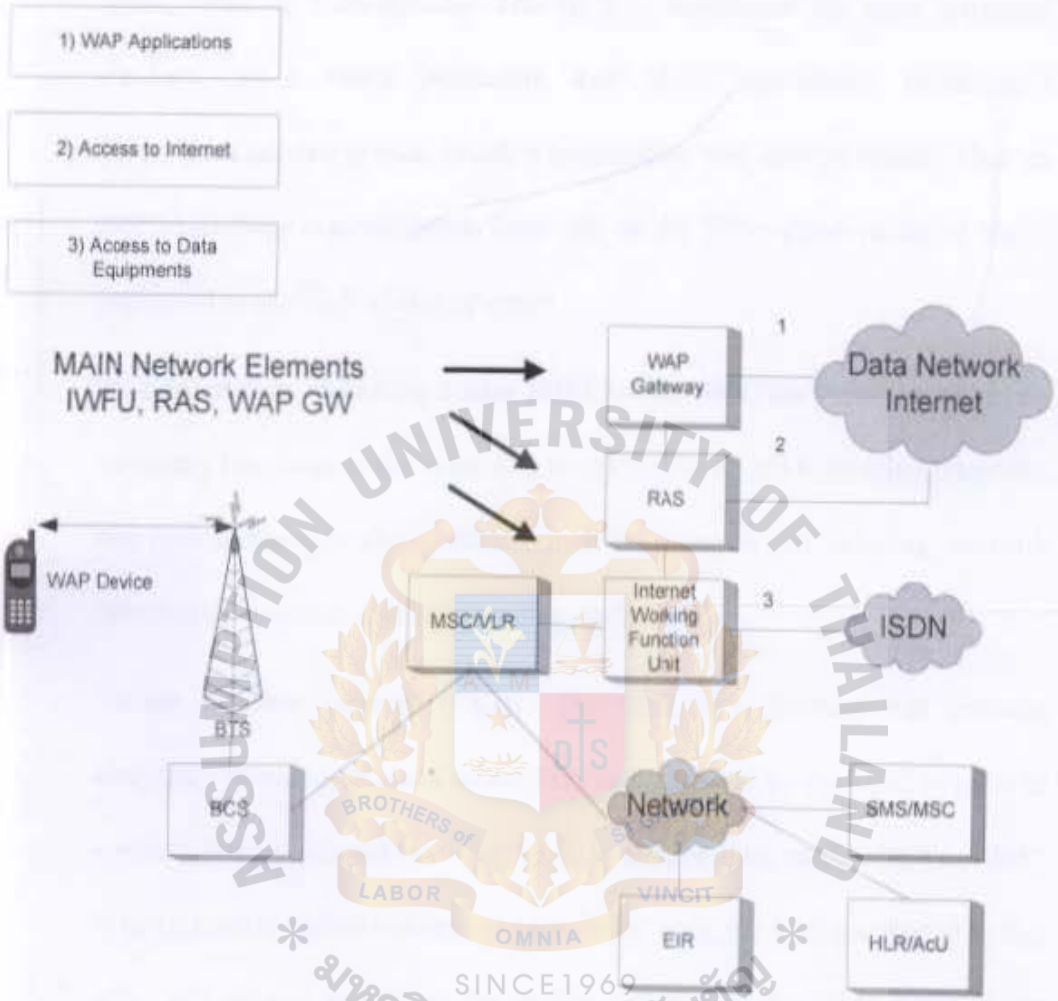

Figure 19: CSD Network

The Function for each units

- **Home location register (HLR)**—The HLR is a database used for storage and management of subscriptions. The HLR is considered the most important database, as it stores permanent data about subscribers, including a subscriber's service profile, location information, and activity status. When an individual buys a subscription from one of the PCS operators, he or she is registered in the HLR of that operator.

- **Mobile services switching center (MSC)**—The MSC performs the telephony switching functions of the system. It controls calls to and from other telephone and data systems. It also performs such functions as toll ticketing, network interfacing, common channel signaling, and others.

- **Visitor location register (VLR)**—The VLR is a database that contains temporary information about subscribers that is needed by the MSC in order to service visiting subscribers. The VLR is always integrated with the MSC. When a mobile station roams into a new MSC area, the VLR connected to that MSC will request data about the mobile station from the HLR. Later, if the mobile station makes a call, the VLR will have the information needed for call setup without having to interrogate the HLR each time.

- **Authentication center (AUC)**—A unit called the AUC provides authentication and encryption parameters that verify the user's identity and ensure the confidentiality of each call. The AUC protects network operators from different types of fraud found in today's cellular world.

- **Equipment identity register (EIR)**—The EIR is a database that contains information about the identity of mobile equipment that prevents calls from

stolen, unauthorized, or defective mobile stations. The AUC and EIR are implemented as stand-alone nodes or as a combined AUC/EIR node.

- **BSC**—The BSC provides all the control functions and physical links between the MSC and BTS. It is a high-capacity switch that provides functions such as handover, cell configuration data, and control of radio frequency (RF) power levels in base transceiver stations. A number of BSCs are served by an MSC.
- **BTS**—The BTS handles the radio interface to the mobile station. The BTS is the radio equipment (transceivers and antennas) needed to service each cell in the network. A group of BTSs are controlled by a BSC.

4.10 The relational database model

The relational model is based on the storage of attributes as two-dimensional tables. As illustrated in Figure 17, multiple tables can be linked or related based on a common and unique identifying attribute. Columns represent what traditionally have been referred to as data "elements," and rows represent data "records." The map is "tagged" with a unique number that is used to link to a database as depicted in Figure 17.

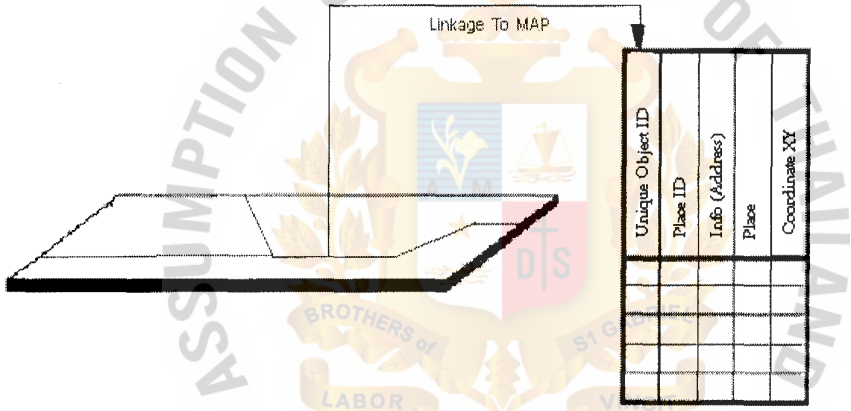

Figure 20: Linkage of Tabular Attributes to Map Data

4.11 The Design of a Tree Structure

Common activities will be performed through the shortest possible interaction path, while less common operations may take longer to access so that we will organize the cards and decks of my application in a hierarchy and make the "Main Menu Card" of this hierarchy the application entry point. Each level of my tree is sorted based on step of activities. Once the user accesses to the site, the "First Card" appeared as a "Welcome Card" and the "Main Menu Card" appeared consequently. Starting with the first activity, I have designed the user interface to ensure that the higher priority activities are always available with the fewest keystrokes possible. In addition, the tree structure works connection with backwards navigation (shown by dashed lines), since users are able to move back towards the "Main Menu Card" very quickly. The tree structure of my application is illustrated in the diagram below:

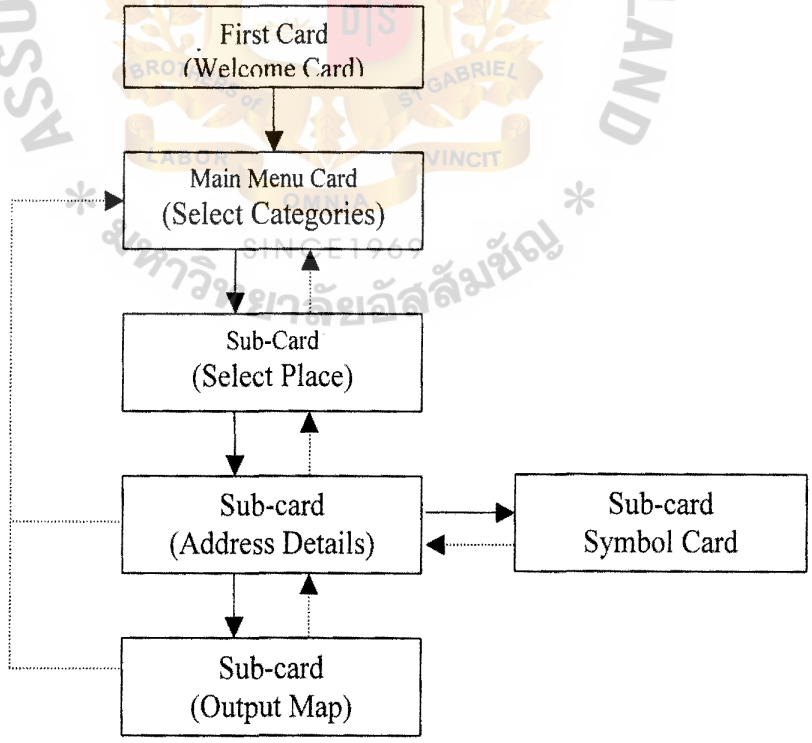

Figure 21: Design a Tree Structure

4.12 Algorithm of the output Application

Connect http://www//

Greeting Message

Mobile Process As

/* Send requested command server */

Call Maximize screen;

Call Initial menu;

If Function Id = "Enter" Then

Call Map Information(Object Id In, Info Out);

Receive Information which return from server;

End if;

Execute command Display Info data on mobile screen;

If Function Id = "Enter" Then

Call Place Information(Object Id, Info Out);

Receive Information which return from server;

End if;

Execute command Display Info data;

If Function Id = "Enter" Then

Call Place Address(Place Id In, Info Out);

Receive Information which return from server;

End if;

Execute command Display Info data;

If Function Id = "Enter" and Object id = "Map" Then

```
    Call display map(Place Id In, Picture Out);

    Receive Picture  which return from server;

End if;

Execute command Display picture data;

If  Function Id = "Enter"  and Object  = "Zoom" Then

    Call Map Zoom (Object Id In, Picture Out);

Else If Function Id = "Enter"  and Object  = "Scroll" Then

    Call Map Scroll(Object Id In, Picture Out);

Else Disconnect from web site  Then

    Program Terminate;

End if;
```

Function Call Map Information(Info Out);

```
Select  Place Group , Group Description

From   Place Group table;

Return (Service Map place);

Function Place Information (Place Group Id In, Info Out)

Select  Place Code , Place Description

From   Place table

Where Place Group =  : Place Group Id;

/* Object Id is the place group according to  user select from mobile screen */

Return (Place Information);

Function Place Address (Place Id In, Info Out)
```

```
Select   Place Address Description

From   Place Address table

Where Place Id =  : Place Id;

/* Place Id is the place object that user chose from mobile screen */

Return (Place Address Info ,Picture Id);
```

Function Display Map (Place Id in ,Object id In, Picture Out)

```
Select   coordinator XY

From   Place Address table

Where Place Id =  : Place Id;

Call Create map ;

/* Place Id is the place object according to user select from mobile screen */

Return (Picture);
```

Function Create Map (Place Id in ,Object id In, Picture Out)

```
GenerateMap(XY);

If  ErrorMap  <>  "Success" Then

    CreateMap (False);

End if;

Generate WML Map(XY);

If  ErrorWML  <>  "Success" Then

    Create WML Map (False);

End if;
```

```
Create web page from template file(Directory of template,CGI Map,WML code);
If ErrorTemplate <> "Success" Then
    Create Template (False);
Else
    Create Template (True);
End if;
End Create Map;
```

```
Function Maximize Screen As
<Declare Variable> <Zoom_var>
<Declare Variable> <Scoll_var>
Begin
/* Initial size of Map : general size of mobile the maximum values are 90 : 90*/
Width := Max(Width Length);
Height := Max(Height Length);
Call Check Size Map(Map Id, Width : Height);
If Check Size Map does not match Then
     Program Terminate ;
Else
   Send picture to mobile(picture id);
End if;
```

Function Scroll As

<Declare Variable> <X Origin_var>

<Declare Variable> <Y Origin_var>

Begin

If Scrolling East is true Then

New Origin East := (New Origin East + Previous Extend)

End if;

If Scrolling West is true Then

New Origin West := (New Origin West + Previous Extend)

End if;

If Scrolling North is true Then

New Origin North := (New Origin North + Previous Extend)

End if;

If Scrolling South is true Then

New Origin South := (New Origin South + Previous Extend)

End if;

Call Check Size Map(Map Id, New Origin Width : Height);

If Check Size Map does not match Then

Program Terminate ;

Else

Send picture to mobile(picture id);

End if;

```
Function Map Zoom(Zoom Type) As

<Declare Variable><New Scale>

Begin

If Zoom Type = 'Zoom In" Then

Call Check Size Map(Map Id, New Scale / 2);

If Check Size Map is  match Then

      Zoom In Process ;

End if;

Else if  Zoom Type = 'Zoom Out" Then

Call Check Size Map(Map Id, New Scale * 2);

If Check Size Map is match Then

      Zoom Out Process ;

      Send picture to mobile(picture id);

End if;
```

CHAPTER 5: CONCLUSTION

With the advance of the Internet, WAP has now grown to enormous proportions, and emerging digital mapping provides a good platform for a new class of mobile mapping service. Such a system could provide personal assistance service, route and information services. My platform also has some advantages and limitations as following:

5.1 Advantages

Such a paradigm creates a new application environment that has quite strong restrictions. Another side of such a rapid breakthrough in the telecommunication technologies is the expansion of the Internet to mobile users and a possibility for development of new class of information services. Below, we discuss distinctions of mobile environment in comparison with conventional wired network environment and WAP standard, which offers optimised and a bearer independent platform for information services.

Firstly, a wireless network provides a more complex environment compared to wired networks because of the limitations of power and mobility. These are some of the basic distinctive features of a wireless network:

- Low bandwidth;
- Frequent disconnection;
- Long Latency;
- High bandwidth variability;
- Unpredictable disconnection;

We can use different network technologies for data transfer. The current GSM network provides bandwidth of 9.6 Kbits/s for data transfer. GPRS speed for data transmission is 43.2 Kbits/s.

The second sources of restrictions are mobile devices because of the limitations of power and form factor. By the form factor of a mobile terminal, we mean its physical and constructive characteristics. For example, a mobile terminal should always have a small size in order to be mobile. Therefore, the small size leads towards the small screen size, limited of batteries. Used input devices for mobile terminals are also different from a conventional computer keyboard and mouse. The developers have to keep in mind these factors as well as the environment in which people use mobiles. Consequently, the user interface will be different from one for conventional personal computers.

The following features characterise almost all handheld devices:

- Limited memory;
- Limited computational power;
- Small screen size;
- Limited battery life;

Accordingly, the restrictions mentioned above that reflect hardware properties of mobile environment are passed to the application layer. The output system can handle all limitations mentioned as above.

The advantage that kept map data as vector graphic

- The tourists can easily use map on WAP by searching the driving direction on when they move.
- Multi-Scale Map: The users can zoom in and zoom out. The vector format is closer to map encoding than the bitmap format. The strong advantage of the vector format is ability to perform zooming without a quality loss.
- WAP when compared with the GPS, the costs of installation systems are different. For the WAP, tourists use only the mobile phone, access via the internet through the WAP gateway. But the GPS system usually displays map in real-time and track the positions where are you now. They need to track longitude and latitude and match the position and locate to the map. The user should have the GPS receiver to get the information from the Satellite. So, the WAP system is cheaper than the GPS.
- The map data storage at the server is kept as vector graphic. It is the duty of the server to complete the requested map. Finally, the system will convert the output map from vector graphic into a display-ready format (wbmp) for mobile terminals. The advantages of vector map storage are
    - Vector Map uses less space.
    - Vector is easy to edit such as you can add many restaurants or tourist places like one object inserted in the file.
- Multi-Layer Map: My map uses layers to organize drawings into groups of object. It will show more detail, when the user zoom in at large scale

- The output map can presents on low power processing devices such as mobile phone.
- In this case, the Server works both as WAP server and WEB Server for Map Online Service. You can use the only one Map and database file to provide Map Online Service, but the scripts on both WAP and WEB to get the data from the Map and database file are different.

5.2 Limitations

Since my system works as the web server, the limitation of map service is that the system can serve only black and white image. Also, locating the position is not supported.

5.3 Future Work

After the thesis system is merged with the location services, the mobile station can obtain either its own geographical coordinates or coordinates of a target mobile station. As a result of this, when the user makes a request to the station, the location service server should check rights of the requesting client for such types of operation and ability of performing positioning of the target terminal. If all rights were in order, the location server would define the position of the target mobile terminal and return the result to the requesting station. Its system will use the coordinate position of the user terminal to calculate the nearest place and send the information to requesting terminal.

Location Services

One of the parts of personal navigation system is the block for location determination it provides information about the user's geographical location on the earth. Output of such a block is usually coordinated in one of the possible coordinate system. There are two possible ways to determinate user's coordinates:

- Use of satellite -based navigation systems such as GPS (Global Position System)
- Use of the network infrastructure based location services

GPS based positioning method

GPS (Global Position System) is a complex system, which can be used to achieve position accuracy ranging from 100 m to a few millimeters depending on the equipment used and procedures followed.

Cellular network based position method

In GSM there are several timing parameters, which can calculate the distance from a base station to a mobile phone. If the staff knows coordinates of at least three base stations and distance from them to a mobile terminal, they can determine geographical coordinates of a mobile. Therefore, positioning a target mobile terminal involves two main steps: signal measurements and location estimate computation based on the measured signals.

5.4 Comparison of mobile map on each devices

The purpose of this topic is to compare output design with other designs. This table has compared the characteristic of resource, bearer and input type of each design.

	Resource	Bearer	Input type
Output Design on WAP Phone	Low	Low	Simple
Other Design on WAP Phone	Low	Low	Difficult
Other Design on GPRS Phone	High	High	Simple, Medium
Other Design on Palm	Medium	Low	Simple, Medium
Other Design on Notebook	High	High	Simple, Medium

Table 3: Comparison of graphic format

In summary, my output design is appropriate for a small device and has limited memory as WAP phones.

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Appendix A

WAP Application Server

The most important part of a WAP (Wireless Application Protocol) application is where and how it is going to be a host. After the gateway, browser requests travel in the Internet domain, and the output is XML compliant. As such, a standard web server is able to provide that output. All that you will need to do is add the following MINE types to those that the web server knows about:

Content	MINE	Extension
WML	text/vnd.wap.wml	wml
Compiled WML	application/vnd.wap.wmlc	wmlc
WMLScript	text/vnd.wap.wmlscript	wmls
Compiled WMLScript	application/vnd.wap.wmlscriptc	wmlsc
Wireless bitmap (WBMP)	image/vnd.wap.wbmp	wbmp
Service Indication Push Message	text/vnd.wap.si	si
Compiled Service Indication Push Message	text/vnd.wap.sic	sic
Service Loading Push Message	text/vnd.wap.sl	sl

Content	MINE	Extension
Compiled Service Loading Push Message	text/vnd.wap.slc	slc
Electronic Business Card (VCARD)	text/x-vcard	vcf
Electronic Calendar Event (VCAL)	text/x-vCalendar	vcs

MINE (Multipurpose Internet Mail Extensions) is a specification for the format of data that can be sent over the Internet.

When the server sends data in response to a request it receives, it sends a MIME type with it. This MIME type can also be explicitly set by the application. Normally, the file extension of the requested file is associated with a MIME type and so the server automatically issues the correct MIME type. Then, when a browser receives information from the server, it checks its MIME type to see what to do with it. If, for example, it sees that the data has a MIME type of "image/vnd.wap.wbmp " then it knows to display it as a picture. The server, using information included in the request for data can, also discover the MIME types accepted by the browser, dynamically. An application can explicitly set the MIME type by determining the supported MIME types of the device.

Now, as with static HTML content, static WML content has a very limited scope for providing services. For more complex applications, dynamic generation of pages is a must. This essentially means deploying an application that will dynamically generate pages from database, which keeps maintenance to a minimum. These applications are typically hosted on application servers. To include WAP support, one again, all you need to do is to configure them to use the above MIME type.

Configuring MIME Types with IIS

IIS 5.0 is provided as standard with Windows 2000 and IIS 4.0 is an optional service with Windows NT 4.0

In order to configure the MIME types for IIS, we need to use the Internet Information Services snap-in for the MMC (Microsoft Management Console). You can open this from the Start menu under Administrative Tools in the Programs menu, or simply from the Control Panel:

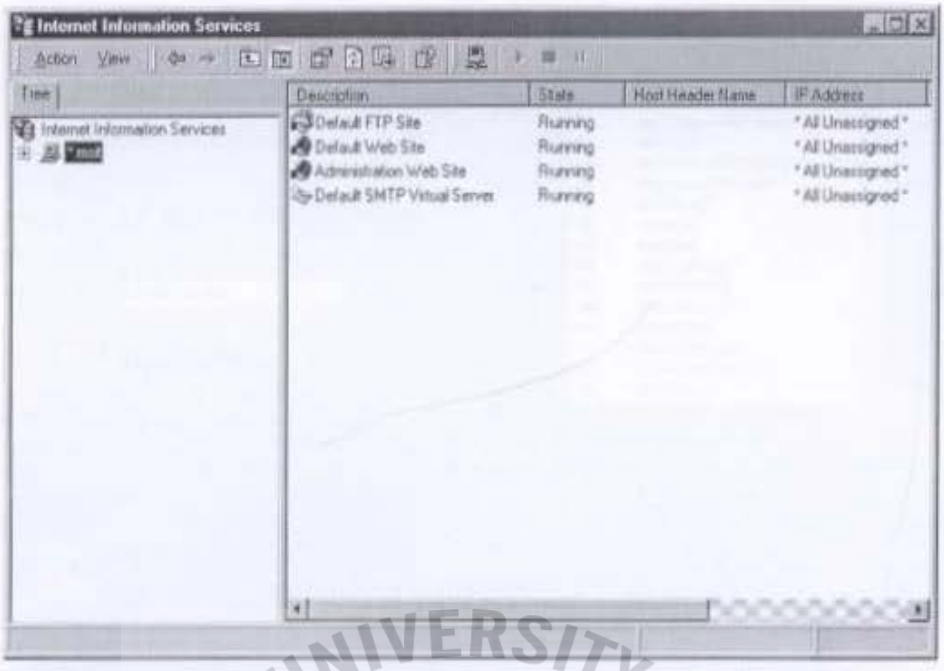

Figure 22: Internet Information Service Windows

The next step is to open the Internet Information Services folder on the left-hand side. The name of the machine will appear as a sub-tree to that folder, as you can see in the diagram above. Right clicking on the machine name brings up a menu from which the Properties option should be selected. A properties window should appear, for which you should select Edit under Computer MIME Map to bring up a window with a list of the recognized MIME types. Use this window to add each of the MIME types given in the table above. Remember to save the settings back to the console when you have finished. The MIME types have then been successfully configured.

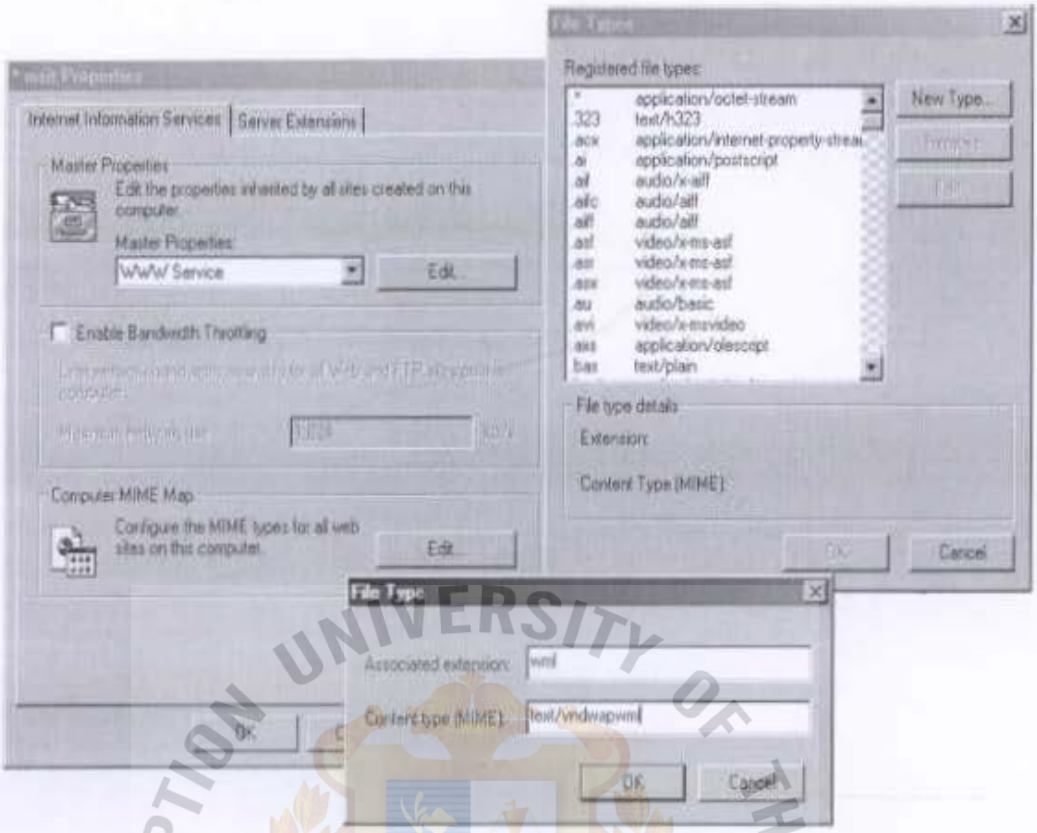

Figure 23: Add MINE Type dialog box

Configuring MIME Types with Personal

Unfortunately, PWS doesn't have a friendly interface for setting up MIME type. Instead, it stores its settings in the registry – a special database that Windows and its applications can use for many different purposes. The easiest and safest way to add information to the registry is with a registry script. This registry script is called *wapmime.reg*, so the source code should look like this:

REGEDIT4

[HKEY_CLASSES_ROOT\.wml]

"Content Type"="text/vnd.wap.wml"

[HKEY_CLASSES_ROOT\.wmlc]

"Content Type"="application/vnd.wap.wmlc"

[HKEY_CLASSES_ROOT\.wmls]

"Content Type"="text/vnd.wap.wmlscript"

[HKEY_CLASSES_ROOT\.wmlsc]

"Content Type"="application/vnd.wap.wmlscriptc"

[HKEY_CLASSES_ROOT\.wbmp]

"Content Type"="image/vnd.wap.wbmp"

Configuring MIME Types with Apache

Apache is an application server in the public domain, which was originally written for UNIX, but which is now available from other platforms.

One way to add the correct MIME types to the Apache server is to create a file called .htaccess within each directory that you have used to store WML files. This file should look like this:

```
Addtype text/vnd.wap.wml wml

Addtype application/vnd.wap.wmlc wmlc

Addtype text/vnd.wap.wmlscript wmls

Addtype application/vnd.wap.wmlscriptc wmlsc

Addtype image/vnd.wap.wbmp.wbmp
```

When the server uses files from this directory or any of its subdirectories, it will send them to the requestor according to the rules in this file.

Note that in order to read these .htaccess files, the server must be configured to recognize them – they are sometimes ignored for reason of security.

Nokia WAP Server

Nokia WAP Server has a duty to run WML file and WAP Application, that makes the browser read and show the information.

System Requirement

1. Pentium-class 266MHz Processor or higher
2. Window NT 4.0 with Service Pack 5 or Windows NT 2000
3. Free Space 100 MB. on hard dish
4. JAVA (TM) Runtime Environment Version 1.2.2
5. JAVA Hot Spot (TM) Performance Engine 1.0.1

After downloading and installing application and it's service completed, we can set up the system is the following steps:

Select Nokia *WAP Server Manager* Menu

Figure 24: Start the Software

Click Connect Button

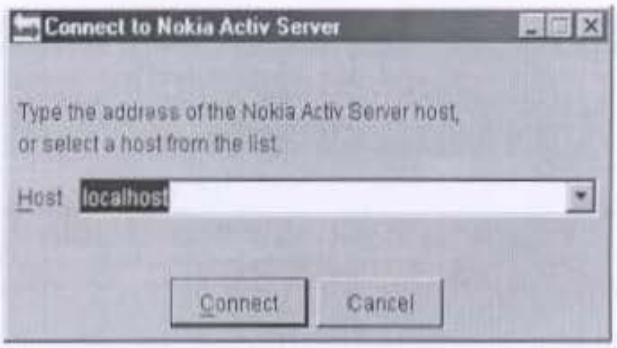

Figure 25: Connect to Nokia Active Server

Input admin in Username: input box

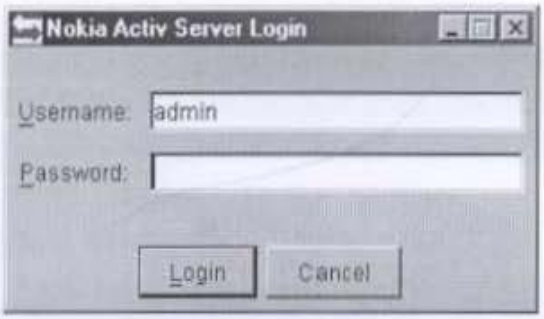

Figure 26: Login Screen

The application will show the WAP Server detail

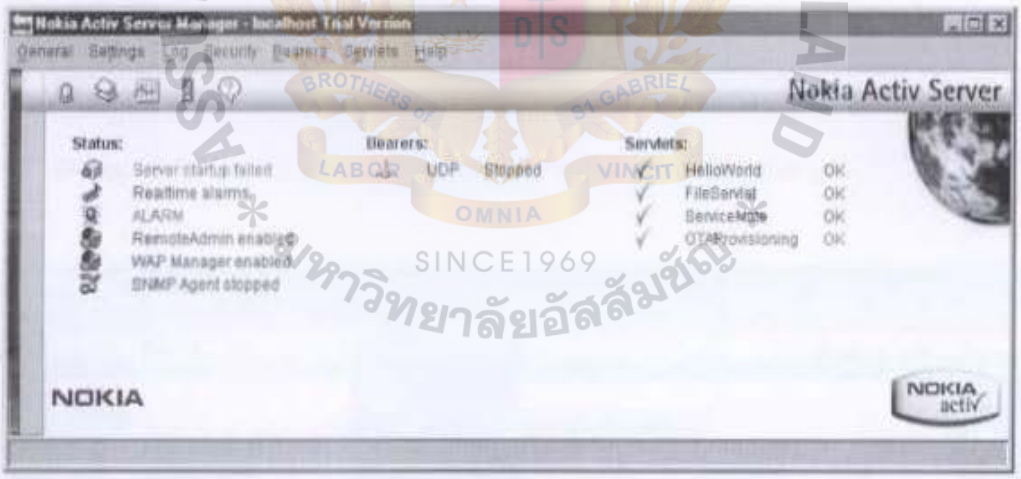

Figure 27: Server Manager Screen

We can start and stop Service at General Menu and select start traffic or stop traffic

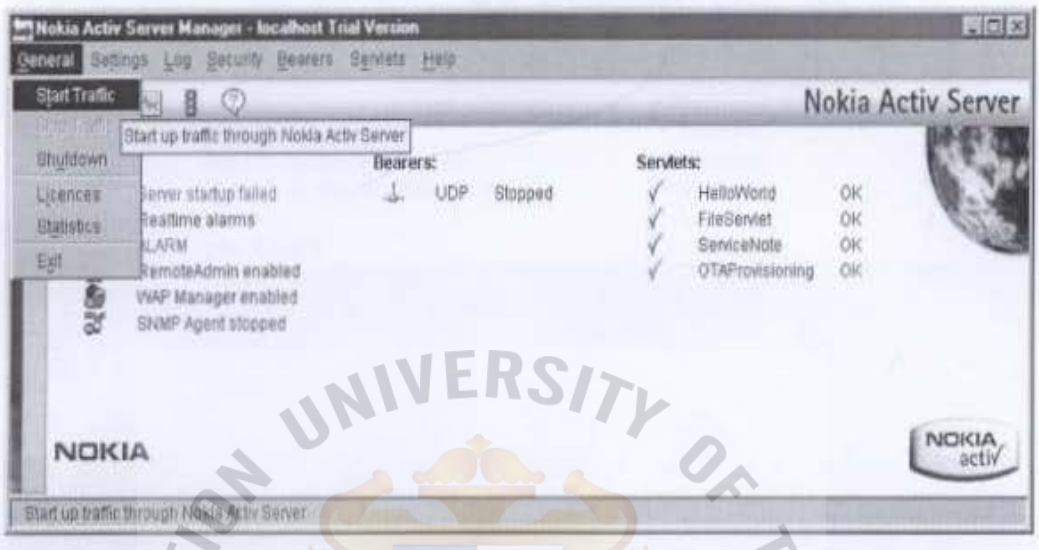

Figure 28: Start Traffic Method

Set Nokia WAP Server URL at Servlets Menu and select Mappinng

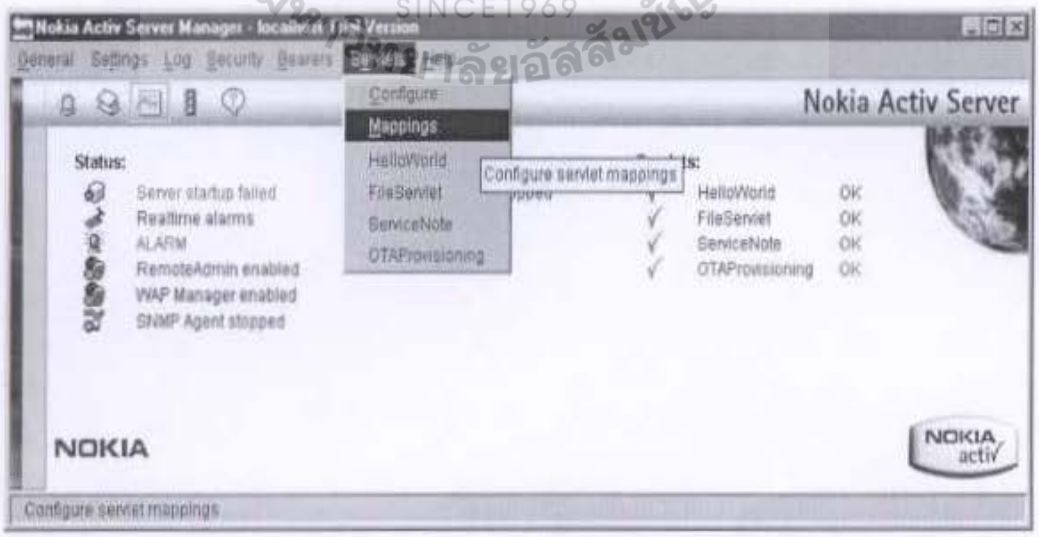

Figure 29: Mapping Method

Click at Create button and input your URL

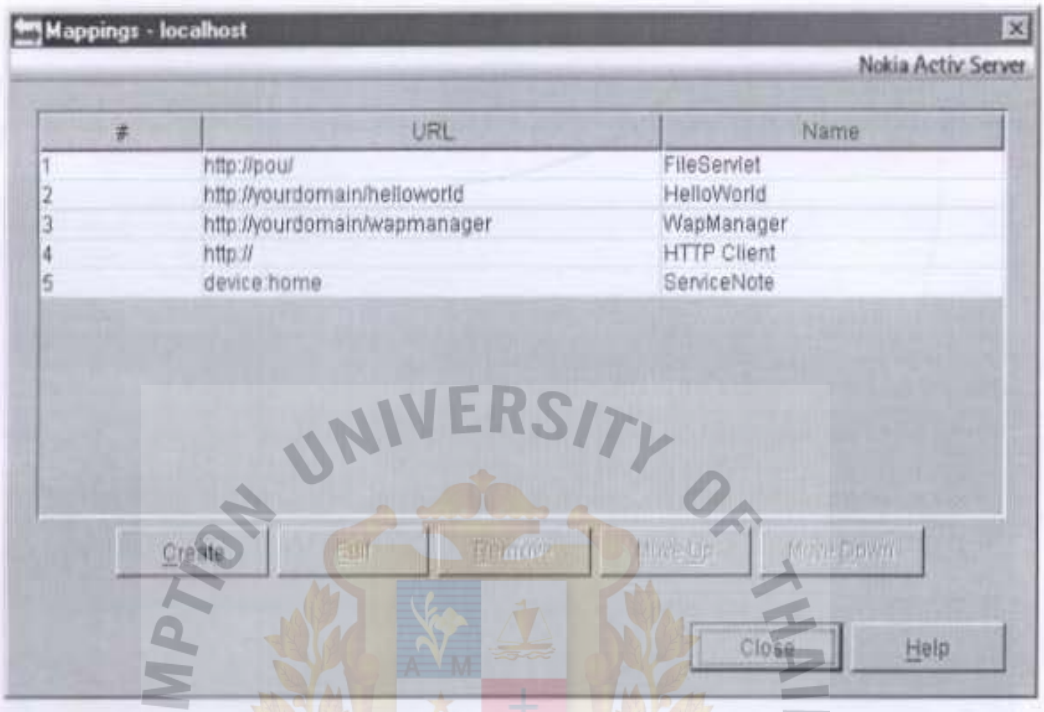

Figure 30: Mapping Screen

The Nokia WAP Server system setting up is finished.

Appendix B

Manages layers in AutoCAD Map

Command line: layer

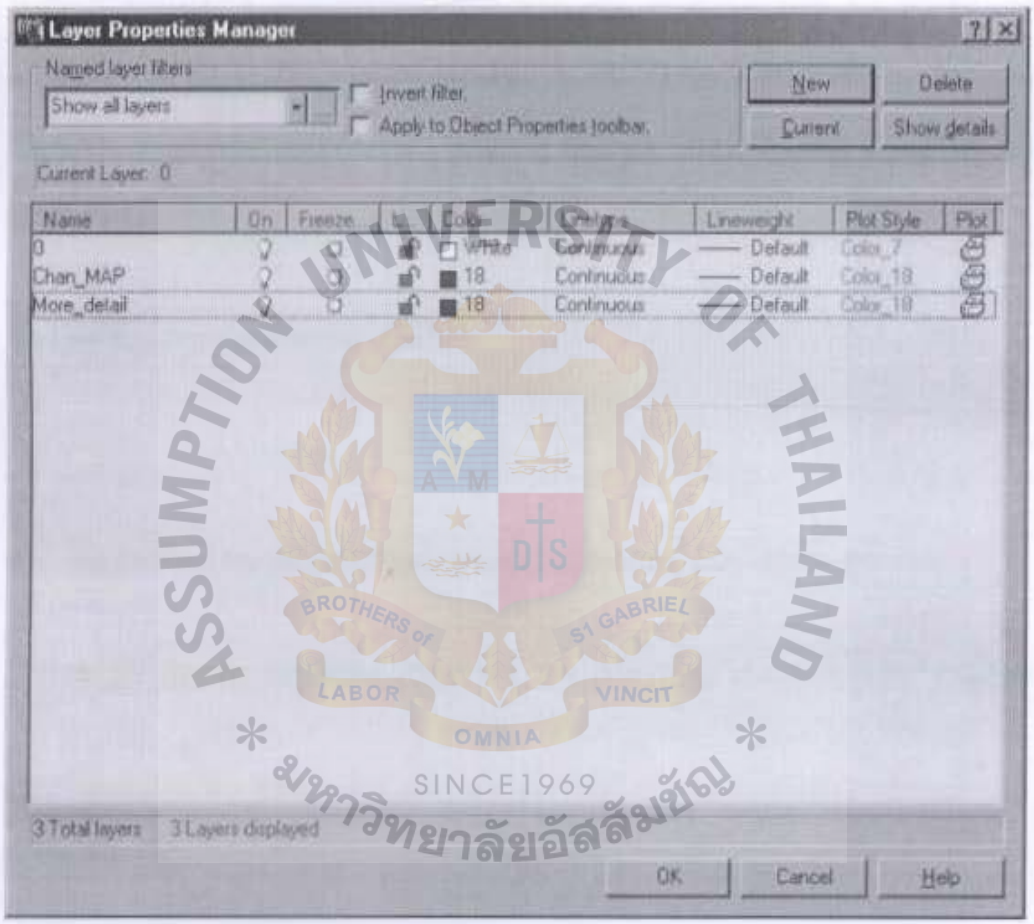

Figure 31: Layer Properties Manager

In this dialog box, a developer can make a layer current, add new layers to the layer name list, and rename an existing layer. You can assign properties to layers, turn layers on and off, freeze and thaw layers globally or by view port, lock and unlock layers, set plot styles for layers, and turn plotting on and off for layers.

Database Configuration

The connectivity feature uses a limited subset of Microsoft's ODBC and OLE DB database configuration utilities. AutoCAD can access data from Microsoft Access 97,dBase V and III and etc. Once you have successfully configured a database to use with AutoCAD, a configuration file with the extension .udl is created. This configuration file contains the information AutoCAD needs to access the configured database. By default, .udl files are stored in the Data Links folder of AutoCAD. You can specify a different location for .udl files from the Options dialog box.

To specify a new location for .udl files

1. From the Tools menu, choose Options.

2. From the Files tab, select Data Sources Location, and then choose Browse.

3. From the Browse for Folder dialog box, navigate to and select the folder you want, and then choose OK.

4. Choose OK.

APPENDIX C

Example of WML Source Code

```
<%

vHttpAccept = LCase(Request.ServerVariables("HTTP_ACCEPT"))

if Instr(vHttpAccept,"wap") then

response.ContentType = "text/vnd.wap.wml"

response.write("<?xml version='1.0'?>")

response.write("<!DOCTYPE wml PUBLIC  'MAP' 'Wap'>")

response.write("<wml>")

response.write("<head>")

response.write("<meta http-equiv='Cache-Control' content='no-cache'/>")

response.write("</head>")

response.write("<card id='Welcome' newcontext='true' title=' Welcome '  >")

response.write("<p align='center'>     ")

response.write("Welcome to Chantaburi Mobile map site")

response.write("</p>")
```

```
response.write("</card>")

response.write("</wml>")

Else

response.Redirect "/index.html"

response.Flush

response.End

End if %>
```

EXAMPLE OF WML TEMPLATE

```
<?xml version="1.0"?>

<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">

<wml>

 <card id="card1" title="MAP">

        <do type = "zoom in" >

        <go method = "post " href = "http://127.0.0.1/scripts/travelmap.exe" >

        <postfield name = "MAP_ORIGIN_X" value = "$MAP_ORIGIN_X" />

        <postfield name = "MAP_ORIGIN_Y" value = "$MAP_ORIGIN_Y" />

        <postfield name = "MAP_SCALE" value = "$MAP_SCALE" />

        <postfield name = "MAP_EXTENT_X" value = "$MAP_EXTENT_X" />

        <postfield name = "MAP_EXTENT_Y" value = "$MAP_EXTENT_Y" />

        <postfield name = "MAP_WIDTH" value = "$MAP_WIDTH" />

        <postfield name = "MAP_HEIGHT" value = "$MAP_HEIGHT" />

        <postfield name = "MAP_ZOOM_IN" value = "true" />

        </go>
```

```
    </do>

  </card>

</wml>
```


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