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## Q-Map Application for Enrichment of a Mobile Directory Assistance Service

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### Abstract

The project described in this paper involves designing and developing a mobile map application, called the *Qatar Map (Q-Map)*, which supports a telephone directory assistance service that runs over the terrestrial cellular network. The application uses WAP Push technology for extending the features available for a conventional directory assistance service. The *Q-Map* enables the network agent to respond to the subscriber with supplementary information when requesting a telephone number for a business. In addition to the telephone number, the information also includes a web address (URL) through which the subscriber can access a Google map covering the business's area and any marketing content (e.g., advertising) uploaded earlier by that business. This service is also offered on-line through the Internet. In this regard, the subscriber can access the *Q-Map* website using a web browser, via either a PC, or a mobile handset.

**Keyword:** Directory Assistance Service, WAP Push Message, Mobile Map Application.

### 1. Introduction

With the proliferation of mobile services worldwide, the use of mobile handsets is no longer limited to traditional voice service. On the contrary, the mobile screen is increasingly becoming a key channel for interactivity with consumers, Internet access, mobile search and delivery of multimedia business services, including e-commerce and advertisements [1].

A map is a useful medium for the dissemination of spatial information. As mobile devices become increasingly powerful and ubiquitous, new possibilities to access map information are created. Recently, many map applications for mobile handset devices have been developed following different approaches, and targeting several services. Most of them allow users to search for points of interest (POI) such as cinemas, cash machines, and coffee shops, with the results

overlaid on a map, and possibly showing the geographical positions relative to the user.

Several map applications are surveyed in the literature, however there is no reference to those used in supporting the directory assistance service. Some of these applications surveyed in the literature are briefly discussed below.

A company called DeCarta Mobile [2] provides mobile application developers, the ability to implement modular maps, zooming, routing, geocoding, reverse geocoding and pin overlays into their applications. The company also provides an address look-up facility, which can convert a street address into latitude and longitude, then match the coordinate to the nearest road network.

Nutiteq [3] is an example of a map application that provides all basic mobile map functions such as viewing different maps, handling location bookmarks, GPS positioning, location tracking, viewing POI content on map, address search and routing. The dynamic map capabilities used by Nutiteq enable the user to zoom in or out, and navigate through the map to view street names, and the direction to the POI.

Another example is a map application called iMapia that enables a user to download maps, driving directions and local points of interest directly into the cell phone. It also provides searching maps using a street address, intersection, zip code or GPS position. In addition, it allows users to browse local businesses, and other POI [4].

Perhaps the most interesting map application found in the literature is the Java based application called "Google Maps for Mobile" that was released in 2006, and intended for mobile devices [5]. Several features have been added to this application over the last three years. Currently, it has a feature called "my location" that does not depend on a GPS receiver in identifying POIs. Instead, it works by utilizing the GPS location of the mobile device, and other information gathered from the nearest wireless networks. "my Location" triangulates the different signal strengths from different cell transmitters and then uses their location property

(retrieved from the on-line cell site database) to aid in determining the user's current location. This service is currently available for several platforms, including Android, iPhone, Windows Mobiles, Nokia Symbian and Blackberry [6].

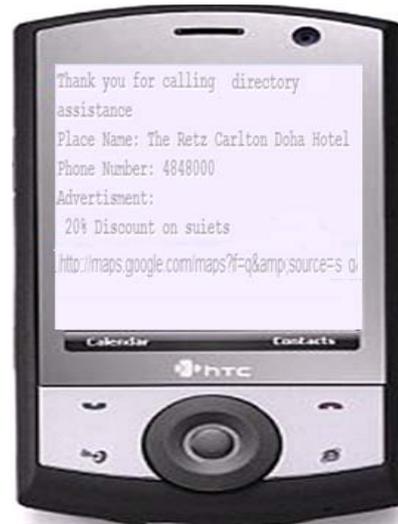
Again, unlike the previously described map applications, the Q-Map is not intended to mimic commercial mobile navigators available in the market. Instead, the Q-Map uses dynamic map technology to extend the capabilities of a conventional directory assistance service. More importantly, the Q-Map can be more beneficial and better functioning if it is interfaced to a location-based system. In this case, the Q-Map can provide more information assistance to the subscriber by determining the nearest cell site to the POI, relevant to his/her position.

## 2. Project Overview

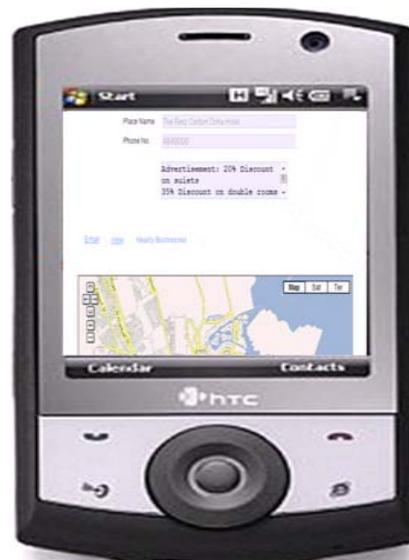
The project described in this paper utilizes the trends of mobile enablement mentioned in the above paragraph. It involves the design and development of a Map Application called Qatar Map (Q-Map). When the Q-Map integrates with the directory assistance for a mobile network, it works as follows:

1. The network subscriber dials the directory assistance number requesting information about a business listing.
2. The network agent receives the call and accesses the Q-Map application to search for the required listing through different business categories.
3. In response, the network agent sends the subscriber a Wireless Application Protocol (WAP) Push notification on his/her handset mobile device. This notification contains the phone number, a link to a map that corresponds to the requested listing, and possibly additional marketing content (e.g., advertising) provided earlier to the network agent by the business. Figure 1 shows the response of the Q-Map on the subscriber's mobile handset, following a request for information on the Ritz Carlton Hotel in Doha.

The subscriber can choose to select the link in the notification message and start an interactive WAP session where the relevant information can be retrieved and explored (refer to Figure 2).



**Figure 1:** SMS with WAP content on the subscriber mobile handset



**Figure 2:** When the WAP link is selected on the subscriber mobile handset

It is also possible to have on-line access to the service described above via a web browser using either a personal computer (PC) or a mobile handset. In this case, a web page containing a search tool will appear to help the subscriber obtaining the desired listing information. This information contains the listing phone number, a digital map, and advertising (if provided). Through the on-line Internet access, the application also gives the subscriber a list of the nearby relevant business listings. In addition, the subscriber will have the option to send the information via an email message.

### 3. System Design Architecture

The brief description for the Q-MAP application given above shows that there are four main actors in the Q-Map application. These are:

*Network subscriber:* dials the number for the directory assistance service, requesting information about a business listing. He/she can also access the service on-line through the network website, using the provided search engine, based on business categories.

*Network agent:* responds to the subscriber's call with an SMS message containing the WAP Push notification sent to his/her handset mobile device, as shown in Figure 2.

*Network administrator:* responsible for maintaining the database for business listings by adding a new listing or deleting or modifying an existing listing.

*Content provider:* a business agent that has an account created through the Q-Map website. He/she can edit, preview (using an emulator), and upload advertising content to the network server.

The software architecture that implements the Q-Map system is a multi-tier client/server that can be broken down into four subsystems: Administrator subsystem; Agent subsystem; Subscriber subsystem; and Server subsystem. Each subsystem is further broken down into other components in terms of the services they provide to each other. In addition, each subsystem is built or customized, then integrated with other subsystems to achieve the defined set of functions described in the above section.

The website for the Q-Map was built using the C# programming language within the integrated development environment (IDE) of the Visual Studio, and ASP.NET for the middleware. All the four actors – network administrator, network agent, content provider (businesses), and network subscriber, can access the Q-Map website via the GUIs at their ends, which are connected to the server interface. They should first be successfully authenticated by the server.

As discussed earlier, the content providers use this website to register on-line and to enter the advertising information. This information is stored in a secured database connected to the network server. In this configuration, the SQL commands are conveyed to the database through the server interface in order to fetch data or to update the database with new changes. For example, when the administrator modifies some information of a business, the application on the server receives the request and updates the business information table located in the database with the new location information.

### 4. Q-Map implementation

For the Q-Map application, a GUI was designed for every actor (the network administrator, the network agent, the content provider, or the subscriber) with the aim of creating steadiness, consistency and flexibility. These GUIs were built using Microsoft Visual Studio along with a cascading style sheet (CSS), and written in HTML and XHTML.

To implement the GUI of the Q-Map, four master pages were created: Agent Master Page, User Master Page, Logged Master Page, and Provider Master Page. All Agent pages inherit from the Agent Master Page, all administrator pages inherit from the Logged Master Page, and all other pages such as the Home Page and the User Page inherit from the User Master Page.

The following section briefly discusses the implementation of the primary functional requirements for each actor participating in Q-Map activities. In this study all the functional requirements for all actors are implemented and integrated to each other, and collectively function to achieve the role of the Q-Map application.

#### A. Network Administrator Functionalities

The administrator is the person who has the authority to add, delete, and modify business listings in the database of the directory assistance. In this project, the grid view control that shows the listings which belong to a category chosen by the administrator are used. That selection is made by choosing from the categories drop down list control. Each row in the grid view has "add", "edit" or "delete" options. Some of these functions are:

**Add listing:** In the Q-Map application, the administrator can add the following attributes: name, phone number, business's category type, and the map link taken from Google Maps.

**Modify listing:** The option "edit" which appears beside each row in the grid view is used for modification. When is selected, the row becomes editable and the administrator can insert the new values of the attributes to the row. The query responsible for that action is shown below.

```
//Updating phone number of business with consideration
to change
// the phone in the provider table
command1.CommandText = "select Phone_Number
from Business_Info where Place_ID=@place_ID";
command1.Parameters.Add(new
SqlParameter("@place_ID", int.Parse(ID.ToString())));
adapter1.SelectCommand = command1;
connection1.Open();
int status1 = adapter1.Fill(dataSet1);
if (status1 <= 0)
{
    connection1.Close();
}
else
{
    int phone =
int.Parse(dataSet1.Tables[0].Rows[0].ItemArray[0].ToString(
));
    string serverName =
Server.MachineName.ToString();
    SqlConnection connection = new
SqlConnection(@"Data Source=" + serverName +
@"\SQLEXPRESS;Initial Catalog= LBS_Database;Persist
Security Info=True;User ID=sa;password=sa123");
    SqlCommand command = new SqlCommand();
    SqlDataAdapter adapter = new SqlDataAdapter();
```

```

DataSet dataSet = new DataSet();
command.Connection = connection;
command.CommandText = "UPDATE Provider SET
Phone_No=@phone WHERE Phone_No=@phone1";
command.Parameters.Add(new
SqlParameter("@phone", int.Parse(phone.ToString())));
command.Parameters.Add(new
SqlParameter("@phone1",
int.Parse(Label2.Text.ToString()));
adapter.SelectCommand = command;
connection.Open();
int status = adapter.Fill(dataSet);
if (status <= 0)
{
    connection.Close();
}
connection.Close();
}

```

### B. Network Agent Functionalities

In the directory assistance service the network agent is responsible for responding to the subscriber's call. In the Q-Map application, the network agent access the search engine, based on the relevant category, until the requested listing is found. Then, an SMS WAP Push message is sent to the subscriber's mobile handset carrying all the information held in the system for this particular listing. The piece of code used to implement the process of sending the WAP-Push SMS is given below:

```

if (TextBox3.Text.Trim().Length <= 0)
{
    Response.Write("<script>alert('Enter a destination
number');</script>");
    return;
}
mCore.WapPush objWP = objSMS.WapPush();
objSMS.Port = "COM3";
objSMS.BaudRate = mCore.BaudRate.BaudRate_9600;
objSMS.DataBits = mCore.DataBits.Eight;
objSMS.Parity = mCore.Parity.None;
objSMS.StopBits = mCore.StopBits.One;
objSMS.FlowControl = mCore.FlowControl.None;
if (objSMS.Connect())
{
    //Button1.Text = "Send WAP Push";
    // Button1.Enabled = false;
    objWP.Send();
}
try
{
    objWP.Destination = TextBox3.Text; //Destination
phone
    objWP.Text = TextBox1.Text; //Text message
    objWP.URL = TextBox2.Text; //Content URL
    //Send the wap push service message
    objWP.Send();
    Response.Write("<script>alert('WAP push has been
sent');</script>"); }

```

### C. Content Provider Functionalities

In the Q-Map system, many functions have been designed and implemented for the content provider (e.g., businesses). Some of these functions are:

**Request an Account:** the account is created once the content provider completes an on-line registration form.

**Edit, View, and Upload Content:** the Q-Map enables the content provider to edit, view (using an emulator to a mobile handset) and upload advertising content to the network server.

### D. Subscriber Functionalities

In the Q-Map, several functional requirements for the subscriber were implemented, including the following: *request a listing, view the map by selecting the link in the WAP Push message, full view of the map, zoom-in and zoom-out of the map, look-up the nearby locations, and use on-line directory assistance*, where the subscriber can send an email containing the listing information.

## 5. Testing Q-Map for Usability

The Q-Map application was tested using the Usability testing technique that examines the usability of the user interface design of the system. It also assesses the system performance, based on the client expectation.

For this test, a comparison was made between the mobile Directory Assistance Service (DAS) at Qatar Telecommunication (Qtel), and the Q-Map. During one working day at different times, several call requests for business listings were made at DAS, and for each call, the waiting time was calculated. The waiting time involves the time spent by the network agent to find the requested listing plus the time spent until the SMS message is received on the mobile handset belonging to the subscriber that initiated the request.

On the Q-Map side, the waiting times for the same business listings were also calculated in a similar way using a simulated network environment. For this simulation, a GSM/GPRS Wavecom FASTRACK Modem [7], attached to the Q-Map server, was used in this test to send a WAP Push notification via SMS message to the subscriber HTC Smartphone. The difference between the waiting time values for Qtel DAS and the Q-Map is given in Figure 3. It is noticed from the Figure that the waiting time for the Q-Map is longer than Qtel DA. For this reason, it is recommended to have the Q-Map application on a separate line, so the subscribers do not have to wait for unwanted data to be received (i.e. a map of location).

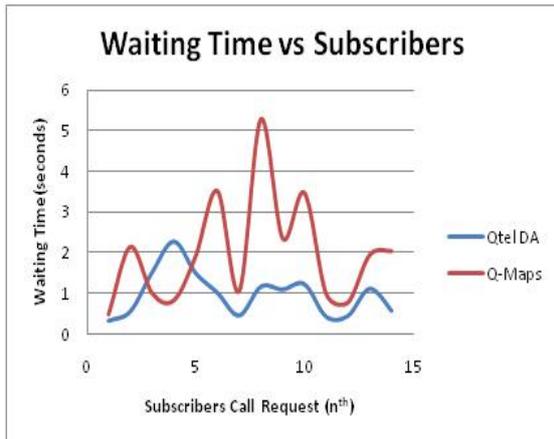


Figure 3: Q-Maps versus Qtel DAS

## 6. Conclusion

The Q-Map application developed in this project uses dynamic map technology and the WAP Push concept to extend the capabilities of a conventional directory assistance service. In addition to the listing name and number for a business, the Q-Map enables the network agent to respond to the subscriber with supplementary information containing a web address (URL) through which the subscriber can access a Google map covering the business's area and any marketing content (e.g., advertising) uploaded earlier by that business. This service is also offered to the subscribers on-line over the Internet. A Q-Map allows the subscriber to use the web browser either on a PC or on a mobile handset to search through different business categories for the desired listing. Moreover, the application provides the subscriber with a list of the relevant nearby business listings (near to the desired listing). It also enables the subscriber to send the information via an email message.

This Q-Map application assists both the business and the network agents. It enables the business agent to prepare, preview, and upload the marketing content. The network agents can also use the Q-Map for managing, composing, and delivering business information through a directory assistance service.

The system architecture of the Q-Map is a multi-tier client server that has several elements, which include graphical user interfaces (GUI) that cover almost all the functional requirements for businesses, subscribers and network agents.

In this study, when the Q-Map was tested, in a simulated network environment, it was observed that the network agent requires a slightly longer time to respond to the subscriber, compared to the response time for a network agent operating on the DAS for Qtel. For this reason, it is recommended that Q-Map directory assistance is used only as an optional service, offered in particular when a subscriber requests a listing that relates to a business. However, further tests are needed when the Q-Map application is interfaced to

the Qtel DAS platform, in order to assess the response time of the application in real circumstances.

More importantly, the Q-Map can prove more beneficial, and function even better if a location-based technology is provided, and locations can be precisely identified. In this case, the Q-Map can provide more information assistance to the subscriber by determining the nearest cell site of the POI, relevant to his/her position.

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