

Deploying Thick Mobile Clients using Thin Client Architecture: a Case in Mobile Tourist Guides

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Abstract. This paper introduces an approach of enhancing tourism web sites, giving the ability for such sites to be used as a tool to allow tourists to tag content of choice for downloading and viewing on their own mobile device whilst on visit. Tourists, upon installation to their mobile device, can view content material and a map of Mytilene (Lesvos, Greece) without the need to “connect” to any mobile operator network, thereby saving high roaming charges. Our case-study has been the design and implementation of a Multi-Platform Mobile Tourist Guide system for the Municipality of Mytilene (Greece), which uses a thin PC client via Internet to present tourist content giving the user the opportunity to select content of choice and the ability to dynamically build a thick client mobile tourist application or use the PDA Installation available at the Municipal tourist office.

Keywords: mobile tourism, web platforms, PDA guides, Java ME mobile clients, mobile porting.

1 Introduction

Mobile tourist guides enhance tourism experience and offer a more appreciative experience [3], even more so by incorporating features like maps and location-based services [18][14]. However, there are issues which still hinder the penetration and market success of such technology. Not only are there usability issues when designing for mobile devices, like device capabilities, screen size and input methods [1]; one must take into account the compatibility issues of web platforms in comparison to mobile web platforms [16] and the cost of use of such technology for tourists [10]. The convergence of traditional web technology to mobile web technology is becoming an international reality [5]. It has been argued, the main reason behind the low impact of mobile web technology applications was the high cost which users bear when connecting to the mobile web [10].

Admittedly, due to high roaming charges, tourists have been one of the last target groups that accessed data via mobile devices while traveling. Recently, the European commission has set the pace to lower roaming charges by somehow forcing network

operators to decrease prices of roaming [4]; tourists are amongst the user groups that will benefit from use of mobile web services.

Nevertheless, it is argued that even if prices drop to an affordable level, 65% of the mobile phone users will not be keen on paying for these extra services and would use them only if they were free of charge [11]. So the question is: can a tourist benefit from the use of mobile technology enough so as to be motivated to use the mobile web and incur the corresponding costs? This question in part has been answered by research [1], [2], [10], [18], [20] in the past 10 years: dynamic live data, location-based services, dynamic maps, multimodality, and ubiquity are all benefits of use of mobile web devices. While traveling though, roaming charges are not a negligible parameter for most tourists. Given the fact that the cost of an online experience abroad can reach 17 €/per MB [17] and that the average size of our mobile tourist application can reach and exceed the 5 MB mark, it can be argued that cost of data roaming are unacceptable.

Thus, allowing for the tourists to ‘build’ unique tourist guides before or whilst on their visit, which runs on any mobile device without incurring any costs of connection, is believed to represent a rather promising mobile business paradigm. This paper conveys the experiences gained from designing and developing a complete e-tourist framework for the Mytilene Municipal council for both web and mobile device users.

The remainder of this paper is organized as follows: Section 2 reviews related work in the field. Sections 2 and 3 discuss the design and implementation issues for our mobile e-guide project. Section 4 concludes our work.

2 Relevant work

In the past decade a growing body of commercial and research initiatives that incorporate electronic tourist guide functionality into mobile devices have been reported [18]. Many navigational assistants either in-car systems or pedestrian navigational assistants used as a way finding or route planning system have in built city guide information. These technologies in general have had a limited success; this is mainly due to the lack of study of the special characteristics of tourism [20], yet also due to the vast technology based problems that arise trying to port mobile applications to readily available mobile devices. In the following paragraphs, we present a review a selection of commercial and research projects completed in the field of mobile tourism guides. Key features shared among these systems are the client-server architecture and the use of location-based services.

The GUIDE project was one of the first mobile systems to integrate maps to provide guidance, information and communication to tourists visiting Lancaster, UK [21]. The system integrates a cell-based wireless communications infrastructure based on a distributed and dynamic information model to locate users in which case derives context-aware adaptive hypermedia that is displayed via a customized pc based web-browser interface. Similarly, the LoL@ (LOcal Location assistant) project [22] was designed to offer guidance using map based positioning and mulimodal input. This mobile tourist guide provided predefined tours of the city center of Vienna to visitors

including information about sights while having navigational assistance with route finding using multimodal interaction and offering an electronic tour diary as a way of staying in contact with family and friends [23]. The TellMaris, a Nokia Research center prototype [24], was one of the first mobile systems to use OpenGL based 3D map prototype in combination with 2D maps for the city of Tonsberg in Norway. This project involves an application-based system offering exploration-based services for tourists. Lastly the commercially available Nokia Maps version 2.0 [26], [27], [28] is a downloadable application which is compatible with all S60 3rd Edition phones. This application is mapping and navigation applications which require either built-in GPS or external Bluetooth GPS receivers, yet it works in simulation mode for those who do not have a GPS unit. It was stated as having maps for more than 150 countries, and with 15 million points of interest pre-loaded as such offering navigational and route planning features. Route navigation is selected by using current GPS location as a starting point and by searching a destination either by address, by previously stored location (landmark), from additional city guides (which can be bought separately), from recent searches or directly from the map.

3 Design Issues

One of the main design issues stated for this project was the initiative of giving tourists ubiquitous multimedia information for designated tourist locations of the Municipal Council of Mytilene. This project contains three subsystems, an Static internet based tourist guide system, a mobile tourist application incorporating user selected content from the Static internet system and a PDA installation offered to tourists to roam around the city or to use via predefined tours. The design of the system was broken down to three separate systems; the PC website, the mobile application, giving way for the first to be used as a tool to build the second and the PDA installation.

The multi-platform application has been designed taking into account several usability guidelines associated to three main characteristics of mobile applications, namely, small screens, limited input and mobility, as well as requirements results performed in past experiments [3] which are:

- Both the web and mobile interface is appealing to a wide range of users with various skills and expertise
- The mobile application must include short and concise textual descriptions accompanied by pictures and multimedia content which is used to provide tourist information (e.g. museums, buildings, walking paths etc.)
- Both web and mobile application presentations follow a hierarchical multi-level structure that helps users to easily search for/browse/understand specific information of their interest. This design approach has been dictated by usability studies which have shown that a combination of summary and keywords of each document at first is more efficient for users to locate relevant information from a list of documents than displaying entire documents directly [29]
- Similar menus have been designed in order to help the user to easily reach the desired information [30]. Menus and buttons are clearly labeled and consistent to

help the user navigation, learnability and memorability. To minimize cognitive load, long lists of choices have been avoided and support has been added for backtracking and easy accessing of earlier pages/home page. Finally, the menus' structure assist users to finish tasks with minimum interaction with the mobile device (e.g., scrolling and button clicks).

In the design of the e-guide system, e-commerce concepts were used. The user has the ability to tag the content of choice just like an "add to shopping cart" function, upon going to the "download now" section just like the "checkout" area of an e-commerce site. The user is given the choice to download a customized tourist mobile application to his PC and then to his mobile phone, as suggested in [10]. In the actual implementation of this overall project the Municipality of Mytilene has anticipated situations where visitors have already arrived to the island and have no access to the internet/PC. An info kiosk will be installed (July 2008) at the airport of Mytilene and at the local tourist office both with Bluetooth capabilities which upon completion of download section the PC application will push the mobile guide directly to the users mobile phone via a Bluetooth connection. The PDA installation has been installed at the municipality's local tourist office, where upon tourists can freely loan a PDA which has been loaded with content of the city and with predefined tours incorporating text images and video narrations.

4 Development of a Multi-Platform Mobile Tourist Guide

In the course of designing and implementing the tourist guide, the project team was confronted with ubiquity platform problems, i.e. the adaptation of the developed online PC web application to a mobile web application for mobile devices (PDAs and mobile phones) which can be used in an offline environment. The traditional PC web client platforms are not fully compatible with mobile web client platforms [7]. This means that mobile web applications are not able to provide rich user interfaces or allow applications to run offline or more so, to run online whenever there is data to retrieve [13]. Additionally, for the mobile application there was a need to access device capabilities, i.e. access to GPS, camera which could not be achieved by using a web application through a mobile web client. This meant that the web application needed to be re-designed and re-implemented to be used on a mobile device with a rich user interface, to be able to run offline and have access to device capabilities.

A solution which best fits this case is the use of thin clients (i.e. web browser) technology for PC web and the use of thick clients (i.e. applications ported to various mobile handsets) technology for mobile devices. An example of this approach is Google maps [6]. Google maps are based on a technology called AJAX [7], a client-side technology not completely supported by mini web browsers [15]. A user can view Google maps via a PC web browser; however, Gmaps Java ME application should be installed to view Google maps via a mobile device [16]. Gmaps can be downloaded to a PC and then installed via cable, IR or Bluetooth to the phone or can be installed via WAP [5].

The tourist web site was implemented using JSP [9] / MySQL [12] web technologies and follows a 3-tier model, i.e. presentation - logic - database. Figure 1a, shows the

website main screen page in the center there is a Ajax based map which show location markers of tourist content. The content was categorized with respect to content type (Figure 1b). The menu situated on the left shows the category of all the content i.e. Archeological sites, museums, churches etc., while the menu on the top shows all the regions of the municipality of Mytilene (Figure 1c). Navigation to the content can be achieved with the use of the left and top menus or the mouse or the keyboard to drag the map and click to the desired marker of choice. Figure 1d demonstrates the content page of a chosen content. On the top right hand the “Add to guide” button is emphasized. If the add to e-guide button is pressed the specific content will marked for download. The “download now” button selection (check out) initiates the process of downloading and customizing the content to the user’s device. This is a 4-step process where the user is asked to login/register, to specify the device desired for the application to be ported on, to choose to include memory consuming images, videos, and workable map files, to dynamically generate the e-guide that can be download on to their personal device (mobile phone or PDA).

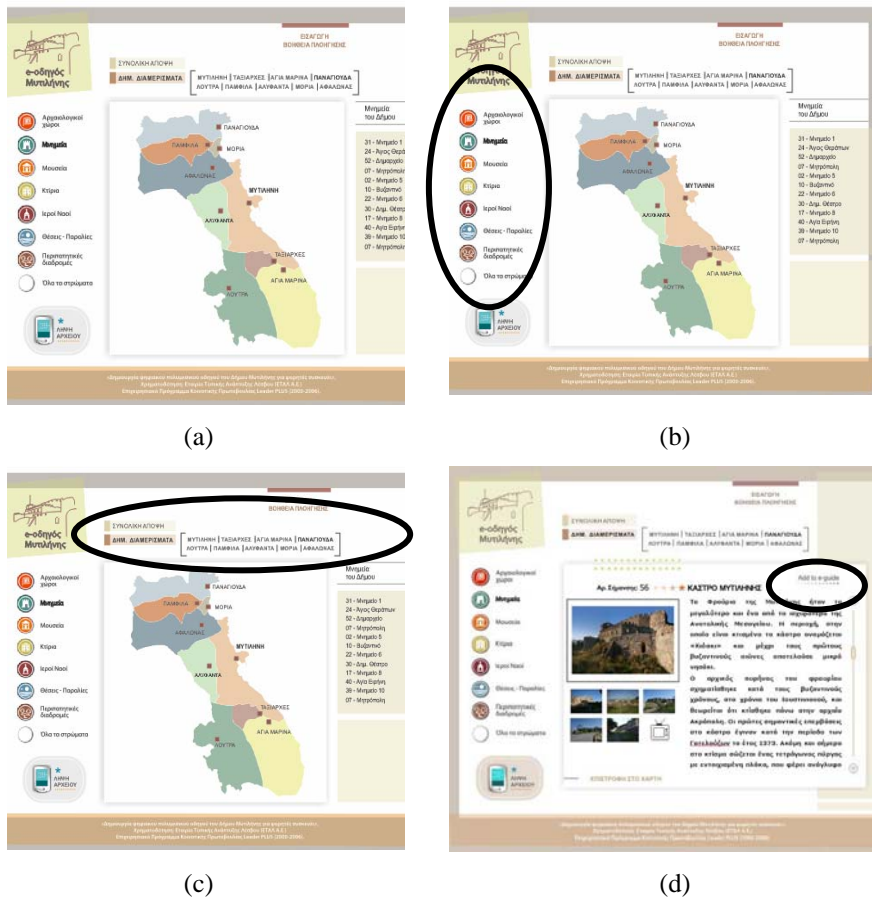


Figure 1. Screenshots taken from the *Mytilene e-guide web application*.

The actual mobile application has been developed on the top of Java ME Platform [8], (previously known as Java 2 Platform, Micro Edition or J2ME), essentially comprising a certified collection of Java APIs for the development of software for small, resource-constrained devices such as cell phones, PDAs and set-top boxes. Shown in the Figure 2 are the screens of the Java ME application.

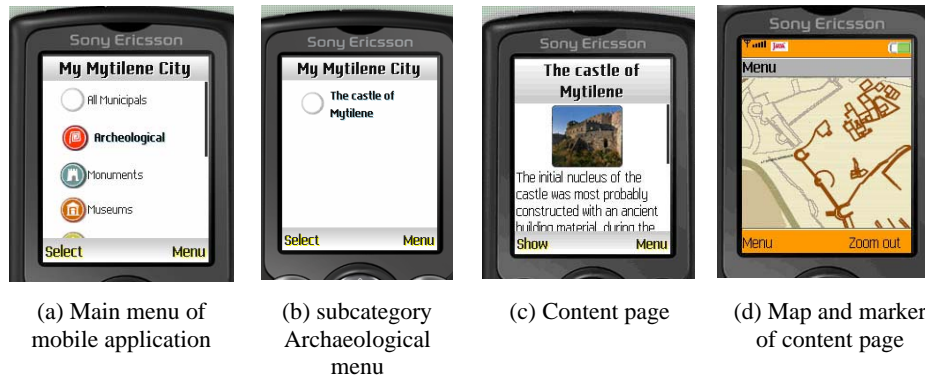
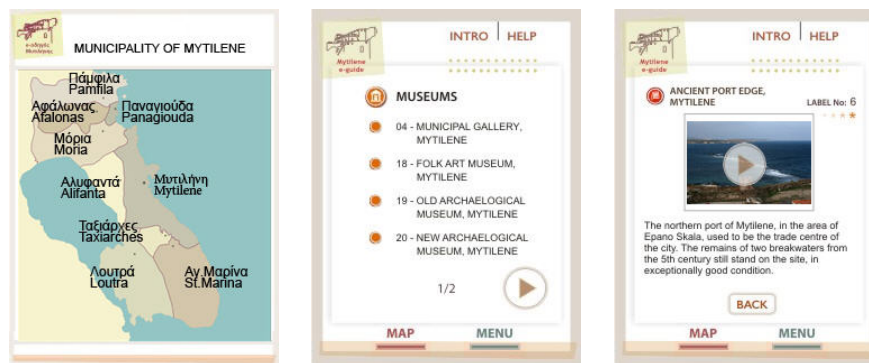


Figure 2. Screenshots of the *Mytilene e-guide* Java ME-based mobile tourist application taken from a mobile phone emulator

The mobile tourist application allows for dual navigation, from the text menu or directly from the map where the content is shown via markers which can be displayed by category or by municipal region. In Figure 2a, the main menu is shown; this menu is dynamically built by the mobile application via the xml file which was generated by the web site. If no Monuments were chosen by the user on the web site this menu item would not be shown. In the Figure 2b the content item of the Archeological menu item is shown; this menu item is color coded in respect to the municipal region (white for Municipal of Mytilene). In Figure 2c the content page is shown, this content has only one image and a short description; other content may include more images and some other descriptive fields. The Java ME application has been designed in such a way as to dynamically build the content pages accordingly. The last figure (2d) show the map which was shown from inside the content page shown the exact location of the specified content. This application also handles multiple video and audio files used as narrations for tourists whilst on location.

The PDA application has been implemented using the NaviPocket v. 2.4 by OPHRYS SYSTEMS (founded in 1992 is a company specializing in audio-guides and information systems for museums and cultural sites). It has been designed to meet the demands of Theme and Leisure Parks, Museums and Cultural sectors (gardens, zoos, aquariums, etc.) in developing multimedia guides. Navipocket is an authoring tool which allows the creation of multimedia applications on electronic message minders of PDA type. The latest version works with Microsoft PocketPCTM 2002 and Windows Mobile 2003. The application has been designed for mobility by providing an interface with simple menus (see Figure 3) and concise information so that interaction with the application requires minimal effort and does not distract the user's attention from other activities (walking, talking etc.). The user can navigate

through the content by choosing manually the sections of interest with a PDA stylus. Alternatively, the content can be automatically selected by the software, since it makes use of GPS technology which determines the visitors' position in the city. The user can choose to switch between manual and auto guidance at any time while using the system. In addition, in order to avoid user distraction and to address the stakeholders' request for incorporating multimedia techniques to effectively provide information about a sight, videos made of narration and animated pictures were included in the application



(a) Map screen of the PDA (b) Hierarchical menu screen (c) Content screen showing video

Figure 3. Screenshots of the PDA application which tourist can freely loan from the local tourist office.

5 Evaluation and Future work

Both experimental and field studies were performed revealing a high degree of satisfaction among participants although. However, useful feedback was received on how to improve the application's content and on types of new services to be added. Participants' feedback was gathered for improving the application's content and introducing new services to be added [10]. A compilation of these suggestions follows and will be taken into account in future releases of the electronic guide:

- exchange of tourist reviews/impressions/suggestions with other tourists, especially with those that share similar tourist interests
- inclusion of emergency contacts in the city map (pharmacies, hospitals, police stations, port & tourist police authorities, etc) and search facilities to locate the shortest contacts, depending on the current location of the user
- inclusion of 3D city maps to ease the recognition of the surrounding environment

- enhancement of digitized maps so as to provide three zoom levels (instead of two), target highlighting, street names and clickable objects, like city attractions, to provide quick access to important tourist information
- provision of daily/weekly weather forecast reports
- provision of multimodal orientation and navigation features (e.g. synthetic speech in addition to textual and graphical information)
- suggestion of daily, personalized tourist itineraries that will dynamically adapt on current weather conditions.

Conclusions

In this paper we presented three case studies which have been developed, which focused on the use of the web, mobile phones and PDAs for providing cultural and tourist information and promoting cultural content and tourist facilities. The prototypes implementation contributed to the evaluation of the main advantages and shortcomings of such development technologies.

In the context of the Municipal Council of Mytilene project, a three part system was implemented. A website tool was built to offer tourist to build a customized mobile application for there visit. A thick client application platform was used to build the mobile web application which does not need constant connection to the internet and a PDA installation which tourist can manually view tourist content or use in automatic mode where depending on Position the user is pushed information. of the municipal whilst having multimedia content on hand. Lastly a PDA system was implemented using a Hierarchical menu system which can easily be used by tourist in a roaming environment.

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