

# Personalized Mobile Multimedia meets Location-Based Services

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**Abstract:** When traveling and visiting new places, tourists are mobile as they wander around and follow tours through cities and landscapes. Location-based mobile systems today typically provide and deliver the the same information to all users which however does not necessarily meet the individual user's needs. In the presented approach, we aim to address the limitations of mobile devices, the unreliability of the network, and the different user's interest for the selection and the delivery of multimedia information to mobile devices. For this, a modular platform for mobile location-aware applications and a software framework for the generation of personalized multimedia content are integrated. Our sample application shows how the approach can provide a generic application support that allows the generation of mobile location-based personalized multimedia content in the domain of travel and tourism.

## 1 Introduction

Travel and tourism are domains in which individuals visit cities and places they are in general not familiar with and which they like to discover and learn more about. For these users, applications on mobile devices in combination with positioning systems enable the provision of location-based information. These services typically concentrate on the support for navigation and routing tasks. In addition, they provide information about points of interest such as hotels and restaurants nearby. What is missing, however, is the availability of *personalized* and also multimedia-rich content. In particular, the exploitation of user profile information allows a selection and content delivery that meets the individual preferences, interests, and end user's device characteristics. For mobile applications the user's

context plays an important role which can be exploited to best meet the user's individual information needs at the mobile client – this is where location based services (and context) meet personalized mobile multimedia.

In this paper, a system architecture and a sample application for mobile tourist information is presented, in which the user gets location-based personalized multimedia information about sights on demand. Its foundation are the underlying mobileMM4U framework for creating personalized multimedia content and the mobile location-aware Niccimon platform. Meeting the specific demands of mobile applications, the paper shows how a client/server distribution of application logic and media data can meet the heterogeneous mobile environment. The sample application illustrates how today's mobile location-aware applications can move on towards personalized mobile multimedia applications.

The remainder of this paper is structured as follows: Section 2 presents the related work in the field. In Sections 3 and 4, the mobile tourist guide's architecture and its foundation are presented. In Section 5, implementation issues are considered and application screenshots of the system are shown before the paper is concluded in Section 6.

## **2 Related Work**

In the area of location-based services we find that tourist guides are the most common application scenario. The mobile city guide GUIDE [DCMF99] for the city of Lancaster, UK, was one of the first systems to integrate “personalized” information to the user. Nevertheless, due to the time the project started, real personalized “multimedia” on mobile devices was out of the question. More recent projects like LoL@ [PKK01] presenting a city guide for the city of Vienna, Austria, integrated multimedia in mobile city guides. However, these systems do not address a dynamic creation of personalized multimedia which is the aim of the presented approach. When looking on the dynamic creation of personalized content, we find interesting research approaches with the Cuypers system [vOCG<sup>+</sup>00] and in the context of the OPERA project [BJK01]. Even though dealing with personalization, mobile devices are not in their focus. The dynamic creation of mobile multimedia content can be found, e. g., with the research approaches [MLK<sup>+</sup>01, LL02], which use constraints, transformation rules, style sheets, and other to achieve the generation of personalized multimedia content. However, our observation is that these approaches are limited when it comes to more complex or very application specific personalization tasks.

## **3 The system's architecture**

In the domain of mobile computing, location-based multimedia content can be retrieved either from the mobile device itself or from a remote server (system) according to the user's current position. Personalization of the multimedia content adds additional challenges here: as the multimedia presentation is created on demand for the individual user, the

application needs access to the potentially relevant media. The limited resources of a mobile device and the potentially unavailability of a wireless network connection influence the generation and distribution of the personalized multimedia content.

In order to provide such an individualized information delivery, the system architecture presented in Fig. 1 has been developed. In an optional pre-trip phase the desktop PC is used to prepare the trip. Depending on the capabilities of the device and the network conditions, the architecture allows to pre-generate personalized content for the end user's trip or leave this open to the trip (thin or thick client variant). Following the trip, a post tour analysis can be carried out. Technically, the presented architecture addresses the heterogeneity of mobile devices with regard to computing power, memory, network bandwidth, and changing network availability. It is based on a sightseeing server, which gives access to multimedia data and profile information.

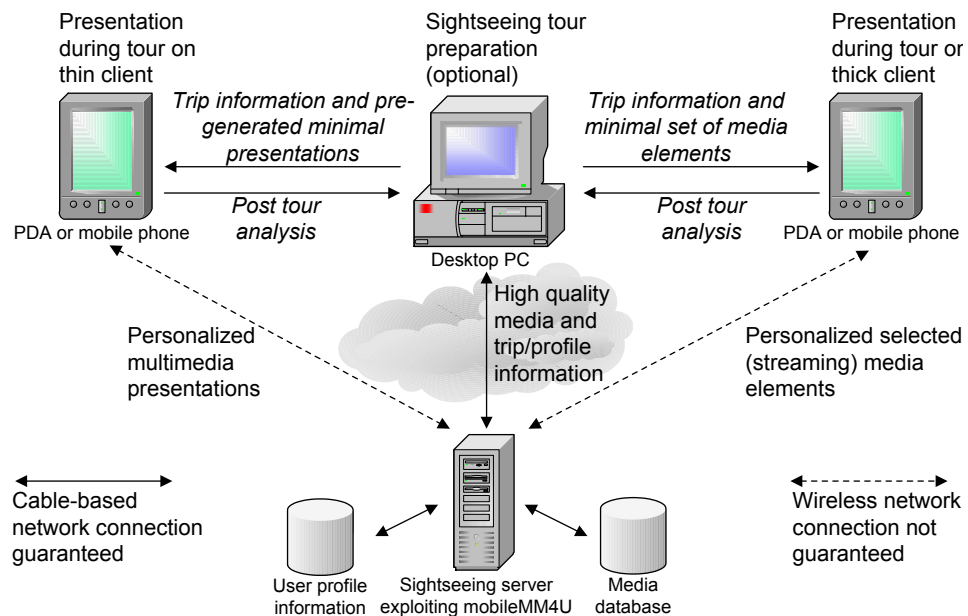


Figure 1: The architecture of the generic mobile tourist IS

For the connectivity of the mobile client, we assume a wireless network connection as default channel to receive multimedia presentations and/or single media elements. The availability of a wireless network connection allows the client to retrieve personalized multimedia presentations or individually selected media elements from the sightseeing server that reflect the latest user profile information. If the network connection is lost, the client can use the pre-generated presentations as fall back. A thin and a thick client variant with regard to the distribution of the application logic are discussed in the following:

**Thick client:** In this case the multimedia presentations are generated on the client device depending on the user’s profile information. If there is no network connection, the minimal media assets copied to the mobile device beforehand is used to create the actual presentations on the mobile device applying the mobileMM4U framework. When a network connection exists, more sophisticated and up-to-date media elements reflecting the user’s profile information are retrieved from the remote sightseeing server. To overcome the download time, the presentation nevertheless starts with an “introduction” exploiting the minimal media assets.

**Thin client:** Here, up-to-date personalized multimedia presentations are not created on the device itself, but generated on demand by the remote sightseeing server and transferred to the client. For the case that there is a wireless network connection failure during the trip, all presentations are also pre-generated by the user’s desktop PC and copied to the mobile device in advance. These presentations may nevertheless not reflect the current situation due to their prefabricated nature. In both cases, the computing power for the presentation generation is only needed at the server. The client just renders the presentations.

Figure 2 summarizes how the client architecture (thin or thick) and the availability of a wireless network connection influence the generation and distribution of the multimedia content.

	Wireless network connection available	No wireless network connection available
Thin client architecture	Multimedia presentations from Sightseeing4U server	Pre-generated, pre-stored minimal presentations
Thick client architecture	Media elements from network and presentation generation on client-side	Presentation generation on client-side using a minimal set of pre-stored media elements

Figure 2: Impact of client architectures and network availability to the content generation

## 4 The system’s foundation

To realize the system architecture we integrated our location-aware Niccimon platform and the mobileMM4U framework supporting personalized multimedia presentations which we describe shortly in the following.

In the Niccimon project, a modular system platform that supports the rapid development and deployment of such mobile applications is build. The modules of the Niccimon platform provide functionality for the specific requirements of mobile multimedia applications, such as location-aware mobile navigation and orientation support, multimodal user interface, and location-based information and services. For the developed generic tourist guide, we exploit diverse modules and integrate existing mobile multimedia players as new system modules.

MobileMM4U is a generic software framework for the dynamic generation of personalized multimedia presentations in the context of mobile systems [SB04]. The aim of mobileMM4U is to provide a substantial improvement of the multimedia software development process for personalized mobile applications. Addressing the different variants of thin and thick clients of the system's architecture, we integrated its functionality into the mobile client to allow both pre-trip and on demand creation of personalized multimedia presentations.

## 5 Implementation and sample application

We implemented the generic tourist guide's architecture and are currently developing a concrete mobile demonstrator for our home town Oldenburg, Germany. The city guide application allows to create multimedia presentations in different mobile presentation formats like SMIL, SVG, and MPEG-4, different end devices (PDA and mobiles phones), as well as the personalization in regard of the user's interests and preferred language. Depending on the specific sightseeing interests the proper sights are automatically selected for the user. This is realized by category matching of the user's interests with meta data associated to the sights. With regard to the location, the user receives that multimedia presentation of the sight her or she approaches. Currently, the thin and thick client variants are implemented integrating different mobile multimedia players as for example IBM's MPEG-4 player [IBM]. Fig. 3 shows the generic tourist guide application on a PDA and a mobile phone. The left hand presentation is targeted at a user who is hungry and searches for a good restaurant in Oldenburg, whereas the right hand presentation is generated for a user interested in culture in Oldenburg.



Figure 3: Screenshots of our mobile demonstrator for Oldenburg

## 6 Conclusion

The presented approach of a generic tourist guide integrates the support for creating personalized multimedia presentation with mobile location-based services. The architecture addresses the specific demands of personalized mobile multimedia applications. Depend-

ing on the availability of a wireless network, a user can go on the trip with pre-generated personalized presentations but also generate those just on demand while being on the way. Embracing the tourist life cycle, a user can use pre-planning to pack the potentially relevant media information to the mobile device. Additionally, a post processing of the tour can take place, e. g., the trip's path can be logged and annotated with pictures taken by the user's digital camera.

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