

Location Aware Visually Enhanced Ubiquitous Services¹

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ABSTRACT

The convergence of evolving mobile technologies (2.5G, and 3G) and the Internet using available or soon to become available bandwidth will enable completely new services to be developed. Based on the bandwidth and new core services being made available through next generation mobile networks, the LoVEUS (**L**ocation aware **V**isually **E**nhanced **U**biquitous **S**ervices) system will allow the provisioning of location- and orientation-sensitive multimedia information to the user's next generation mobile terminal.

I. INTRODUCTION

The aim of the LoVEUS project is to provide European citizens with ubiquitous services for personalized, tourism-oriented multimedia information related to the location and orientation within cultural sites or urban settings, occasionally enriched with relevant advertisements. More specifically, the project's objectives are:

- The design, implementation and evaluation of a system that allows a completely new service for the European citizen to become available, namely the *provision of location and orientation sensitive multimedia information delivery (with strong focus on information visualization) to the user's new generation mobile terminal*.
- The development of a *user friendly, ubiquitous mobile next generation terminal* that integrates mobile phone, Portable Digital Assistant (PDA) and wearable computer technologies and features into one, enhanced by the

presence of a Geographic Positioning System (GPS) and a digital compass.

- The provision, through this basic infrastructure, of *a new paradigm for promoting tourism, cultural heritage as well as commercial services*, exploiting and expanding the ideas of location aware services.

Paper Outline

After this introduction, section II illustrates the most promising application scenarios. Section III discusses the overall LoVEUS architecture at a general level while section IV covers the planned trials. Section V describes some of the most important results of the requirements gathering process. Section VI finally concludes this paper.

II. APPLICATION SCENARIOS

Three basic application scenarios for LOVEUS will be outlined in detail for each type of value-added service (VAS) recognized as promising from the analysis with focus on the context in which each VAS will operate. In detail this will be the following:

- Visually enhanced content at premium sites,
- Active Map with City Navigation, and
- Panoramic View.

Figure 1 shows the *visually enhanced content at premium sites*, which targets the cultural heritage and tourist guide functionality. This will allow the European traveler e.g. to view the reconstruction of an important monument he is looking at. In this way the monument's "readability" (i.e. the degree to which a monument can be comprehended or understood in terms of its original architecture, form and function) can be dramatically

¹ This presentation introduces concepts and technologies deployed within the framework of the IST project LoVEUS (IST-2000-30155), which is funded in part by the European Commission. The authors would like to acknowledge that they are solely responsible for this document, that it does not represent the opinion of the Commission, and that the Commission is not responsible for any use that might be made of data appearing therein.

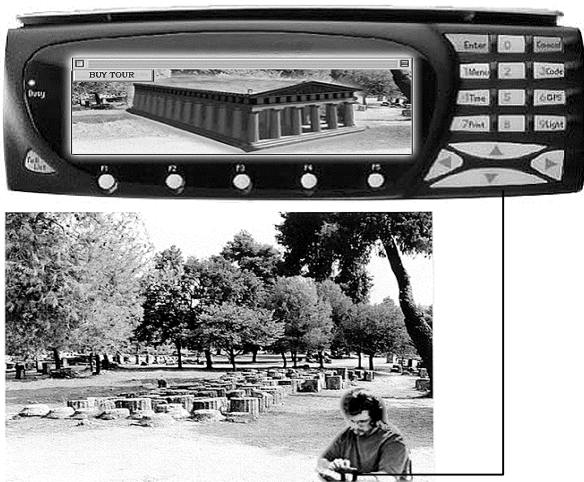


Figure 1: content at premium sites

enhanced. The information received on the user's terminal will be personalized, matching his individual preferences in terms of content focus (e.g. sports), format (e.g. audio, video) and language.²

Figure 2 focuses on the next generation *visually enhanced city navigation with active maps* providing additional information to the simple positioning within a digital map. It will provide guidance for the user in terms of available facilities of interest (according to his individual preferences) as well as information about the significant parts and monuments of the city.

Additionally this enables a new way of *promotion of commercial services*. Given the location of the user, and his individual preferences, the system will deliver relevant commercials on the user's display. As an example, while the user is strolling in the downtown area of a city, the display on his terminal will show a city map (incorporating his position and orientation in form of e.g. an arrow on the map) enhanced with icons



Figure 2: Active Map with City Navigation

² In figure 1 to 3 the user has his back turned to the scene for better visualization of the next generation terminal and the earphones; in actual settings the user would be looking towards the presented scene.



Figure 3: Panoramic View

of the commercial premises or products found within them that the user might be interested in. By interacting with these icons, an "infomercial" will be displayed and navigation to the appropriate location will be suggested. Figure 3 copes with the so called "Panoramic View" which consists of a picture of the end-users view enhanced with additional icons showing facilities of interests with optional advertisements. The terminal adapts the displayed picture while the user is turning around. As a result the picture being displayed on the terminal corresponds to the actual view of the user.

III. LoVEUS ARCHITECTURE

The LoVEUS system will establish the necessary hardware, software and network infrastructure for location- and orientation- aware services introducing numerous new features for service providers, infrastructure providers and client terminals. The system itself will follow the client-server principle and will incorporate a server system and numerous clients.

The *server* will consist of a component performing the correct positioning of the client (terminal of the End-User) on the digital map. A user management component will be responsible for managing personal data of every user (e.g. preferences, accounting data) and tasks like the profile-based personalization of the information prior to their transmission to the End-Users terminal. The server will provide an enhanced storage and GIS (Geographic Information System) associating GIS data to multimedia objects enabling the streaming of multimedia content, especially MPEG-4 BIFS (Binary format for scenes) and synchronized audio streams. Finally a component being responsible for the transmission to and reception from the client terminal of information will be delivered.

In addition authoring tools will be developed for the production of the MPEG-4 content and the insertion of content enhancements, like advertisements.

The *augmented reality* views are made feasible by two major advantages of the system:

- *No time constraints*: calculations will take place off-line (regarding the operation of the

system) and may last as long as necessary for high quality results,

- *No high precision positioning constraints:* the usage of the outcome will have to be satisfactory from an aesthetic point of view but does not require the precision of positioning that is necessary in medical or various industrial applications of augmented reality.

The *client* will investigate the merging of wearable computer technology with next generation mobile phones (2.5G and 3G) and PDA-like functionality into one device, providing the user with independence from “switching” between devices for carrying out similar activities. It will incorporate a digital compass, introducing the notion of orientation, and a GPS module for the exact positioning of the end-user. Also crucial is the operating system granting access to all parts of the terminal, especially to the colour display.

The software of the mobile terminals will take care of information exchange with the server and the control for the correct rendering of audible and visual information enabling multi-modal interactions.

The *solution for location and orientation tracking* proposed by the LoVEUS consortium concentrates on the availability of location technologies that are device-based. Alternative technologies that may be provided by the network will be considered as they become available. The mobile network operator participating, in the consortium, will enable the cell-ID and the TA-

parameter to be uploaded to the location server. The possible location will be then limited to a circular sector ring of 550m.

The other methods used for positioning (EOTD, AGPS, etc.) require extra equipment and are out of the projects scope. The terminal/network assisted technology is well suited in the case of poor unassisted GPS satellite visibility, e.g. in urban canyons. The communication protocol between the location server of LoVEUS and the mobile terminal will take into consideration these alternatives and introduce the necessary encoding and information exchange.

The selection of equipment to be used within the context of the project will be aimed at the use of off-the-shelf hardware and software components, with next generation mobile terminals.

IV. LoVEUS TRIALS

LoVEUS results will be evaluated through the execution of in-field trials that will assess the technical and commercial advances and constraints of the proposed architecture. One of the most interesting results, which depends strongly on the mobile network infrastructure, is the maximum number of simultaneously supported users.

Two trial periods are foreseen, whereas the 1st will take place by the end of 2002 in the wider area of Athens, Greece and the second by the end of 2003 (the location is not yet fixed).

LoVEUS will pay particular attention to the project specifications and trials/scenarios definition due to the current UMTS mobile terminals unavailability. The initial announcements of the hardware providers about dates of availability are within the time schedule of the project. Furthermore, there is an additional uncertainty on the UMTS development and demonstration of services due to potential unavailability and quality of the network infrastructure. The recently assigned licenses for UMTS operation, especially in Greece, bind the network operators to a tight schedule, which will allow for coverage of the wider area of Athens until December 2003.

In the context of the 3G terminal devices the consortium will initiate the development and trials at a PDA platform (or Smartphones if relevant equipment is available) that resemble the expected terminal characteristics. First the available prototypes will be deployed for the testing within a laboratory environment and finally in the real outdoors network. The devices to follow the PDA (and/or Smartphones) implementations will be actual 3G terminals. These terminals will be equipped with the necessary devices for the location and orientation tracking, namely GPS and digital compass, as well as wearable interaction means.

V. USER REQUIREMENTS

The requirements gathering process was driven by the use of a questionnaire that intended to reveal the general

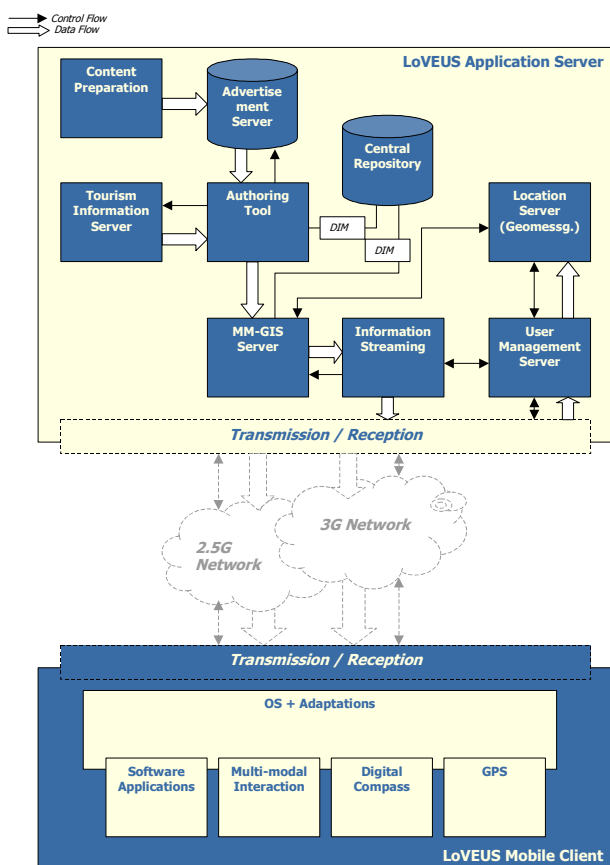


Figure 4: LoVEUS Overall Architecture

profile of the user, the tourist/travel profile and the opinion of the user with respect to each one of the proposed application scenarios. The questionnaire was uploaded to the web (Internet questionnaire) as well as to selected clientele (phone interview) of the mobile network operator LOVEUS partner.

Users participating in the survey had a strong technological background. Their technology familiarity was verified from their extensive usage of PC/PDA/mobile phone, from their high education level, the young age and the technology/positive science profile of their occupation. This does not reduce the value of the current survey since the future LOVEUS services are VAS, which are expected to pump their customer base rather from the technology adopters, than the less "high-tech" friends.

In table 1 some indicative results of the users' preferences are illustrated. The first four columns indicate the percentage of people, which visit tourist sites generally as well as some indicative categories as archeological sites, museums and Old cities. The other two refer to the percentage of the users that use tourist guides in case of inland and abroad tourist visits. The most familiar sites seem to be the old cities. Moreover, the users often utilize tourist guides when they visit foreign countries and not so often when visiting their own country. These results indicate the potential market of the future LOVEUS services.

In table 2 the familiarity of the questioned people regarding available tourist guides is presented. It is obvious that people use mainly the Internet in order to get tourist/travel information. This is attributed to the strong technology-friendly profile of the users. The other competitive means are less favourable, with the book guide to be the main competitor. However, this is a classic type of guide that always will attract the users. In table 3 there are some results with respect to AS1 of

	General	Arch. sites	Museum	Old city	Inland	Abroad
never	1.0%	12.4%	12.4%	3.7%	21.1%	9.4%
rarely	31.9%	63.1%	64.1%	31.5%	45.3%	34.9%
often	45.3%	18.5%	20.1%	53.0%	22.8%	34.6%
every time	21.8%	6.0%	3.4%	11.7%	10.7%	21.1%

Table 1: The users' preferences with respect to tourist visits and the use of tourist guides. (Rarely indicates less than twice a year, often 3-5 times a year and every time more than 6 times per year)

	books	photo books	audio tapes	video tapes	CDROM DVD	guides	Web
never	10.1%	30.9%	88.9%	86.9%	67.4%	56.0%	12.8%
rarely	32.2%	36.2%	4.4%	11.1%	23.2%	33.6%	14.1%
often	39.6%	27.2%	0.7%	2.0%	8.4%	9.4%	36.6%
every time	18.1%	5.7%	0.0%	0.0%	1.0%	1.0%	36.6%

Table 2: The preference of the users with respect to the different types of tourist guides

	RA/A		RA/A
Reconstruction of the site	53.8%	History	81.5%
Video	43.0%	Architecture	58.4%
Selected info	62.2%	Athletics	32.2%
Detailed info according to user interests	66.1%	Social life	74.8%
Search ability	51.4%	Nature	64.7%

Table 3: The driving characteristics and the favored content for the AS1. (RA/A=Rather Agree/Agree)

	RA/A		RA/A
Food	76.6%	Where am I	62.9%
Car related stores (gas station etc.)	44.1%	Friend finder	30.8%
Hotels	63.6%	Show the way to POI	71.3%
Transport	87.4%	Save position	21.3%
Entertainment	60.8%	Zoom In/Out	39.9%
Essentials (pharmacy)	58.4%		

Table 4: The preference of content accompanying the AS2, 3 services. (POI=point of interest)

the LOVEUS services. The first two columns refer to decisive and/or driving characteristics of the AS1 services, which can motivate the user in order to buy this kind of services. The video-content seems to be less favoured than the other content. In fact one of the main goals of the project is to provide a service that contains site reconstruction via video. From this point of view and as the users favour the reconstruction functionality, video will be used for the specific service³. The other services reach very high acceptance and are really motives to make future users buying them. The results with respect to the favored types of content give guidelines to the future ASP (Application Service Provider) for the proper content that will offer financially viable solution.

In table 4 some of the user preferences about the AS2 and AS3 are presented. Users prefer to receive mainly transportation, food and hotels information. Moreover, in a map-like service there is a need for showing the current position of the user as well as the way for a POI. Figure 5 shows that people do not use maps in their town very often. On the contrary, tourists are the map adopters and therefore form the future customer base.

In table 5 the users' opinion about some overall characteristics of the proposed services is presented. The users are asked for (a) which is the best way for them to be notified from the system that there is something available in their area and (b) which is the maximum time that they are available to wait for the service completion.

Confirming the worldwide familiarity of mobile users with the SMS, the questioned people seem to prefer to receive SMS in order to be notified from the network, that there is tourist guide content available. Another

³ In fact a rather better statement of the question should be "site reconstruction in a video format"

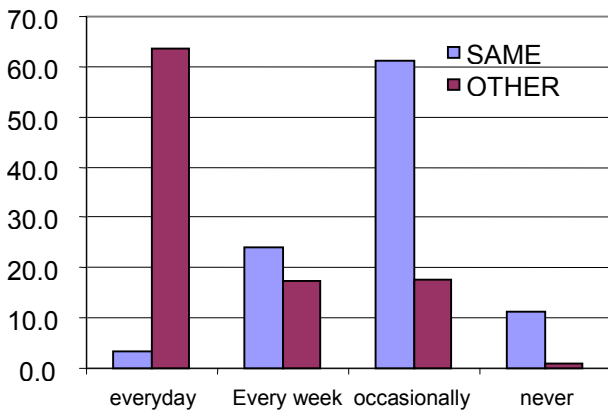


Figure 5: The use of maps.

user-favored solution is a more complex and fancy one, which is based on having an icon, like the SMS-icon, which highlights when information is available. These user preferences imply technical and application issues. For example, SMS have to be predefined and ready to broadcast to roamers, in their language, with special care not to overload signaling channels. The same issue holds if the alternative solution (e.g. MMS to the user) will be applied. In the latter situation, the application has to be specially designed in order to be appealing to the customer of these services. Perhaps the SMS idea is familiar to the users but involves also another problem of storing many SMS in the terminal in a typical situation where a user walks around a city center full of monuments. This indicates that the alternative way like the highlighted icon pass-through the screen (via signaling channels) would be more preferable.

Regarding the service completion time tolerance of the users, the overall LOVEUS system has to be carefully designed in order to meet the users' performance preferences. The call setup, the location calculation, the (after personalized filtering) retrieval of the content, the network resources and protocols performance etc. have to be optimized for minimal serving time. This is one of the most important non-functional requirements of the user and special attention has to be paid to it.

Referring to the payment issues (not shown), the most desirable way (64%) was the "pay per use". Alternative ways of payment were not very attractive. It is worth mentioning that many companies like operators, consultants and universities currently investigate the

different ways of payment. Optimization of "payment" is considered as one of the "hot-topics" of the techno-economic issues of the current telecom era.

Finally, the possibility of delivery of advertisements together with the LOVEUS services in order to offer lower tariffs to the end-users was examined. 41,8% of the people were negative while 38,2% were positive, indicating that both options have to be taken into account in order to satisfy all target groups.

VI. CONCLUSION

Having almost finished the requirement specification it is obvious that the services the LoVEUS system will provide are more than welcomed by the future target groups. One group willing to pay for these services and another preferring to have advertisement/commercials included in order to use the services for free.

Considering both payment models and having a component based extensible architecture, services such as the ones provided by the LoVEUS system could have significant impact on other application areas, such as the forthcoming Olympic Games.

The Olympic Games will take place in Athens, where the organization of the Olympics is combining athletic with cultural events. The LoVEUS service will help the visitors of Greece to explore the cultural wealth of the country beyond the possibilities being available today. For example dedicated content related to the Olympics could be used to provide visitors with a novel experience. In the advertisement domain, all articles and places related to sponsors, and the games themselves, are a desired target for the specialized deployment of the service.

The LoVEUS system could be extended by dedicated software modules dealing with additional applications. One possible application scenario is the real time monitoring of high security-rated visitors during great events, used to track the person of interest and to establish voice or data interconnection.

Out of the 2,000,000 visitors that are expected during the Olympics period, a number of 35,000 persons can be considered as Official Guests and VIPs. Additional to the visitors employees could be monitored.

Other potential extensions are user/car navigation to several destinations or events related to the Olympic Games considering the user's and his vehicle's location along with the traffic flow.

ACKNOWLEDGEMENT

The Authors would like to acknowledge the contributions of their colleagues from Road Editions S.A., OgilvyInteractive S.A., Université Catholique de Louvain, Motorola Limited, Oy Arbonaut Limited and Fraunhofer Institute for Computer Graphics.

Notification type		Tolerance to service time	
receive SMS	37.8%	<5 sec	16.1%
preview	8.4%	5-10 sec	45.8%
send SMS	15.7%	10-20 sec	27.6%
"Icon"	29.4%	>20 sec	10.5%
Audio alert	8.7%		

(a)

(b)

Table 5: The user preference about the notification by the system and the tolerance of the service time.