SEAMLESS ACCESS TO MOBILE SERVICES FOR THE MOBILE USER

Daniele Sacchetti[1], Angel Talamona[1], Christophe Cerisara[1], Rafik Chibout[1], Slim Ben Atallah[1], Wolfgang Van Raemdonck[2], Nikolaos Georgantas[1] and Valérie Issarny[1]

[1] INRIA, Domaine de Voluceau, BP 105, 78153 Le Chesnay Cedex, France
{First.Lastname@inria.fr}
[2] IMEC, Kapeldreef 75, B-3001 Leuven, Belgium
{raemdonc@imec.be}

Abstract

While available technologies provide us with base enablers of the ambient intelligence vision, there is still a long way to go before offering robust ambient intelligence systems to consumers, which requires advances in most areas relating to computer science. Our contribution in the area focuses on development support for ambient intelligence software systems, introducing a service-based middleware for anytime, anywhere access to content and services in the mobile environment. Exploitation of the middleware is illustrated in the context of a mobile user accessing services in various situations.

1. Introduction

Ambient intelligence is an emerging user-centric service provision paradigm that aims at enhancing the quality of life by seamlessly offering relevant information and services to the individual, anywhere and at anytime. Systemically, this is realized as a synergistic combination of intelligent

interfaces, ubiquitous computing and ubiquitous networking. Towards easing the development of ambient intelligence applications, we have introduced the WSAMI (Web Services for Ambient Intelligence) middleware[1] that supports seamless access to mobile services for the mobile user (whether pedestrian, in a car or in public transport) [1], as part of the Ozone IST project [2]. WSAMI allows for the abstract specification of ambient intelligence applications in the form of composite services, together with their dynamic composition according to the environment. WSAMI builds on the Web services architecture, whose pervasiveness enables services availability in most environments. In addition, dynamic composition of applications is dealt with in a way that integrates services deployed on mobile, wireless terminals and on the Internet. Service composition further enforces quality of service for deployed applications in terms of security and performance through the systematic customization of connectors, which dynamically integrates relevant middleware-related services [1].

The video illustrates use of the WSAMI middleware for enabling ambient intelligence scenarios involving mobile users who are able to seamlessly access mobile services from an automated vehicle, using the various terminals that are available in their surroundings (i.e., car computers and wireless PDAs), as illustrated in *Figure 1*. The demonstrator that is presented addresses challenges related to: (i) Interaction through a mobile device with remote services via a WLAN, both in the ad hoc and infrastructure-based modes; (ii) Seamless access to Web services that are available in the local and wide area and possibly hosted by mobile terminals; (iii) Enforcement of non-functional properties related to performance and security; and (iv) intelligent interfaces.

The next section provides an overview of the WSAMI middleware. Section 3 then introduces the demonstrator that is presented, discussing related scenarios. Finally, Section 4 concludes with a summary of our contribution.

Figure 1: Seamless access to services in the mobile environment

2. WSAMI: A Middleware for Mobile Web Services

The WSAMI core middleware subdivides into: (i) the WSAMI SOAP-based core broker, including the CSOAP SOAP container for wireless, resource-constrained devices; and (ii) the Naming and Discovery (ND) service for the dynamic discovery of (possibly mobile) services that are available in the local and wide area, according to network connectivity and available resources. The ND

[1] WSAMI is available under LGPL license at http://www-rocq.inria.fr/arles/download/ozone

service further includes support for connector customization, so as to enforce quality of service through the dynamic integration of middleware-related services over the network path.
Components developed as part of the WSAMI core broker exist in any Web services platform; a new implementation has been elaborated, so as to allow for execution on resource-constrained devices. The CSOAP SOAP container prototype has been in particular developed to cope with the limitations imposed by resource-constrained devices. The CSOAP prototype implementation is mainly based on Sun's JAX-RPC specification, which aims at enabling the development of SOAP-based interoperable and portable Web services. The memory footprint of our CSOAP implementation is 90KB, as opposed to the 1100KB of the Sun's reference implementation. The overall memory footprint of our Web services platform is 3.9MB, including 3MB for the underlying CVM and 815KB for the Xerces XML parser, in addition to the CSOAP implementation. We have further carried out a number of experiments to investigate the performance of our lightweight Web services platform [1]. Experiments have shown that: (i) the development of ambient intelligence systems using WSAMI does not add any complexity to the one of Web services; and (ii) the performance of the resulting systems is comparable to the one obtained with traditional middleware, and allows execution on wireless, resource-constrained devices. In addition, the overhead related to the functions handling user mobility (i.e., dynamic service composition relying on service discovery and connector customization for enforcing quality of service) compares to the cost of base Web services access.
Our prototype has been used for the implementation of demonstrator applications in the field of ambient intelligence, such as the ones presented in the video, as part of the Ozone IST project.

3. Demonstrator Scenarios

The demonstrator that is presented illustrates seamless access to mobile services by the mobile user. Using his wireless PDA, the mobile user is able to book an automated vehicle to go to some place and later access available services, either on the Internet or hosted by a nearby wireless terminal. Ubiquitous networking is achieved using WiFi, combining the network's ad hoc and infrastructure-based modes. A number of scenarios are presented, which relate to accessing mobile and Internet services from various terminals. All the services involved in the demonstrator are implemented as Web services on top of WSAMI, which supports the deployment and the dynamic discovery and composition of Web services in the mobile environment.
Part of the video shows the reservation of a CyberCar (automated vehicle) using either a fixed or a wireless terminal connected to the infrastructure-based network, from which the CyberCar reservation system that is available on the Internet is accessed (see left on *Figure 2*). The user specifies where and when he wants to be taken and his final destination. At the requested time, the CyberCar comes and takes the user who is then able to benefit from the terminals available in the CyberCar in addition to his own PDA (see right on Figure 2), for seamlessly accessing services, as, e.g., discussed below.


Figure 2: CyberCar reservation on PDA and the CyberCar's terminals

The video focuses on access to services in the mobile environment, including services deployed on wireless, resource-constrained terminals, using multi-modal interfaces. For instance, we see Christophe interacting with a transport information system through speech and gesture, to find the best way to go from Versailles to Paris. We further see Daniele in the CyberCar, who would like to book a room in his favorite hotel for the night; he makes the reservation on the Internet using his PDA, through ad hoc interaction with a gateway service offered by the laptop available in the CyberCar. Daniele and his friends would further like to go out for dinner but do not know any restaurant in the area, while Daniele's PDA hosts a yellow page service storing his favorite local restaurants. Angel then browses the list of local restaurants on his laptop through ad hoc interaction with Daniele's PDA and then chooses a restaurant, which he visits through a 3D virtual tour.

4. Conclusion

The vision of ambient intelligence is among today's most challenging topics for information technology. Realizing this vision means that consumers will be provided with universal and immediate access to available content and services, together with ways of effectively exploiting them. However, while base networking and hardware technologies are here to enable this vision to become a reality, there is still a long way to go before its full, robust realization. Our demonstrator illustrates use of the WSAMI middleware support for the development of ambient intelligence software systems. Our solution primarily builds on results of service-based software engineering and architecture-based development of software systems, which have been proven successful for the development of distributed software systems: ambient intelligence applications are developed in terms of the composition of services that are defined through their abstract interfaces. The ambient intelligence requirement of enabling anytime, anywhere access to applications from any terminal further leads to bind with related service instances at runtime, according to the environment in which the service is requested and in particular the service instances that may be reached.

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References

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