# AmIVital: Digital Personal Environment for Health and Well-Being

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**Abstract.** This work introduces AmIVital, a Spanish project which aims to provide a platform that meets the bases of AAL (Ambient Assisted Living) and facilitates the development of applications and business models for an emerging sector. AmIVital focuses on social needs of first order, and presents the work undertaken in developing the mobile platform. This platform creates a digital personal environment for health and well-being that produces new and innovative e-Health, e-Information, e-Learning, e-Leisure, and e-Assistance services based on Ambient Intelligence (AmI) paradigm. AmI helps make easier the development of services thought to be consumed by elderly, disabled and people with chronic diseases in order to improve their life quality.

**Keywords:** platform; AAL; mobile computing; OSGi; ESB; SOA; AmI; chronic illness; dependant people; elderly people.

## 1 Introduction

Current society must face up to the ageing of the world population as one main challenge for the future. According to well-known statistics, the proportion of dependant people will increase substantially in the next years.

One direct consequence of this life enlargement is that it will increase in the same way, the number of adults with disability, people with chronic illness and old people. It is estimated that chronic illness will represent more than 60% of the total illness in the 2020 year. Other study foresees that, in the 2050 year, the third part of the population will be between 65 and 79 years old, in other words a 44% more than at the beginning of this century [1].

Ambient Assisted Living [2] (AAL) pretends to enhance the quality of life of older people by means of the new Information and Communication Technologies (ICT). AAL is an application domain of Ambient Intelligence (AmI) and also includes personal health-related applications.

AmI environments are sensitive and responsive to the presence of people, being aware of the specific characteristics of human presence and personalities, take care of needs and are capable of responding intelligently in an unobtrusive way.

J. Lin and K.S. Nikita (Eds.): MobiHealth 2010, LNICST 55, pp. 160–167, 2011.

To achieve the objectives of AAL concept, services and applications of different nature must be provided, which makes the need arises of using diverse technologies both for the development and the coexistence between them in a same system.

AmIVital [3] is a Spanish project, which aims to provide a platform that meets the bases of AAL and facilitates the development of applications and business models for an emerging sector, concentrated on social needs of first order, solving problems derived from the interconnection between different technologies. This platform is based on the research of a complete and coherent vision of the AmI technological services, and attempting to create a technological background that allows developing services and applications for personal environment of those who need to control their health, life habits and social state. In summary, the result will be an integral and technological proposal for improving the life quality of chronic illness, dependant and elderly people, providing tools for those stakeholders related to the users such as doctors, assistances, relatives and so on.

As starting point, AAL services were selected for covering a wide variety of life aspects such as leisure, health, nutrition, physical exercise, etc. From this selection, common properties from these services were detected, focusing on the non-functional requirements, whether coming from the own services, or being a pre-condition established by the initial project objectives. On the other side, the project analyzed the state of art of new technologies that would enable the development of the final architecture. This analysis was based on the following basis: the selected technologies should facilitate the development, they should make easier the inclusion of new services, they had to be modular and they should improve the deployment capabilities of already-existing services oriented platforms.

Based on the user profiles and the requirements derived from the AAL objectives, AmIVital is divided in three main scenarios with similar architecture that share data model and protocols, being the Coordination Center, Fixed Gateway and Mobile Gateway.

The Coordination Center is in charge of giving support for the professionals and coordinating communications between both platforms, fixed and mobile. It also integrates external service providers, such as social services, emergency services, insurance companies, etc. The Fixed Gateway covers the needs of the user at his home. And finally, the Mobile Gateway covers the same services and those specifics for outdoor environments.

This article is focused on explaining AmIVital project, which is a global architecture that proposes a standardized and interoperable model for improving the life quality to elderly, disabled and people with chronic diseases.

## 2 Materials and Methods

Services have to be communicated among themselves, regardless the gateway (mobile, fixed or coordination center) where they are deployed. This fact makes the need arises of researching about Enterprise Application Integration approaches (EAI) in order to integrate applications between different organizations, *i.e. a hospital and a service provider*. EAI is a business need to make diverse applications in an enterprise including partner systems to communicate to each other to achieve an objective irrespective of platform and geographical location of these applications. service & event oriented architecture (SOA) [4] and EAI coexist being the prime choice for large scale integration.

SOA represents an architectural paradigm for applications, with Web Services capabilities are implemented, which are available to other applications through application and standard network interfaces and protocols. SOA advocates an approach in which a software component provides its functionality as a service that can be consumed by other software components. Components (or services) represent reusable software building blocks.

The project technological backbone it is SOA architecture applied to an Ambient Intelligence scenario. The most promising technology related to these concepts is OSGi[5], which combined with Web Services[6] are the main architecture foundations. The services are accessible in a transparent way inside the OSGi container; these components are not reachable from or could not access external services, to make this possible the components should publish/consume Web Services. This solution is completed with the use of Enterprise Service Bus (ESB) [7], which is an infrastructure to facilitate the implementation of the SOA approach. It gives API that can be used to develop services and makes services interact with each other reliably.

AmIVital is a distributed architecture based on AmI and SOA 2.0 that is developed through a technological architecture, which main elements are OSGi, Web Services, ESB and Business Process Execution Language (BPEL), providing network connectivity and interoperability among different network environments.

## 3 AmIVital Architecture

This section presents the AmIVital architecture, giving an overview regarding the three computational nodes deployed on the platform: fixed Gateway (AmI home space), Mobile Gateway (body AmI space) and the Coordination Centre as coordinator of all the services.

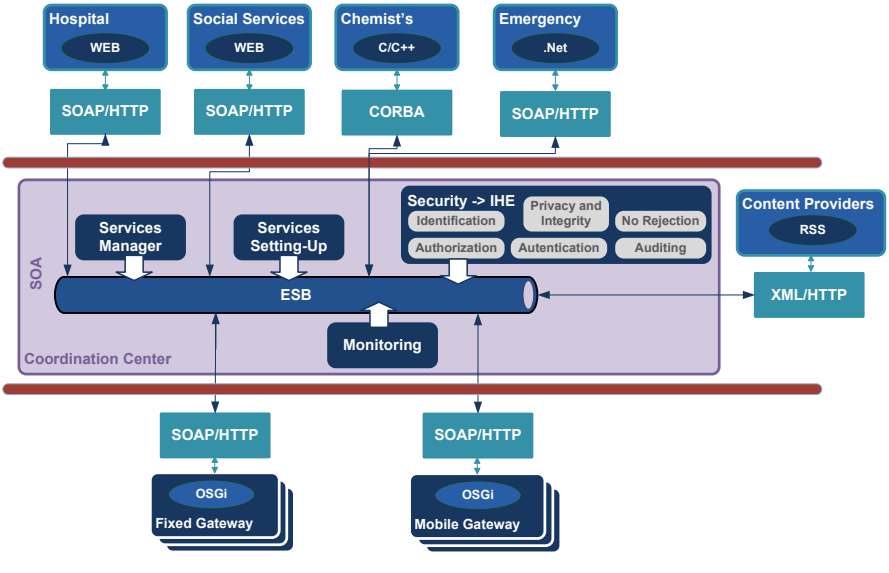


**Fig. 1.** AmIVital technological deployment

The **coordination center** integrates the mobile and fixed gateways, and communicates both with external service providers. In the following figure can be better appreciated that fixed and mobile gateways are connected through the ESB with the external providers, using as SOAP/HTTP interfaces. Security covers the whole architecture. It is defined by IHE profiles, and it is implemented through WS-Security standard and the SAML assertion language.

The below figure represents the logical reference architecture of the AmIVital platform. This approach is followed by the fixed and mobile gateways.

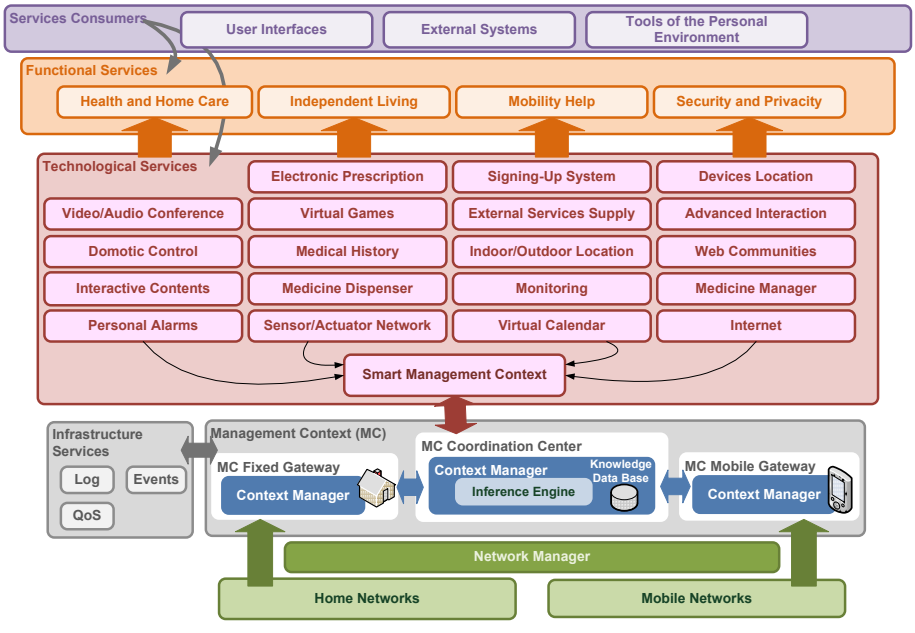


**Fig. 2.** AmIVital architecture

**Fixed and mobile gateways** are service oriented, for that categorization of services has been made as functional, technological and infrastructure services.

***Functional services*** are those that arrive to the end user (infarct cerebral prevention service, which control vital signs of patients and send alarms if there appears a risk situation).

***Technological services*** are AmI services and are composed by infrastructure or base services. Each application has underneath a set of technological services that implement its functionalities (infarct cerebral prevention service is composed by monitoring, localization, and contact manager technological services.

***Infrastructure services*** are located in the base of the architecture, and are used to compose technological services, *i.e. the monitoring technological service makes use of the device manager infrastructure service that control sensors connected to the gateway*, the context manager infrastructure service, which is involved in the data evaluation, the persistence infrastructure service for storing data and so on.

Due to resource limitations of mobile devices have been used different technologies for fixed and mobile gateways.

To assure the operation security has been designed and implemented a specific hardware for the **fixed gateway** in order to guarantee the basic services in any moment, including: software, SO, communications and power supplier failure. Some components are worth mentioning such as the context manager, which uses Bossam as reasoning engine and JADE as multiagent platform. Ontologies are in charge of the data model to share all data from inside and outside of AmIVital. OWL-DL is used as ontological language to define the internal ontology.

For the User Graphical Interface has been use GWT [8] technology that provide the intuitive and easy-to-use user interfaces for each of the services described by the project, in available devices *i.e. mobiles or TV*. The main advantage of this approach is that the generated code is completely executed by a web browser through HTML and JavaScript lightening the computational load of the user interface generation.

The communication network is based on IP Multimedia Subsystem (IMS), which is a set of international standards in order to provide a framework that allow making independent the access to services and applications both from the device (PC, mobile) and the access network (DSL, WiFi, cable, WiMAX, etc). Integrated with voice and data networks, also include text, pictures, video or combinations between them. IMS services are offered by itself directly to the platform, so Web Services are used to integrate them into the system.

The **mobile gateway** make use of OSGi as deployment environment, based on an adapted version of eRCP [9] for mobile devices, which will be completed with additional modules in order to add functionality for the users' framework. Among the infrastructure services deployed, the most relevant services are the event manager that provides a communication mechanism between bundles, the log manager that is a general mechanism to write log messages on the platform. The **device manager** provides a single interface, which makes transparent for the gateway the process of device-deployment and enables to connect several types of sensors such as biosensors (ECG, heart rate, respiration rate, pressure, weight, height, SpO2,…) and biomedical clothes. Also the use and application of ambient and presence sensors (location, temperature, activity,…) that operate in a cooperative way.

The **web services manager**, based on Axis [10], which allows consuming mobile gateway services from other platforms. The mobile gateway includes the **persistence** service implemented with db4o [11], which is an object-oriented database engine as well as a graphic user interface that presents the gateway to users (eSWT [12]). Also a **personal alarm manager** has been deployed in order to allow the user asking for help in a fast and easy way. Another deployed service in the gateway is **virtual calendar** service (iCal4j [13]). This service manages programmed events. Finally, the **context manager** is an improved version of 3APL-M [14] inference engine that evaluates information that comes from the mobile gateway.

These *technological services* were selected to be deployed into the mobile gateway. The **monitoring** service provides information of biometric parameters, each measure comes from the sensor devices or manual inputs by means of graphical user interface. Those measures are sent to the context manager, where they will be analyzed in order to determine anomalous states, and to be stored in a persistent way.

If something is wrong, then the **personal alarm manager** will send an alarm to the coordination center and will call to a pre-configured telephone number.

The **virtual calendar** manages appointments and reminders and keeps informed the user about all scheduled events. It is synchronized with the coordination center. The **content manager** is used to download multimedia resources from the coordination center repository. This content teaches how to use available services in the platform with explanatory videos. The **personal agenda** provides access to the patient's favorite telephone numbers. Finally, the **domotic control** service is connected to the fixed gateway, allowing the user to switch off/on lights, control temperature, etc.

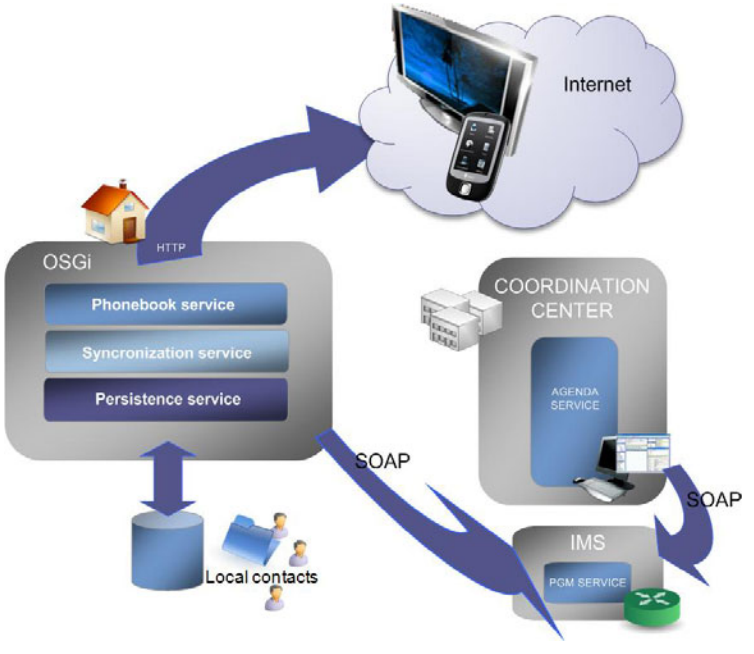


**Fig. 3.** Contact list service

As example of a functional service of the platform, contact list service is showed in the above figure. It introduces the concept "always connected", by means of the active synchronization of the contacts from the network. The user adds a new contact from a device where the fixed or mobile gateway is deployed. The contact list service interacts with the technological and infrastructure services that it requires, updating the local contact list and doing a synchronization data with the coordination center, where it will keep the master data copy. This synchronization is done through the IMS service.

## 4 Conclusions and Future Work

AmIVital is oriented especially to sanitary actuations, but applied in a Social Environment, focused on elderly, disabled and people with chronic diseases for improving

their life quality. AmIVital asumes available ICT, concentrating the effort in providing a global architecture and propose a standardized and interoperable model to achieve this objective.

The work done proves that the results meet the initial expectations for the coordination center, the fixed and the mobile gateway. In this paper has been explained the work carried out specifically in the mobile gateway, proving that is possible to combine the resource limitations of current devices and services required by the user, providing and robust platform together the rest of AmIVital logical nodes in order to improve the quality of life of end users.

Currently additional services such as videoconference using IMS, and the improvement of security mechanisms are being developed for the mobile gateway. In the last phase of the project a proof of concept will be carried out in a controlled environment with real users. It is prepared in based on interdisciplinary, technical, social and epidemiologic studies (300 patients) with the entire user involved in the project, where COPD Cerebrovascular Disease and Heart Failure is the proposal for the functional validation of the AmIVital technological platform. A positive answer was detected from those studies against the use of personal monitoring devices.

As future work, the results obtained of AmIVital will be used as input in universAAL[15] project, of which the main objective is to make technically feasible and economically viable to conceive, design and deploy innovate new AAL services. Other actions are being done in collaboration with Spanish projects as Inredis [16].

## Acknowledgments

The project AmIVital (CENIT 2007-2010), is financed by the Centre for the Development of Industrial Technology (CDTI) which is a Spanish public organisation, under the Ministry of Science and Innovation, whose objective is to help Spanish companies to increase the technological profile of said companies. The authors would like to appreciate the work done by the members of AmIVital consortium, and specially to Telefónica I+D Granada for its involvement together to ITACA in all the process of mobile gateway development, without their contribution it could not have been possible.

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