

Tele-assistance Services to Improve the Quality of Life for Elderly Patients and their Relatives: The Tele-CARE Approach

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ABSTRACT

Tele-assistance services based on information and communications technologies (ICT) have the potential to improve the quality of life for both elderly people and their relatives. In particular they can increase their peace of mind, confidence and security. This paper describes two of the services, Agenda Reminder and Living Status Monitoring, that have been developed for the TeleCARE platform. Functional aspects of these services, and how they work in practice, to improve patients' quality of life and security are illustrated with examples.

INTRODUCTION

Tele-assistance is a set of services which, with the aid of new technologies in computing and telecommunications enables elderly people to be connected to one or more specialised care centres. These are staffed by qualified personnel who in response to an emergency can provide appropriate action either by themselves or by mobilising other resources. A major perceived advantage of the provision of such services is that they allow elderly people to lead an independent life with the reassurance that in the event of a crisis, e.g. an accident or medical emergency, they will be able to immediately obtain appropriate help. In addition the services also help them to deal with lesser problems such as anxiety and loneliness.

By enabling vulnerable people to remain in their habitual surroundings, tele-assistance offers elderly people the following benefits^{1,2}:

- Improved quality of life
- Increased confidence, well-being and safety
- Avoidance of personal, social and economic costs associated with leaving familiar surroundings

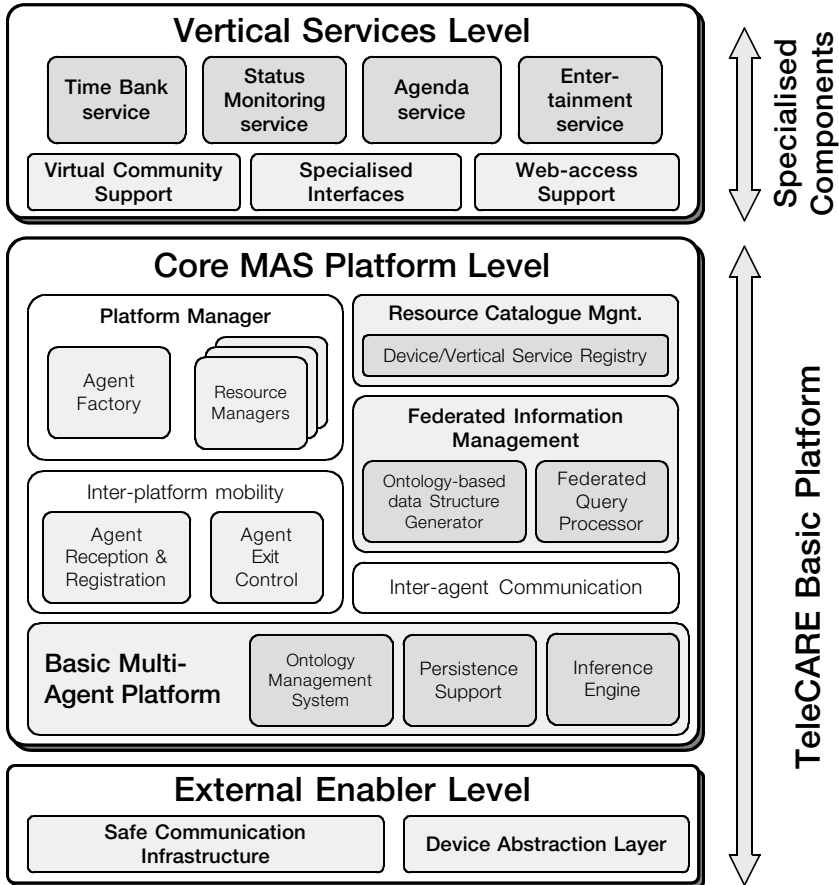


Figure 1. The TeleCARE platform reference architecture

- Facilitates contact with social and family members
- Ensures immediate intervention in the event of personal, social or medical crises

To be able to offer an effective and efficient tele-assistance service, the TeleCARE project³⁻⁶ has developed the model shown in Figure 1.

The model consists of a basic platform that supports fundamental functions such as communication and information management, and a specialised platform which provides a range of services. Two of these are:

- **Agenda Reminder**
- **Living Status Monitoring**

AGENDA REMINDER SERVICE

The 'Agenda Reminder' service of the TeleCARE platform aims to provide elderly people with a better well-being by reminding them of activities they have to do in

Table 1. *Functionalities, target users and topology of the Agenda Reminder Service*

Functionalities	Target users	Topology
– Start new agenda	Care professionals	Care Centre (coordinator)
– Edit agenda entries: exercises, appointments, medication reminder, etc.		or Tele-assistance Centres
– Send reminder & get confirmation	Elderly people	Elderly homes
– Generate alert to Care Centre	Elderly people's	
– Generate alert to relative(s)	relatives	Relatives' homes/work places

order to keep them healthy and socially integrated⁷. A common problem experienced by elderly people is forgetfulness. Consequently they frequently miss appointments and activities that could enhance their social and physical well-being.

The 'Agenda Reminder' service requires the co-operation and input of the elderly person, their relatives and carers (Table 1). An agenda is created for the elderly person by the carer which can be modified in response to instructions from the elderly person, relatives or on the initiative of the carer. For the system to function properly, appropriate software and hardware has to be installed in the Care Centre, in the homes of elderly people and the homes of their relatives.

To enhance flexibility and functionality, the service is structured in three sub-systems.

- **Agenda Management:** This centralises all the management and maintenance activities of the elderly person. It has the tools⁸ to allow the Care Centre staff to deal with proposals for updates, and, based on these, to create, modify or delete an entry in the agenda. In addition, the Care Centre will directly enter all appointments or events it deems appropriate for the benefit of the elderly person.
- **Proposal Management:** This allows the elderly person or his/her relatives to make proposals for creating, modifying and deleting events from the agenda.
- **Reminder Management:** This generates automatic reminders of events and sends them to the elderly person. The system is designed to assure receipt of the reminder, and whenever possible confirmation that the person has attended the event. If the person does not attend the event an alert is generated and sent to the Care Centre. A staff member at the Care Centre then directly contacts the elderly person or a relative to establish a cause for the non attendance.

Although the Agenda service is initiated in the Care Centre, it then utilises the mobile agent technology⁹⁻¹² of the basic multi-agent platform as shown in Figure 2.

At the Care Centre an **Agenda Reminder Server Manager Agent** is responsible for the entire management and control of the service. This includes tasks such as management of proposals, events and alerts, and the registration of new elderly people for the service. Incoming and outgoing data flow and the Windows-based interface of the care staff is managed by a **Server Interface Agent**. A **Web Connector Agent** may be used to set up a bridge to the Internet through a web server. This agent does not really belong to the Agenda, but forms part of the Web Access module that is used by relatives from their home or office.

Whenever an elderly person is registered with the Agenda service, an Agenda Reminder Client Manager agent is created in the Centre. This agent will travel (with the data on the elderly person) to the node installed in his or her house, to deploy the service there. All communications between the two nodes pass through this agent. It is also responsible for managing proposals in the home, generating notifications and generating service-related alerts in the home.

This is a clear example of how agent mobility works. This deployment consists of creating the other two component agents of the service in the elderly person's home, the **Clock Agent** and the **Client Interface Agent**, that are also shown in Figure 2. The Clock Agent is responsible for launching the events at the appropriate time. The Client Interface Agent manages the interface with the elderly person, controlling the information which appears on the specialised interface^{13,14} and the incoming and outgoing data, all of which are always oriented towards the elderly person. Once the deployment has been carried out, the Agenda is active in the elderly person's home.

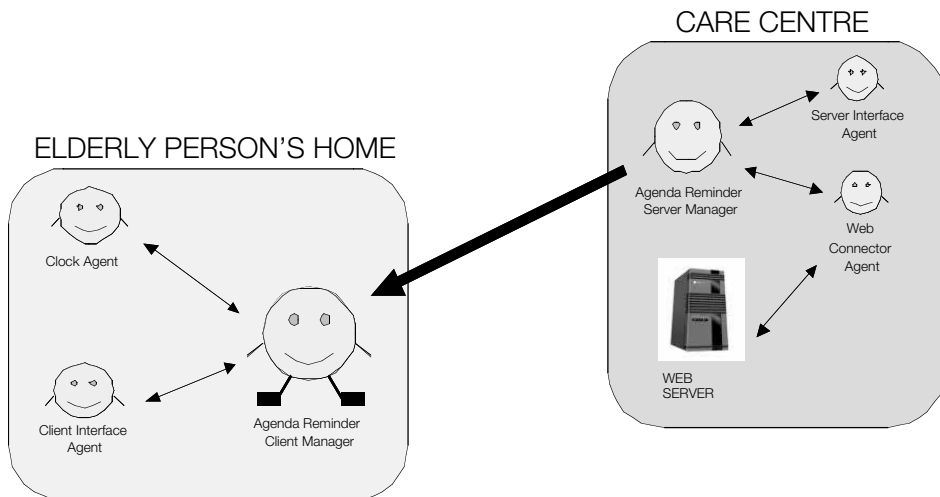


Figure 2. *Agenda Reminder deployment*

Agenda Reminder Scenario

Juan and Ana are 72 and 68 years old respectively. They live in their own home in an agricultural village 50 kilometres from the city centre. Juan is in the early stages of Alzheimer's disease and has memory problems. Ana suffers with arthritis in her hands and also frequently forgets to do daily tasks. They have one daughter who lives and works in the city. Both of them prefer to stay in their home instead of going to live in an elderly persons care centre.

The Agenda system reminds them every morning of the tasks and appointments they have to do that day, e.g. the groceries they need to buy, or any medical appointments they have. For example, one morning the system reminds them that Ana has an appointment that evening at the health centre. When Ana goes to the health centre, Juan stays alone at home and watches a TV programme. During the programme the system reminds him that he has to take his evening medication.

LIVING STATUS MONITORING SERVICE

The Living Status Monitoring (LSM) service is designed to provide assistance either on the demand of the user (requested assistance), e.g. by pressing an alert button, or automatically (automatic assistance) via information provided by special sensing devices. To enable staff at the Care Centre to more accurately assess the situation, bi-directional information flow and complementary information from other sources, e.g. cameras, are also provided. These measures help to reduce the incidence of false alarms.

Key perceived benefits of the system are³:

- Enabling the elderly and their relatives to enjoy a higher peace of mind, and thus improve their quality of life
- Cost savings by ensuring that assistance provided is both necessary and appropriate

The LSM service basically consists of monitoring and supervising the activities of the elderly person in his/her own home, by means of a number of devices which, upon detecting any irregular behaviour, inform the Care Centre so that appropriate action can be taken (Table 2).

In its operational state, the system has the following functional subsystems:

- **Behaviour Profile Management:** This subsystem makes it possible to define standard behaviour profiles for each elderly person. Once these are established, monitoring devices installed in the home will enable the system to distinguish between normal and irregular behaviour
- **Monitoring Management:** This subsystem is the heart of the LSM. It is responsible for:
 - Carrying out the entire process of analysing the information collected by the devices

Table 2. Functionalities, target users and topology of the Living Status Monitoring vertical service

Functionalities	Target users	Topology
<ul style="list-style-type: none"> - Define monitoring conditions - Collect information from sensors - Call for assistance (alarm button) - Access elderly people's file - Locate elderly people 	Care professionals	Care Centre (coordinator) or Tele-assistance Centres
<ul style="list-style-type: none"> - Contact/advise elderly people - Generate alert/warning to Care Centre - Generate alert/warning to relatives - Call emergency services 	Elderly people Elderly people's relatives	Elderly persons' homes Relatives homes/work places (notification only)

- Correlating this data with the profile of the elderly person
- Generating pertinent notifications and/or alarms

All of the situations that occur are stored in a log which can be used as feedback for the system, and to generate reports.

- **Communication Management:** This subsystem allows direct communication with the elderly person by means of devices such as loudspeakers and/or the web camera installed in the home. The elderly person may contact the Care Centre directly whenever he/she wishes, and the Care Centre and the relative may establish communication and/or view the images from the camera installed in the elderly person's home.

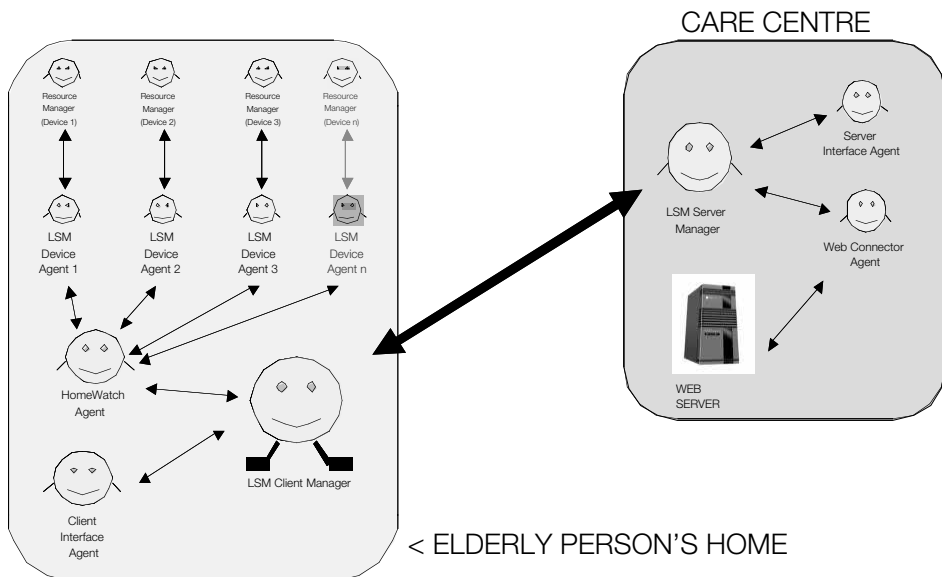


Figure 3. Living Status Monitoring deployment

The LSM works in a similar way to the Agenda service⁸⁻¹², but in this case different agents are involved. Figure 3 shows the set of agents involved in both the Care Centre and the elderly person's home. As with the Agenda, the service is initiated in the Centre, and services are launched from there to the homes of elderly people registered with the LSM.

In this case two agents once again make up the service in the Centre, and a Web connector agent provides access via the Internet.

The service interface agent and the web connector agent perform the same tasks as in the Agenda service. The **LSM Server Manager Agent** is in charge of the management and control of the service at the Care Centre. However, its tasks are different to those performed in the Agenda service. Its tasks include the registration of new elderly people in the service, inputting and managing the elderly person's lifestyle pattern according to the system's parameters, management of alerts, direct connection to the home and the temporary activation or deactivation of the service.

The deployment of the service is the same as for the Agenda service once a new elderly person subscribes to the LSM. However, in this case, as shown in Figure 3, once the LSM Client Manager agent travels to the home, a greater number of agents are created to form the service.

The **LSM Client Manager Agent** is a bridge that stores all the information related to the Centre and the elderly person. All communications between the two nodes pass through this agent.

The **Home Watch Agent** is the brain of the service and is in charge of analysing what is happening inside the home. It collects and analyses all the information from the sensors, using the information on the elderly person's lifestyle and everything that has happened previously in the home. This analysis will bring about a response if an anomalous situation is detected. This response may take the form of an automatic call to the elderly person requesting a confirmation that he or she is well, or an alert sent to the Care Centre for the initiation of the appropriate action, which may include a direct connection with the home.

The **Client Interface Agent** manages the interface with the elderly person. It controls the information which appears on the specialised interface¹³⁻¹⁴ and the incoming and outgoing data, all of which are always oriented towards the elderly person.

For each of the devices located in the home, a device agent is created as a go-between. The **LSM Device Agents** interrogate the resource catalogue to find out whether such a device exists, and if not will notify the system of the non-existence of the device.

As with the Web agent, **Resource Managers** do not form part of the service, but appear in the diagram for the sake of completeness. They are created in the elderly person's home when the device they manage is installed. They are the agents in closest contact with the devices, and can even implement, when necessary, the

proprietary code for the device. They constitute a device abstraction layer, making the devices transparent to the remainder of the system.

Once again, when the deployment is complete, Living Status Monitoring can be considered to be active in the elderly person's home.

Living Status Monitoring Scenario

Mrs. Dolores Fernández is a 74 year old widow who lives alone. One morning she feels unwell and contacts the Care Centre by pressing the panic button. A member of staff at the Centre checks her personal information and learns that she is a non-insulin dependent diabetic taking glicazide tablets. On questioning he discovers that she has taken her medication that morning but not eaten any breakfast. He advises her to take a sugary drink or eat a chocolate bar. He then checks back 30 minutes later to find that she is feeling much better. Three weeks later, sensors installed at Mrs Fernández's home send an alert to the Care Centre since no movement was detected in the home between 6 and 7pm. A member at the Care Centre rings her home to check that she is all right, but obtains no response. The staff member then alerts the emergency services and her relatives. He is able to give the medical emergency services details of her medical history. The emergency services enter her house and find that she has suffered a stroke. The immediately transport her to hospital.

CONCLUSION

This paper describes the functions of the Agenda Reminder and Living Status Monitoring Services of the TeleCARE project. It demonstrates the suitability of the technologies selected for the TeleCARE platform to achieve the objectives of helping elderly people lead high quality, independent life-styles with security and peace of mind.

The mobile multi-agent platform appears to be the best option for establishing a network of nodes which are heterogeneous, autonomous and with a wide physical distribution. The federated information management is well-suited to the purpose intended. Agents can be sent to collect information from each node, and at no time is there any centralisation of data, which would be highly inappropriate in this type of situation. As regards security, both with respect to the communications infrastructure and management of information, privacy is maintained at all times and access to information is controlled using both roles and user identification. Finally, all of the aspects added to the system, such as the modular design, making use of abstraction layers at several levels, plug and play support and the use of standards or common practices where viable, have made it possible for the architecture to be generic, open and flexible, thus fulfilling the initial aim of the project.

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