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Analysis of platforms and needed services

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Relaxed Care Consortium

Relaxed Care (AAL 2012-5-199.) is a project within the AAL Joint Programme Call 5

The consortium members are:

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Abbreviations

Abbrev.	Description
AP	End-user, Assisted Person
APP	Smartphone APPlication
HOMER	HOMe Event Recognition system, an OSGi-based software platform
IC	End-user, Informal Caregiver
NFC	Near Field Communication
PIR	Passive Infrared Sensor
PT	Prototype
RC	RelaxedCare
RF	Radio frequency
UI	User Interface

Executive Summary

Deliverable 3.1 is based on Task T3.1 Analysis of platforms and needed services:

"A detailed analysis of needs will be followed by an analysis of existing solutions in regard to platform and services. A focus is put on existing open platforms with a high probability for long use and open source extendibility. "

D 3.1. Analysis of platforms and needed services is a basic building block on which the consortium make its research and prepare solutions. Based on D 3.1 analisys about platforms and services RC partners decide which solutions can be used in our projects to minimize development cost and shorten future TTM (TimeToMarket).

AAL system is made from a technical solution built from building blocks made from platforms and services with specific equipment for making all-in-one solutions/products which help all stakeholders. The general building blocks are: Sensors, In-house equipment, Mobile Platform and Care centres equipment. Some of general building blocks are made with existing Dedicated AAL-Platforms and Frameworks, which were developed for commercial purposes or they are licensed as open source.

For RC project also some Reference Frameworks / Platforms / Middleware / Projects can be used. On the market there is also lot of already developed services which are free or commercial, especially Mood reporting services.

Deliverable also deals with available systems/products on the market which are our main future competitors.

Despite a huge amount of information available on-line, it is not possible to cover all, so only brief introduction is made.

Based on knowledge from D 3.1 the consortium decided to start with solutions made from IBE (In-house sensors and solutions), AIT (HOMER) and MOB (InvisibleCare, SensorPlatform), OpenSource RabbitMQ platform and OpenSource MQTT platform.

In M24 to M29 the whole document was reviewed again to check what changed on the market and how market changes and new external and internal findings influence on platform development.

1 About this Document

1.1 Role of the deliverable

The role of this deliverable is to analyse tools, products and services already available on the market and what consortium partners can provide.

1.2 Introduction to this deliverable

The AAL system is made from a technical solution in which all stakeholders are included. The system is built from building blocks made from platforms and services with specific equipment for making all-in-one solutions/products which helps all stakeholders.

1.3 Content of the deliverable

It is a matter of discussion (or focus) how platform and service definitions are distinguished. For the purpose of this document, the following description will be used: a platform is a product, solution or resource that can be used to build a new product or solution without which, the undertaking could not be done. Service is a solution that someone provides for use. Some services are based on platforms.

2 General system/product building blocks

2.1 Sensors

AAL systems differentiate sensors/buttons to different groups:

- Position
    - In-house, fixed, like different sensors (motion, door, bed, toilet sensors, chair, water, scale, switch and similar) and buttons (emergency, call)
    - Mobile (on body), like different bio-sensors (HR, ECG, Glucose, activity, SpO_2 and similar), internal sensors (audio level, accelerometers) and buttons (emergency, call)
- Type of measurement – what specific sensor measures
- Comm. Interface (wired, wireless like BT, BT Smart, ZigBee)

2.1.1 In-house equipment

2.1.1.1 Introduction

The APs are spending a big amount of their time in their houses. So, controlling what is happening inside the house is essential to allow the Relaxed Care system to know how the AP could feel in each moment.

2.1.1.2 In-house equipment overview

The Relaxed Care system needs several kinds of sensors in order to get data that can be used to estimate the status of the AP. The "in-house" sensors are fixed sensors installed at strategic points inside the AP house.

Using wireless sensors is a good way to maintain a simple platform inside the house. The sensors are supplied with long-life primary batteries and they use radiofrequency (RF) for the communication, so the installation is very simple.

Initially, the following kinds of sensors were selected as the most useful for this project:

- PIR, passive infrared sensor.

- CS, contact sensor.

- PS, pressure sensor.

In order to have connectivity between the RF sensors and the application which is running in a computer a gateway is necessary.

The next image shows the basic scheme for the in-house sensors.
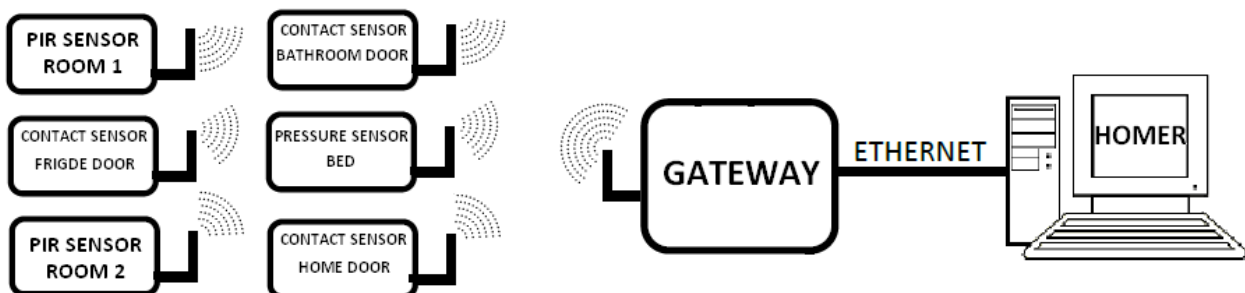
Figure 1 - IBERNEX sensors

The sensors from IBERNEX use a simple proprietary RF protocol, using the free-use band of 868 MHz. This kind of RF communication means that the sensors are cheap, reliable, energy efficient (large battery life) and the range is sufficient for a standard sized house.

The RF communication is bidirectional, and the protocol includes:

- 32 bits unique identifier for every device

- 16 bits CRC for error checking in every message

- Protocol with acknowledgement

- Periodic status message

2.1.1.3 PIR sensor (Passive infrared sensor)
The PIR sensor allows the system to know if the AP is moving around within a defined zone.

It measures the infrared light radiating from objects with different temperatures in its field of view. When the measured radiation changes significantly, the sensor generates a "movement" event.

The PIR sensor can be oriented and masked in order to define the monitored zone.

Picture 1 - PIR sensor

The sensor, by default, it is in IDLE mode, waiting movement detection. Each time that the sensor detects movement, it sends a RF message. After sending the message it goes into a sleep mode during few seconds, in order to save the energy of the battery. Additionally, the sensor also sends an "I am alive" message every few hours, to let the system know that it is working.

2.1.1.4 CS sensor (Contact sensor)
The CS sensor allows the system to detect if the AP is closing or opening a door or window.

The sensor can be installed in different doors and windows. The main entrance door can give information about when the user is entering of leaving the house (or receiving a visit, or if he/she has forgotten to close the door). The WC door can give information about when (and how long) the AP is using the bathroom. The bedroom window can indicate if the user is ventilating the house. Installing a contact sensor in the fridge door is particularly useful because it lets the system be approximate the food intake of the AP.

The CS sensor consists of a moving part (installed in the moving part of the door/window) and a fixed part (installed in the frame). The moving part is just a small magnet. The fixed part includes a small reed switch (operated by a magnetic field), that detects when it is near the magnet.

It sends a message when the sensor passes from being open to being closed or vice versa. Additionally, the sensor also sends an "I am alive" message every few hours, to let the system know that it is working.

Picture 2 - CS sensor

2.1.1.5 PS sensor (Pressure Sensor)

The PS sensor informs the system about when the user is on the bed or on a sofa.

There are some commercial systems that measure the pressure of a sealed cushion, but the durability of the sensor is limited, and may not work correctly with some types of beds or mattresses.

The IBERNEX bed/chair sensor uses a piezoelectric sensor instead of a pressure sensor. The result is easier to install, it works with every kind of bed and mattress and it is installed under the mattress (so it is not noticeable by the user).

The IBERNEX bed sensor measures the vibrations but it can measure neither pressure nor weight. The sensor is usually installed under the mattress, approximately in the centre of the bed, near the user's chest. The sensor has a great sensibility, so it is able to detect the small vibrations that the body produces when the user is sleeping (breath, heartbeat...).

Picture 3 - PS sensor / 1

Picture 4 - PS hub

The sensor signal is processed at a small box installed in or near the bed (a "hub") in order to avoid noise and spurious signals, processing the signal to obtain a "presence" or "absence" signal. And it send a RF signal when the state changes.

The hub sends the following messages:

- The presence message is sent when a vibration is detected.

- The absence message is sent, after a presence had been detected but during a few seconds the sensor has not detected any vibration.

- The error message is sent when the sensor element is disconnected.

- The "I am alive" message is sent every few hours to let the system know that it is working.

2.1.1.6 Gateway

This part allows transmit the information between the sensors to the computer where HOMER is installed. Physically, the gateway is supplied in a small box, It can be installed anywhere in the house, without being visible, because the box does not require any user interaction. It includes a Linux operating system and two Ethernet ports with internal switch function.

Picture 5 - Gateway

The RF communication with the sensors is provided using a small electronic board.

The communication with HOMER is done through Ethernet.

The gateway is supplied using an external power supply of 230 VAC. Optionally it can be PoE powered.

2.2 Mobile Platform

2.2.1 Introduction

AAL doesn't mean only in-house AAL. Today APs are moving outside of their houses if they have the possibility. Therefore they need equipment which allows them to do stay mobile. Equipment should follow them – be mobile.

2.2.2 Mobile (device) Platform / mobile phone / PDA – definition

We will use the term "mobile platform" for any type of mobile device, including its OS of choice and the included software, which supports:

- Voice and data communication

- Wireless and wired interfaces (Bluetooth, Bluetooth Smart, WiFi, USB, ZigBee…)

- Screen for data visualization and user interaction

- Keyboard or any other interface for data input (virtual keyboard or similar).

A typical representation would be a smart mobile phone or a tablet.

2.2.3 Current (market) conditions:

In (Feb 2014), there are several smart mobile platforms, including: Android, Apple (iOS), Windows Mobile and others. In Sept 2015 Android and Apple even raised their market share. There are two different approaches from different points (views, parts of the market); some established mobile phone makers (or even pager makers) like Nokia and Blackberry, have evolved their mobile phones and put them on steroids, others came from the computer world, like Google, Microsoft or Apple. For some, a smart mobile phone is a mobile phone with extended functionality, bigger screen, on the other hand a smart mobile phone may be perceived as a tiny computer with phone (voice) functionality. The smart mobile phone market really exploded in the last few years, mainly because of two newcomers: Apple iPhone and Android platform. Let us discuss some reasons as to why this happened:

- Good marketing – Apple has first class marketing

- The rapid expansion of social networking – people are more and more connected nowadays and they wish to stay connected independently in any place or time.

- Users have learnt that there is a possibility to be constantly connected - everywhere…. and they need a small computer or a similar device to achieve this so they've adopted a smart mobile phone.

2.2.4 Mobile platforms – differences

Mobile platforms differ on several important criteria:

- HW platform (processor, screen, memory, interfaces)

- OS, included applications, user-interface

- Application environment / development

- Platform openness

- Platform market share

- Platform known weaknesses and flaws

2.2.5 Short overview of the mobile platforms currently available (smart

mobile phones)

We will only present a brief amount of mobile platforms which are interesting for the RelaxedCare project, as the current market conditions are changing rapidly:

	Manufactures		Market Share[1]
Android	Google (not manufacturer), Acer, Asus, HTC, Huawei, Lenovo, LG, Motorola, NEC, Samsung, Sony, ZTE…	+open platform	
Apple iPhone/iPad	Apple	-closed system -user orientated	
BlackBerry	RIM	+secure	declining (2014), minor market share (2015)
JavaME compatible	Most of manufactures, except Android, Apple, WM	+expanded -fragmentation	declining, but not as fast for seniors (2014), minor market share (2015)
Windows Mobile	Acer, HP, HTC, Samsung, Nokia…	+easily recognizable for developers coming from the PC environment.	declining (2015)

We are mentioning old-fashioned (classical) [BM1]mobile phones because seniors are still very keen to use them.

2.2.6 The basic development problems:

The basic problems developers are facing are:

- Different platforms and program languages (JavaME, Java, C#, …)
- Standardization is only on paper.
- New mobile phone models coming out constantly, which in relation to the aforementioned virtual standardization means that most of the problems aren't being fixed in due time.
- mobile phone fragmentation, especially for Android platform
- mobile application distribution

2.2.7 RelaxedCare mobile platform – Usability

The mobile phone is used for two way communication with different sensors (option), data control and analysis, visualization, the saving of processed data, communication with the user (news, alarms, questions, comments..), two way data and voice, SW updates etc. Most of these tasks must run in real time with as little user input as possible which poses a challenge.

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[1] The market share wasn't added to the spread sheet because of the rapidly changing conditions on this area, as well as the fact that some shares overlap (such as the Nokia phones on the Symbian platform which is JavaME compatible as well). Currently the Android OS and iPhone OS are gaining the biggest market share. We should keep in mind that with the RelaxedCare project the consumer market serves us as an orientation and not as a guideline.

2.2.8 RelaxedCare mobile platform – platform requirements

The requirements for the RelaxedCare project will be defined thoroughly in due time, but we can divide them into the few basic groups:

- Usability
- System safety
- Adaptability
- Connect ability
- Reliability

2.2.9 Challenges posed to the developers of the RC mobile software

- How to control potential future sensors (connect/disconnect, communication, alerts)
- How to control energy usage (the mobile OS needs considerable energy to function without difficulties – the platform must be able to communicate with its users, know how to prioritize and connect/disconnect accordingly)
- How to upgrade the software (OS, application)
- How to base the UI so that it's usable by everyone (patients, professionals)
- System safety
- Control centre (which mobile phones are turned on, which are online, alarms, OS, software)

The processor power of current mobile devices is lower than it could be, mostly due to the optimization of usage. A smart mobile phone should be able to survive for at least a day or two of normal usage (calling, messaging, alarms and control) before having to be charged. The RelaxedCare project poses extreme usage of mobile phone power such as lots of parallel modules working together, undisturbed communication, the ability to operate without user intervention… We will need to use the most modern development environment based on the most modern state-of-the-art hardware. Most of the current mobile phones are already state-of-the-art, but only a few of us are actually aware of this fact as these mobile devices are so deeply entwined with our society, that we look upon them as completely logical and not as a technological marvel.

2.2.10 Choosing the right mobile platform

RelaxedCare intends to combine state-of-the art technologies and innovative solutions into an integrated framework and design – according to this integrated approach – reference architecture for senior care and informal caregivers usage which will ensure the interoperability between heterogeneous devices and services.

Because of the need for interoperability between heterogeneous devices we are unable to target a single manufacturer, not even based on the current market share. We can, on the other hand, base the referential architecture on what we think is the most usable state-of-the-art platform, to make a proof-of-concept and define the standards.

2.2.11 Minimal requirements for the mobile platform:

The mobile platform should fulfil the following minimal requirements in every case:

Multitasking

Continuous multi-parametric monitoring, different communication modes, possible future communication with eHealth platforms, requires true multitasking, which is not present on all of the current mobile platforms.

Open Platform

The platform of choice has to be open to the point where the developer can choose to block some of the features which are usable as far as consumer products go, but are definitely not needed for medical usage (such as the user's installing of web browsers/games/music software...). The mobile platform must also be open to adding functionality from the side of the developer / creator of software, such as safety regulations (device lock, safe data transfer and storage...)

Extended Platform

The term "Extended Platform" refers to an established system with fewer potential problems and an UI, known by its users. The users are quick to acknowledge a new device, as it is already known to them.

Tablet version

On one hand, there are a large number of users which are turning to devices with bigger screens due to an ever-growing need for multimedia; on the other hand there are users which prefer smaller devices due to a need for portability. The screen of a mobile device can become bigger by enlarging the device or by making the keyboard smaller – thus establishing that the device without a keyboard will have the best screen size / device size ratio. This is a natural evolution, but in case of senior users, it is not very accepted – seniors still prefer mobile phones with physical buttons. Some of the users of the RelaxedCare could be subject to any of the forms of blindness / lack of visual perception thus making a bigger screen a great answer to their problems. A tablet computer could prove the answer to this problem, especially if it would use the same or slightly modified OS as smart mobile phone (low costs of development and upkeep on one platform).

2.2.12 Some questions to answer carefully when choosing the platform

Dedicated, specifically developed or consumer product?

RelaxedCare project surveys will show, whether we will be able to use the regular / modified mobile phone (based on the HW and SW side) or if we need to base a dedicated product so that the mobile platform complies with the requirement of the project. It is not so much a case of the capability of the mobile platform as it is of flexibility, safety and adaptability of the project's needs.

RelaxedCare Mobile platform candidates

At this moment there are several capable candidates in play, but the decision revolves mainly around the Android and iPhone platforms. Both of these support mobile phones as well as tablets.

2.2.13 Side by side comparison (Android 4.x vs. iOS 7)

There is a bunch of Android / iPhone comparisons, but for the RelaxedCare project we need different point of view.

Android is an OS using a modified version of the Linux kernel. The Android development is assigned to the Open Handset Alliance™, a group of technology and mobile companies who have come together to accelerate innovation in mobile and offer consumers a richer, less expensive, and better mobile experience. Together they have developed Android™, the first complete, open, and free mobile platform. Android, as an OpenSource OS is implemented by different manufactures using different hardware (different screen sizes, with or without keyboard). Android is multiplatform, multicarrier and a multitasking OS.

The iPhone paradigm is the opposite side: a few devices, one manufacturer and closed system.

When comparing the two OSs there are a lot of similarities but also some major differences:

Table 1- Android / iOS comparison

	Android	Apple
Hardware	Diverse hardware (-)[2]	Unified hardware (+)
Control	OpenSource – more control	Apple controls every aspect (-)
Multitasking	Yes	Yes in new versions

A survey by mobile software tools provider Appcelerator found that more developers prefer Android than iPhone OS for "its OS capabilities, platform openness, and long-term outlook."[3]

2.2.14   Conclusion

We are aware of the fact that development on the field of mobile platforms has been significant in the past few years and will continue to grow intensively during the life time of the project. As such we can only choose the most useable platform, define the minimal hardware requirements, lead the development on the chosen platform and monitor the changing conditions constantly right up to the point where the project ends, when we reconsider all the possibilities, formulate the best state-of-the-art solution of the current time and continue with development.

References:

CHIRON project, www.chiron-project.eu

2.3 Care centres equipment

Care centres use very different technical equipment, which depends on their type and purpose (kind of seniors; historical development, origin of the centre (resulting from general or hospital care), infrastructure, internal organization and law involved). There is no standard solution even in particular country. Centres use very different solutions, but of course they must comply with the minimum standards set by the government. In addition, some centres are connected to health and social care information systems of individual counties or countries, which force the use of special or compatible technical solutions. In principle, from technical equipment perspective are care centres some kind of mix between hospitals and homes.

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[2] Not a big problem, because RelaxedCare aim is not to work on all possible hardware
[3] http://www.sci-tech-today.com/story.xhtml?story_id=011001CEJS6Q

3   Existing Dedicated AAL-Platforms and Frameworks

3.1   Introduction

To allow the environment (here: apartment or house) to assist a person, it must become aware of the context a person has while living in the place. A glimpse of input needed to derive the context a person is momentarily in, is presented in **Fehler! Verweisquelle konnte nicht gefunden werden.**. This schematic focuses on sensory input only. Besides receiving data from sensors, an AAL system has to be able to analyse the sensor data and actively assist a person by utilizing actors. These requirements have led to system architectures comparable to the one provided in **Fehler! Verweisquelle konnte nicht gefunden werden.**. Major components of the system architecture comprise a flexible interface to sensors, flexible blocks for data processing, analysing and services, and the connection to a database.

Since the need for such platforms as described above was identified, many platforms have been developed. This trend was also fuelled by the advances in the computing power of hardware with constantly decreasing form factor. While the academic domain contributed important research in regard to the application of state-of-the-art information technology, only a few platforms were launched into the market. While the number of proposed platforms increased in general, it became obvious that a standard platform is needed. However the tireless work of all the developers was not in vain, for several of the architectural ideas propagated through many new platform implementations, a true standard remains missing.

Numerous projects solved the problem of developing an AAL platform, or provided frameworks for the same purpose. Naturally, the platforms and frameworks were implemented with a specific use case in mind, which resulted often in very specialized solutions, capable of handling "their" challenge but do not excel with their general efficiency and flexibility. There are announcements, which have a clear similarity to RelaxedCare. This broad spectrum makes the effort of comparison a significant task within the RelaxedCare project. A method had to be found to make the comparison and selection of a platform or framework for RelaxedCare less difficult. Therefore the main question in the comparison was: Is the platform or framework available as a software package? It might be speculated, that the life span of most platforms and frameworks do not exceed the duration of the project they were born in. As the consortium of RelaxedCare is determined to focus its work on other aspects than to create yet another platform or framework, the availability of the software became the hardest criterion in the comparison. In fact, the literature research on platforms and frameworks can be reduced almost completely to the question "can we download the software described?" The comparison is given in **Fehler! Verweisquelle konnte nicht gefunden werden.** of the next section.
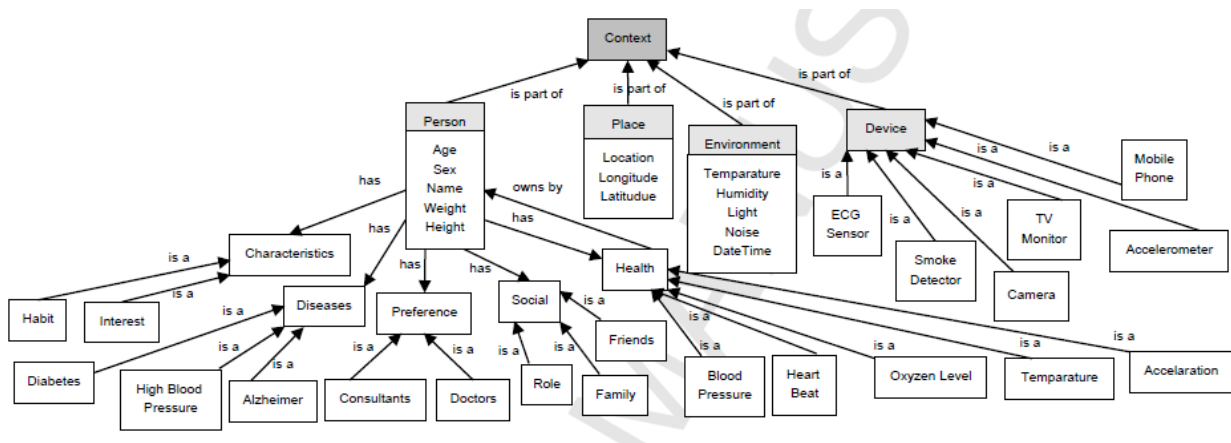

Figure 2 - Structure for context modelling based on web ontology language (OWL) as suggested by (Forkan, Khalil, & Tari, 2013)
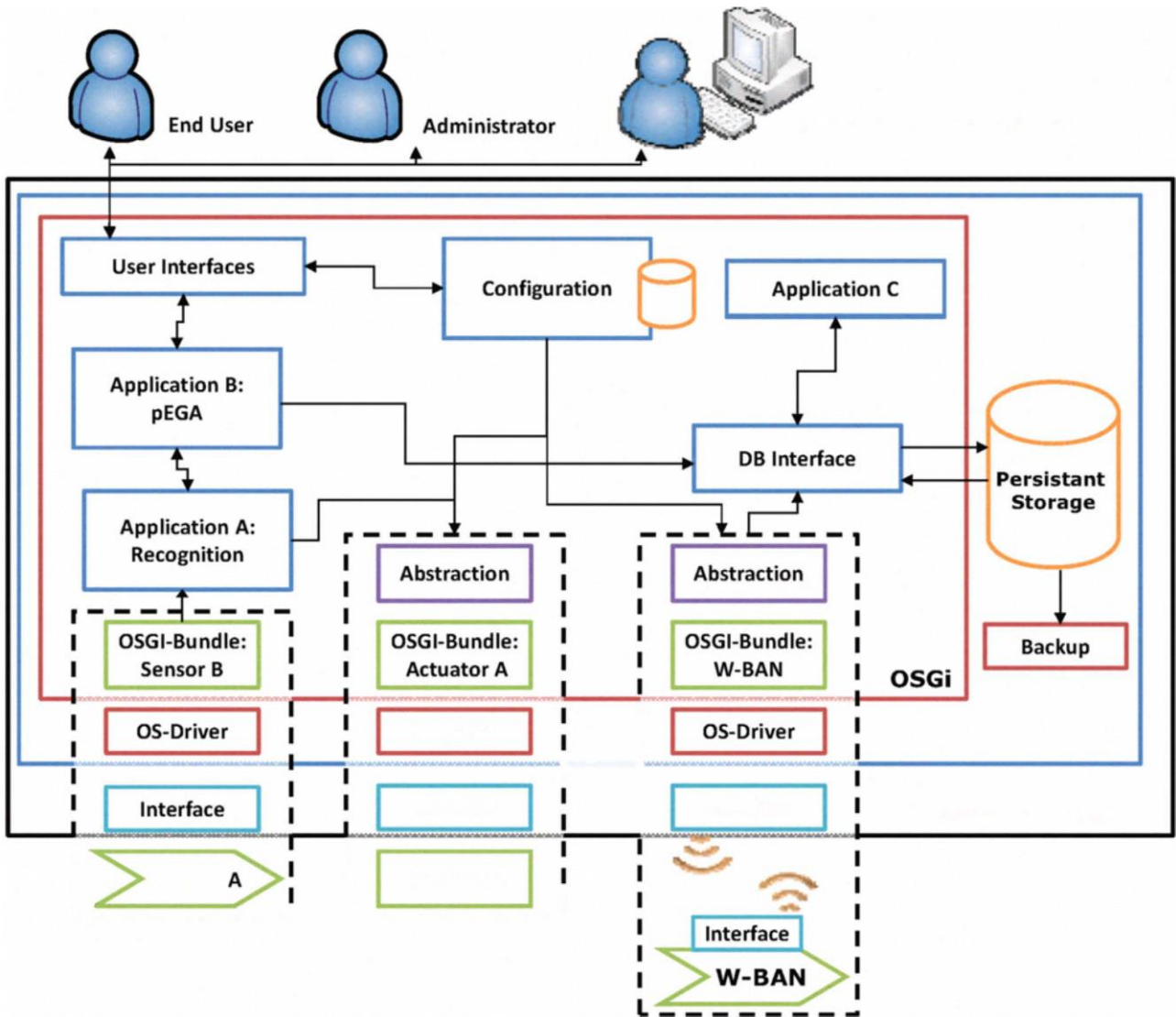
Figure 3 - GAL Middleware Platform Architecture (Eichelberg, Hein, Busching, & Wolf, 2010)
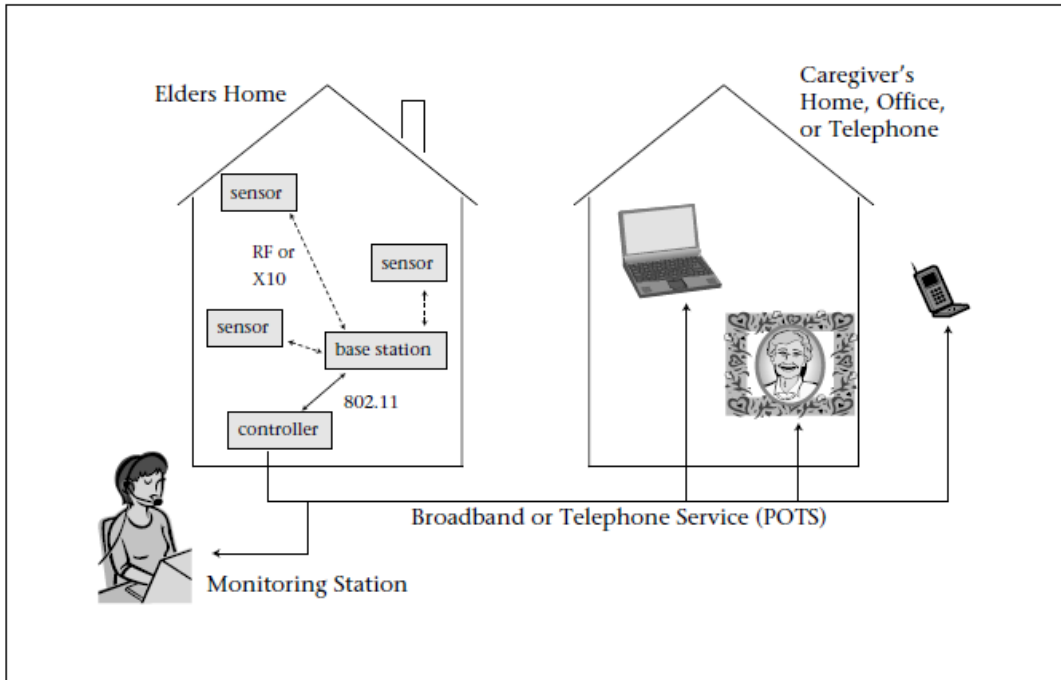
Figure 6. Architecture of an Assurance System.

Figure 4 - Announcements of platforms suitable for the idea of RelaxedCare can be found in many publications, as this example shows. The more difficult question is: Can 3rd parties, like this consortium, take advantage of those existing ideas? Picture: (Pollack, M. E., Intelligent technology for an aging population: The use of AI to assist elders with cognitive impairment, *AI magazine,* **2005***, 26***, 9)**

3.2 Reference Frameworks / Platforms / Middleware / Projects

Contents of this chapter distinguish between reference frameworks (or platforms) and projects. Reference frameworks (or platforms) are documented software-architectures, which validity has been shown by the implementation of the suggested architecture. Often, these implementations have an experimental character and are not available publicly. Additionally to the reference frameworks and platforms, projects, which have to develop a framework or platform in order to achieve their goal, are taken into account.

One system architecture of such an AAL platform is shown in Figure 5**Fehler! Verweisquelle konnte nicht gefunden werden.**.

Figure 5 - Modular framework architecture in HOMER (Fuxreiter, Mayer, Hanke, Gira, Sili, & Kropf, 2010)

Comparing the reference frameworks and platforms is a complex task, since the applications differ significantly from project to project. This means test environments and field tests (if documented) are only rarely comparable. To reduce the complexity, a very pragmatic approach for the comparison was selected. Since the primary focus of RelaxedCare is neither to re-inven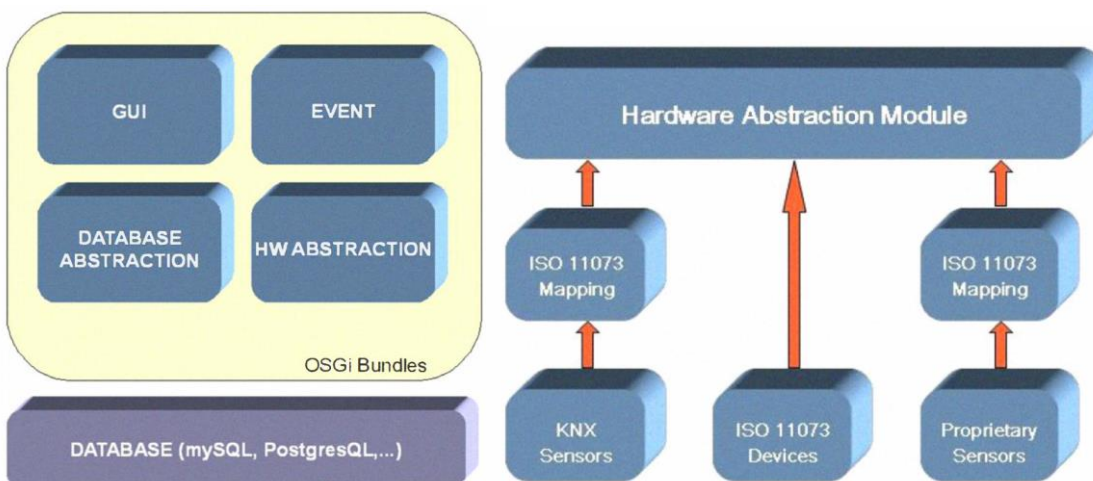t a new AAL-platform, nor to invest a considerable effort in a review of scientific quality, an efficient way had to be found as basis for the comparison of the platforms/framework and finally for the selection of the platform/framework suiting our requirements best.

A comparison of AAL platforms / frameworks found in various sources, mainly scientific literature and the internet, is presented in Table 2. For RelaxedCare shall become a "system in a box," a platform / framework is required, which allows a holistic integration of all system components, comprising sensors, components for data analysis and actors. Frameworks and platforms which provide solely algorithmic solutions, without any interfaces for sensors, are not regarded in the comparison (see deliverable D 4.1 for relevant algorithms). Instead it is assumed that the necessary algorithms can be implemented in the platform / framework when they are modular. Column "3rd party software extensions possible" of the table copes with that question.

Whether the software is available was determined by searching the correlated publication (if available) for a download link, or a corresponding website, and additionally googled for the name of the software package.

Documentation is classified as available, when the publication/announcement is supplemented by further information in form of documents or a wiki.

Although there are solutions like Homematic available, their proprietary character complicates developments. Therefore these solutions a not regarded in the following.

Table 2 - Overview on AAL Platforms & Frameworks

(Platforms marked with * have additional description below)

Name	3rd party software extens. possible	SW avail.	Documentation available	Support address provided	Last sw upda-te	Currently in use in more than one install.	Meeting point for all devel. and users available	Experien. by any of RC partners
*AAliance2	-	-	-	-	-	-	-	N
*Amigo project	-	Y	Y	-	-	-	-	N
*CAMidO	Y (OSGi)	N	N	N	-	-	-	N
*CoCaMAAL	-	N	N	N	-	-	N	N
*ERMHAN	-	N	N	N	-	-	-	N
*HiCon	-	-	-	-	-	-	-	N
*HOMER	Y (OSGi)	Y	Y	Y	10/2013	Y	N	Y
*JACF	-	-	-	-	-	-	-	N
*PERSONA	Y	N	N	N	-	-	-	N
*RCSM	N (802.11)	N	N	N	-	-	-	N
*SOCAM	-	-	-	-	-	-	-	N
*SOPRANO	Y	N	N	N	-	-	-	N

*5W1H	Y	N	N	N	-	-	-	N
An OSGi and agent based control system architecture for smart home	OSGi, UPnP	N	N	N	-	-	-	N
CareStore	-	N	N	N	-	-	-	N
Eclipse-Smarthome	Y	Y	-	Y	05/2014	-	Y	N
i2home	-	N	N	N	-	-	N	N
iLiving								
LinkSmart (HYDRA)	-	-	-	-	-	-	-	N
MoCASH	-	-	-	-	-	-	-	N
MonAMI	-	-	-	-	-	-	-	N
MPOWER	Y	Y	-	-	04/2013	-	N	Y
OASIS	-	-	-	-	-	-	-	N
OpenAAL	Y	Y	Y	Y	07/2013	Y	-	Y
OpenHAB	Y	Y	Y	Y	02/2014	Y	Y	N
OSAmI	-	-	-	-	-	-	-	N
TinySEP	Y	N	N	N	-	Y	-	N
UniversAAL	Y	Y	Y	Y	01/2014	-	N	Y
URC	-	Y	Y	Y	04/2013	-	-	N

There are relations between several platforms / frameworks. openAAL is based, beginning from version 2.0, on universAAL, which in turn has its origin of technology in the PERSONA and MPOWER project. The projects PERSONA and SOPRANO share at least some basic ideas as presented in the conjoint "PERSONA – SOPRANO Workshop."

OpenHAB is also OSGi based and plenty of bindings are already available. Furthermore it was tested on a Raspberry Pi. At the time of writing this document, the eclipse-SmartHome project delivers the latest software developments. Eclipse-SmartHome is based on openHAB.

In this paper, we introduce the design and implementation of innovative and specific mechanisms at the sensory layer middleware which is capable of, first to discriminate spurious motion detections assuming that these signals do not resemble the patterns of real motion detections and, second to reduce the dynamics of messages by a sensor signal processing in order to compress the whole information in one single event. The middleware achieves power saving by modifying the raw information from sensors and adapting it to the predefined semantic of the reasoning layer. It manages the important task of data processing from sensors (raw information), and transfers the

3.2.1 AAliance2

AAliance2	
Description	"AALIANCE2 are the Ambient Assisted Living (AAL) solutions based on advanced ICT technologies for ageing and wellbeing of older persons in Europe. AALIANCE2 has been built upon the successful work and the wide network already established in the AALIANCE Innovation platform" (Source: http://www.aaliance2.eu/projectsummary)
Focus of features	
Downloadable?	
3rd party extension of software possible?	
URL	http://www.aaliance2.eu
Other sources of information	

3.2.2 Amigo Project

Amigo Project	
Description	"The Amigo project develops middleware that dynamically integrates heterogeneous systems to achieve interoperability between services and devices. For example, home appliances (heating systems, lighting systems, washing machines, refrigerators), multimedia players and renderers (that communicate by means of UPnP) and personal devices (mobile phones, PDA's) are connected in the home network to work in an interoperable way. This interoperability across different application domains can also be extended across different homes and locations." (Source: http://www.hitech-projects.com/euprojects/amigo)
Focus of features	
Downloadable?	Y
3rd party extension of software possible?	
URL	http://www.hitech-projects.com/euprojects/amigo
Other sources of information	

3.2.3 CAMidO

CAMidO	
Description	
Focus of features	Context-aware System
Downloadable?	

3rd party extension of software possible?	
URL	http://www.sciencedirect.com/science/article/pii/S0167739X13001544
Other sources of information	Belhanafi, N.; Taconet, C. & Bernard, G. CAMidO, A Context-Aware Middleware based on Ontology meta-model Workshop on Context Awareness for Proactive Systems, 2005, 93-103

3.2.4 CoCaMAAL

CoCaMAAL	
Description	The focus here is on the development of a scalable and context-aware framework and easing the flow between data collection and data processing. The resource-constrained nature of typical wearable body sensors is factored into our proposed model, with cloud computing features utilized to provide a real-time assisted-living service. With the myriad of distributed AAL systems at play, each with unique requirements and eccentricities, the challenge lies in the need to service these disparate systems with a middleware layer that is both coherent and flexible. There is significant complexity in the management of sensor data and the derivation of contextual information, as well as in the monitoring of user activities and in locating appropriate situational services. The proposed CoCaMAAL model seeks to address such issues and implement a service-oriented architecture (SOA) for unified context generation. This is done by efficiently aggregating raw sensor data and the timely selection of appropriate services using a context management system (CMS). With a unified model that includes patients, devices, and computational servers in a single virtual community, AAL services are enhanced.
Focus of features	Context-aware System, Java, unified context generation, cloud
Downloadable?	
3rd party extension of software possible?	
URL	
Other sources of information	Forkan, A.; Khalil, I. & Tari, Z. CoCaMAAL: A cloud-oriented context-aware middleware in ambient assisted living Future Generation Computer Systems, 2013, - Forkan, A.; Khalil, I. & Tari, Z. CoCaMAAL: A cloud-oriented context-aware middleware in ambient assisted living Future Generation Computer Systems , 2013, -

3.2.5 ERMHAN

ERMHAN	
Description	"ERMHAN is a multi-channel context-aware service platform designed to support care networks in cooperating and sharing information with the common goal of improving patient quality of life. In order to meet extensibility and flexibility requirements, this platform has been developed through ontology-based context-aware computing and a service oriented approach."
Focus of features	Context-aware System
Downloadable?	

3rd party extension of software possible?	
URL	
Other sources of information	Paganelli, F.; Spinicci, E.; Mamelli, A.; Bernazzani, R. & Barone, P. ERMHAN: A multi-channel context-aware platform to support mobile caregivers in continuous care networks Pervasive Services, IEEE International Conference on, 2007, 355-360

3.2.6 HiCon

HiCon	
Description	
Focus of features	Context-aware System
Downloadable?	
3rd party extension of software possible?	
URL	
Other sources of information	Cho, K.; Hwang, I.; Kang, S.; Kim, B.; Lee, J.; Lee, S.; Park, S.; Song, J. & Rhee, Y. HiCon: a hierarchical context monitoring and composition framework for next-generation context-aware services Network, IEEE, 2008, 22, 34-42

3.2.7 HOMER AAL platform

HOMER	
Description	HOMER is an open and flexible OSGi-based software platform which aims at the integration of various home automation systems and consequential event and situation recognition for smart home (addressing comfort, energy efficiency, etc.) and Ambient Assisted Living (AAL) applications (addressing safety, autonomy, self-confidence, etc.).
Focus of features	Java OSGi
Downloadable?	Y
3rd party extension of software possible?	Y
URL	http://homer.aaloa.org/
Other sources of information	Fuxreiter, T.; Mayer, C.; Hanke, S.; Gira, M.; Sili, M. & Kropf, J. A modular platform for event recognition in smart homes e-Health Networking Applications and Services (Healthcom), 2010 12th IEEE International Conference on, 2010, 1-6

3.2.8 JACF

JACF	
Description	

Focus of features	Context aware System, Java
Downloadable?	
3rd party extension of software possible?	
URL	
Other sources of information	Bardram, J. Gellersen, H.-W.; Want, R. & Schmidt, A. (Eds.) The Java Context Awareness Framework (JCAF) – A Service Infrastructure and Programming Framework for Context-Aware Applications Pervasive Computing, Springer Berlin Heidelberg, 2005, 3468, 98-115

3.2.9 PERSONA

PERSONA	
Description	The PERSONA project (Perceptive Spaces prOmoting iNdependent Aging) is an EU-funded research project (FP6) that commenced in 2007. It aims at developing a scalable open standard technological platform for building a broad range of Ambient Assisted Living (AAL) services. AAL is the concept that embraces all those technological challenges involved in addressing the problem of population aging in Europe.
	The main technical challenge for PERSONA is the design of a self-organizing middleware infrastructure that guarantees the extensibility of component/ device ensembles in an ad-hoc fashion. In order to achieve this goal, the communication patterns of the infrastructure must be based on distributed coordination strategies for service discovery and utilization.
	The components of a PERSONA system interact using the PERSONA middleware, which allocates a number of communication buses, each adopting specific and extensible communication strategies. Components linked to the PERSONA middleware may register with some of these communication buses; using P2P connections between the middleware instances, instances of the buses collaborate to enable interoperability among components. Currently four types of bus cover the high-level communication needs in AAL spaces: the input bus, the output bus, the context bus and the services bus.
	PERSONA uses a connector-based approach to implement an extensible communication mechanism between distributed instances of the middleware (peers). The current prototype of the PERSONA middleware implemented on the OSGi platform (see Figure 1) uses connectors based on UPnP, Bluetooth and R-OSGi technologies.
Focus of features	
Downloadable?	
3rd party extension of software possible?	
URL	http://www.telemed.no/persona-perceptive-spaces-promoting-independent-aging.541667.html
Other sources of information	Avatangelou, E.; Dommarco, R.; Klein, M.; Müller, S.; Nielsen, C.; Soriano, M.; Schmidt, A.; Tazari, M.-R. & Wichert, R. Mühlhäuser, M.; Ferscha, A. & Aitenbichler, E. (Eds.) Conjoint PERSONA – SOPRANO Workshop Constructing Ambient Intelligence, Springer Berlin Heidelberg, 2008, 11, 448-464

3.2.10 RCSM

RCSM	
Description	
Focus of features	Context Awareness, Adaptive Object Containers
Downloadable?	
3rd party extension of software possible?	
URL	
Other sources of information	Yau, S. S. & Karim, F. A context-sensitive middleware for dynamic integration of mobile devices with network infrastructures Journal of Parallel and Distributed Computing, Elsevier, 2004, 64, 301-317

3.2.11 SOCAM

SOCAM	
Description	
Focus of features	Context Awareness, Java/OSGi
Downloadable?	
3rd party extension of software possible?	
URL	
Other sources of information	Gu, T.; Pung, H. K. & Zhang, D. Q. Toward an OSGi-based infrastructure for context-aware applications Pervasive Computing, IEEE, IEEE, 2004, 3, 66-74 Gu, T.; Pung, H. K. & Zhang, D. Q. A Bayesian approach for dealing with uncertain contexts Advances in Pervasive Computing, 2004, 136

3.2.12 SOPRANO

SOPRANO	
Description	An extensible, open AAL platform for elderly people based on semantical contracts
	"Several initiatives have shown the potentials of applying AI techniques to ambient intelligence in general and ambient assisted living in particular. While these systems succeed in adding "intelligence" to systems, they do not provide the extensibility and openness of products ready for the market. In this paper, we present the SOPRANO approach, which is based on a combination of ontology based techniques and service-oriented device architecture. In this approach, we focus on separating different aspects of the system like sensors & actuators, context information, and system behavior, and provide a framework that clearly defines contracts for different solution contributors utilizing semantic

	technologies."(Source: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.140.4722
Focus of features	
Downloadable?	
3rd party extension of software possible?	
URL	
Other sources of information	Wolf, P.; Schmidt, A. & Klein, M. SOPRANO-An extensible, open AAL platform for elderly people based on semantical contracts 3rd Workshop on Artificial Intelligence Techniques for Ambient Intelligence (AITAmI'08), 18th European Conference on Artificial Intelligence (ECAI 08), Patras, Greece, 2008
	Avatangelou, E.; Dommarco, R.; Klein, M.; Müller, S.; Nielsen, C.; Soriano, M.; Schmidt, A.; Tazari, M.-R. & Wichert, R. Mühlhäuser, M.; Ferscha, A. & Aitenbichler, E. (Eds.) Conjoint PERSONA – SOPRANO Workshop Constructing Ambient Intelligence, Springer Berlin Heidelberg, 2008, 11, 448-464
	Wolf, P.; Schmidt, A. & Klein, M. SOPRANO-An extensible, open AAL platform for elderly people based on semantical contracts 3rd Workshop on Artificial Intelligence Techniques for Ambient Intelligence (AITAmI'08), 18th European Conference on Artificial Intelligence (ECAI 08), Patras, Greece, 2008

3.2.13   5W1H

5W1H	
Description	
Focus of features	Context-aware System, specific smart environment services
Downloadable?	
3rd party extension of software possible?	
URL	
Other sources of information	Oh, Y.; Han, J. & Woo, W. A context management architecture for large-scale smart environments Communications Magazine, IEEE, 2010, 48, 118-126

[BM2]

3.3 Summary

In section 3.2 numerous platforms and frameworks were compared in order to be able to identify the most suitable platform for RelaxedCare. Being able to revert to an existing platform avoids to develop yet another platform (re-inventing the wheel), and resources can be focused on other challenges of the project. Since AAL platforms and frameworks are integral part of AAL projects, the number of published work is considerable. Platforms and frameworks, which are described in more detail, are

listed in Table 2. In order to select an appropriate platform, the most important criterion is availability. It must be noted, that many developments in the research domain did not find to way to public, and developments which stopped at the end of a research project, are outdated already a few years later and lack any support.

After careful consideration of availability of software and support, it was finally decided to choose HOMER.

4 Existing services

4.1 General services building blocks

RelaxedCare has the goal to achieve a system as close as possible to market entry level. Offering customers a holistic system (sensors, services, output devices, and server) requires a considerable effort in development. To increase progress and avoid reinventing the wheel, in this chapter it is analysed what service solutions are readily available on the market or research domain. As displaying (and measuring) the mood of a person is a central topic within the RelaxedCare project, this is also the focus of this chapter. Though it is noted, this deliverable does not cover the scientific foundation of mood recognition, as this is covered in a document dedicated especially for that topic: Deliverable 4.1.

This chapter begins with a section "Available services on the market", which is the introduction to the main-section "Existing mood reporting services," followed by the "Discussion of mood reporting service overview" and ends with the "Summary on existing mood reporting services."

4.2 Available services on the market

There are many existing services on the market that are trying to solve problems related to assisted persons, their informal or formal caregivers. The solutions for helping assisted persons have been on the market for a long time now and usually cover technical aspects of caregiver notifications and alarming in the assisted person home. The list grows longer every day. The assisted persons' home is wired; some sensors are added and connected to the home gateway which communicates with care /alerting centre.

The main disadvantages of three kinds of solutions are:

1. They force assisted persons to stay at home, because technical solutions support them only there

2. Solutions need to redesign the AP's "home"

The Canadian study[4] included recommendations to address the isolation and loneliness issue among older people with the basic suggestion that people should keep in regular contact with older family members, friends and neighbours to ensure that older people feel needed and valued. Widely accessible advances in technology have made staying in touch easier on many different levels. Consider the benefits of large button phones for the visually impaired as well as speech recognition or captioned phones that visually display the caller's speech for the hearing impaired. Another service is built around a device that transmits email messages and photos to recipients without a computer, allowing sending and receiving at any time of day or night and maintaining that all-important connection between family visits.

4.3 Existing mood reporting services

4.3.1 Introduction

A possibility to improve human computer interaction is incorporating context information. Enabling the computer to consider the current temper of the user forms an own domain in research, labelled as emotion recognition and mood recognition. In deliverable D 4.1 an overview on state of the art emotion recognition is provided. In the scope of this chapter, the focus lies on available platforms and services. Below there is a collection of mood reporting tools.

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[4]   http://www.parentgiving.com/elder-care/health-tip/senior-health-tip-14-staying-connected-protects-seniors-from-depression/

4.3.2 Overview

Mood 24/7

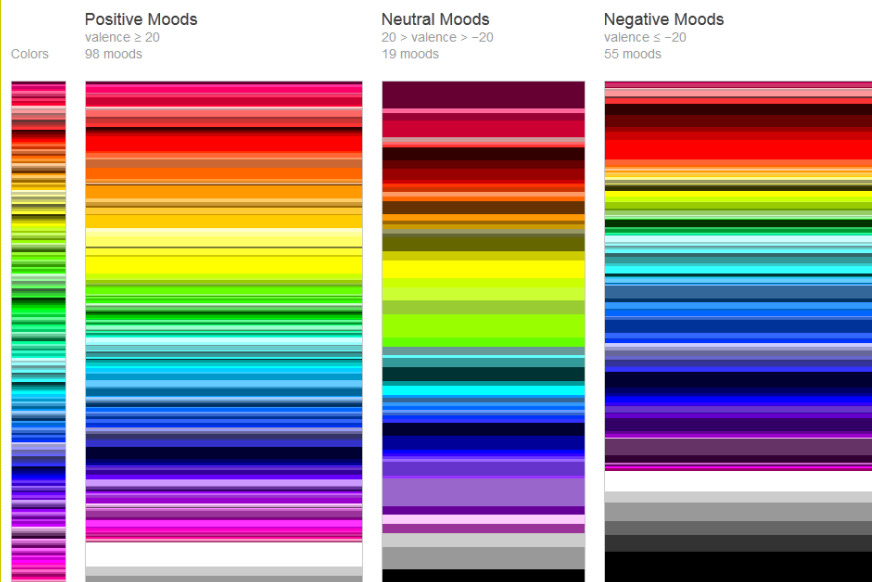| *Mood 24/7*	
Description	Mood 24/7 provides an easy way to record how you're feeling. After registering, Mood 24/7 will ask you how you feel each day via a mobile text message. If you miss a message, Mood 24/7 will send you a reminder later. You can print your chart or share it online with friends, family, or a health professional.
Comment	No information on security measures (database)
Price	"initially free"
OS	Not required (only text messages)
URL	https://www.mood247.com
Other sources of information	http://www.jopm.org/columns/innovations/2011/09/26/just-text-me-using-sms-technology-for-collaborative-patient-mood-charting/

MoodJam

MoodJam	
Description	MoodJam is an online diary that allows people to express their moods and feelings using patterns of color. It has visualizations of your moods and other people's moods. Use MoodJam to: • Keep a record of your moods every hour, day, and weeks—as often as you want, for as long as you want.^ • Visualize your moods in beautiful color strips. • Learn about trends in your moods and colors you associate with specific moods. • Share your moods with friends, family, co-workers, and other people who matter to you.
Comment	Website released in January 2012. Activity and popularity unclear.
Price	free
OS	Non required (website)

URL	http://moodjam.com/about
Other sources of information	http://self.cs.cmu.edu/site/Main/MoodJam

Moody me

Moody me	
Description	- Track your moods whenever, wherever. - Take pictures of what makes you happy or see what makes you sad so you can better manage your mood. - If you're feeling down, play a slideshow of your happy photos for an instant lift! - View a gallery of your mood photos to learn what makes you feel good or bad. - Record events (such as work stress, financial or relationship issues, or menstrual cycles); various symptoms (like anxiety or fatigue); and any treatments you may be taking (including medications) and to see exactly what affects your mood. - See how your mood changes from day-to-day and month-to-month with colourful graphs. - See how your mood trended over the last 90 days to get the big-picture view. - Calendar view quickly shows how you were feeling on a given day and what influenced your mood. - Post questions and get answers to your mood concerns in MedHelp's free support communities. - Whether you're managing a mood disorder or just want to see how you're feeling, Moody Me can help!
Comment	-
Price	Free
OS	iOS (App)
URL	Moody Me - Mood Diary and Tracker. See AppStore: https://itunes.apple.com/ch/app/moody-me-mood-diary-tracker/id411567371?mt=8
Other sources of information	-

Twitter

Twitter	
Description	Twitter is an information network made up of 140-character messages called Tweets. It's an easy way to discover the latest news related to subjects you care about. Twitter contains information you will find valuable. Messages from users you choose to follow will show up on your home page for you to read. It's like being delivered a newspaper whose headlines you'll always find interesting – you can discover news as it's happening, learn more about topics that are important to you, and get the inside scoop in real time.
Comment	Twitter, in some sense could be called a social app of mood. Given its use as a light communication presence application, many find it practical and easy to update how they feel.
Price	Free
OS	No required (website)
URL	http://www.twitter.com/
Other sources of information	-

Facebook

Facebook	
Description	Facebook is an online social networking service. Users must register before using the site, after which they may create a personal profile, add other users as friends, exchange messages, and receive automatic notifications when they update their profile. Additionally, users may join common-interest user groups, organized by

workplace, school or college, or other characteristics, and categorize their friends into lists such as "People From Work" or "Close Friends".

Facebook offers the possibility to "share how you're feeling or what you're doing with an icon in a status update."

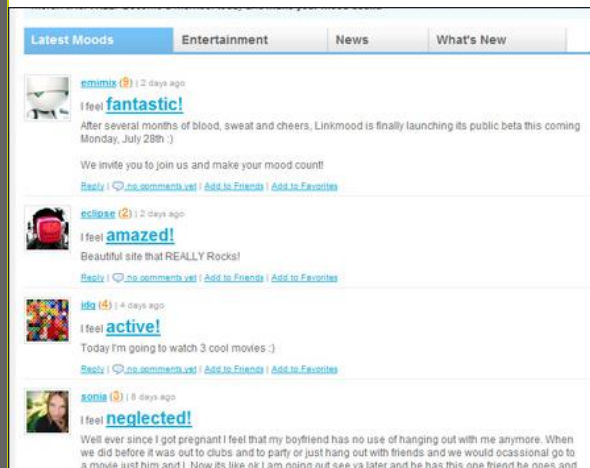|	
Comment	-
Price	Free
OS	Not required (website)
URL	http://www.facebook.com
Other sources of information	-

Skype

Skype	
Description	Skype is a voice over IP tool offering additional possibilities, such as text messages, call forwarding, file transfers and chat. Furthermore it provides a field "mood message", in which the user can add to his profile (visible to all contacts) a short text.
Comment	-
Price	Freemium
OS	Windows, MAC, Linux
URL	http://www.skype.com

Other sources of information	https://support.skype.com/en/faq/FA12111/how-do-i-update-my-status-mood-message-and-profile-picture-in-skype-for-modern-windows

LinkMood

LinkMood	
Description	-
Comment	The website is not online. All information is retrived from 3rd parties.
	Twitter, in some sense could be called a social app of mood. Given its use as a light comms. presence application, many find it practical and easy to update how they feel.
	A similar service is the newly launched LinkMood. LinkMood is a social community dedicated to sharing moods, of course. Basically, it's Twitter with more social features. Users can easily update their feelings– without a 140 character cut-off— they can participate in conversations, make new friends, and catch up with the latest entertainment and international news. Users can browse through messages by mood; their own messages are compiled under the section headed 'My Mood'. Members also get their very own profile pages where they can manage their moods and friends. The site is free to join.
Price	n/a
OS	Not required (website)
URL	http://www.linkmood.comhttp://www.linkmood.com (website down)
Other sources of information	LinkMood introduced by http://www.killerstartups.com/social-networking/linkmood-com-its-all-about-how-you-feel/ was not online (12th Dec 13) at http://www.linkmood.com

Happiness

Happiness	

Description	Track your happiness to become more self-aware and make better decisions in your life.

Journal

- Go beyond your inner dialogue and start finding patterns.

- Becoming mindful of your current emotional state is a good habit to adopt.

- Sometimes it's just helpful to write things down.

- Tagging your entries opens up new ways to explore your feelings over time.

- Keeping a record of when you're happy means that when you hit hard times you have a place to go to remember things.

Reminders

- It's an app that asks you how you are.

- Don't just learn about the times in your life when you happen to feel like using an iPhone app. Record your life while you're living it.

- Reminders come at random based on your preferences. A daily prompt works best but if you want to be asked every hour you can have that too.

- The app starts up quickly and your phone will be back in your pocket before you know it.

Comment	-
Price	-
OS	iOS

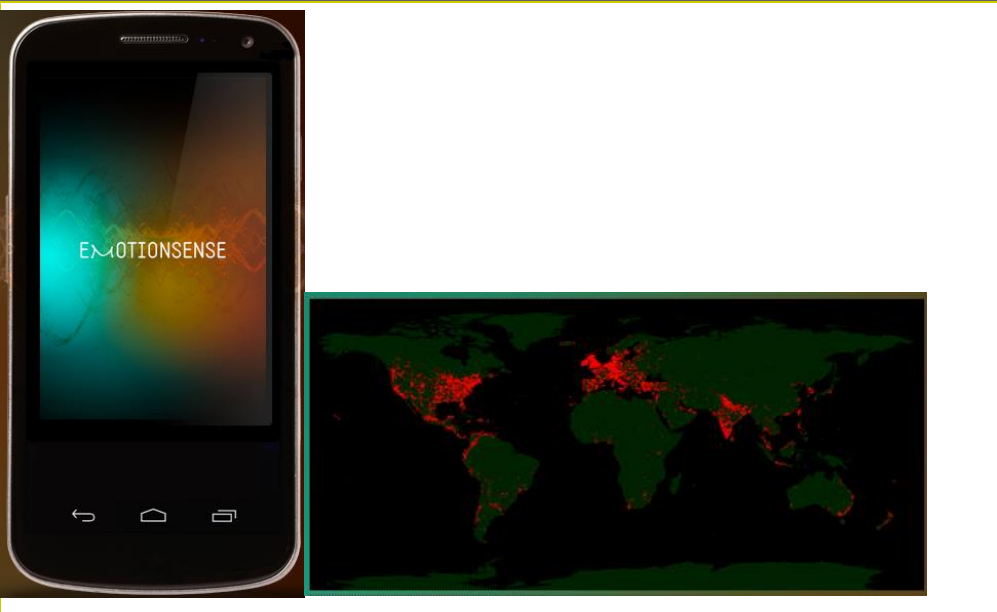| URL	http://goodtohear.co.uk/happiness
Other sources of information	-

My Mood Tracker

My Mood Tracker	
Description	MyMoodTracker is an iPhone and iPod Touch app for recording your mental state and the factors that influence your mood. Keeping track of how you are feeling is an important step towards improving your mental health and wellbeing. MyMoodTracker provides a quick and easy recording mechanism which is with you wherever you go. If you want to start feeling better every day, MyMoodTracker can help get you there.
Comment	-
Price	5 CHF
OS	iOS
URL	http://www.mymoodtracker.com/
Other sources of information	http://tech.co/best-habit-and-mood-tracking-apps-2013-08

T2 Mood Tracker

T2 Mood Tracker	
Description	T2 Mood Tracker is a mobile application that allows users to monitor and track emotional health. Originally developed as a tool for service members to easily record and review their behaviour changes, particularly after combat deployments, it has now become very popular with many civilian users around the world.
	The app records a range of emotions for anxiety, depression, head injury, stress, posttraumatic stress and a user's general well-being. Users can also create items to track their progress in unique areas. The saved results are displayed in an easy-understand graph. The data is saved in a graphical or spreadsheet file which can be transferred by e-mail or other wireless connection.
	T2 Mood Tracker received first place in the "General Wellness" category during the Apps4Army (A4A) competition.
Comment	-
Price	Free
OS	Android
	iOS
URL	http://www.t2.health.mil/apps/t2-mood-tracker#.Ug5GmZLVCSo
Other sources of information	http://tech.co/best-habit-and-mood-tracking-apps-2013-08

Emotion Sense

Emotion Sense	
Description	Emotion Sense is an Android application that lets you explore how your mood relates to the data that your smartphone can invisibly capture as you carry it throughout the day.
Comment	-
Price	Open-source
OS	Android
URL	http://www.emotionsense.org/code.html
Other sources of information	http://tech.co/best-habit-and-mood-tracking-apps-2013-08

movisensXS

movisensXS	
Description	eXperience Sampling for Android!
	movisensXS is the next generation research tool for ambulatory assessment. Ambulatory assessment refers to the use of computer-assisted methodology for self-reports, behavior records, or physiological measurements, while the participant undergoes normal daily activities. This approach includes the experience sampling method (ESM) a.k.a. ecological momentary assessment (EMA).
Comment	-
Price	per device and number of results, ranging from 0 – 10000 EUR
OS	Android
URL	https://xs.movisens.com/
Other sources of information	-

Open Data Kit

Open Data Kit	

Description	Open Data Kit (ODK) is a free and open-source set of tools which help organizations author, field, and manage mobile data collection solutions. ODK provides an out-of-the-box solution for users to:
	Build a data collection form or survey (XLSForm is recommended for larger forms);
	Collect the data on a mobile device and send it to a server; and
	Aggregate the collected data on a server and extract it in useful formats.
	In addition to socio-economic and health surveys with GPS locations and images, ODK is being used to create decision support for clinicians and for building multimedia-rich nature mapping tools. See the list available tools, featured deployments, and implementation companies for more examples of what the ODK community is doing.
	We welcome and encourage participation from the user community. ODK is supported by a growing community of developers, implementers and users as well as various companies. Core ODK development is supported by ongoing research at the University of Washington's Department of Computer Science & Engineering and through donations from users.
Comment	-
Price	Free, open source
OS	Windows, MAC OS, Linux
URL	http://opendatakit.org/
Other sources of information	-

iDialogPad

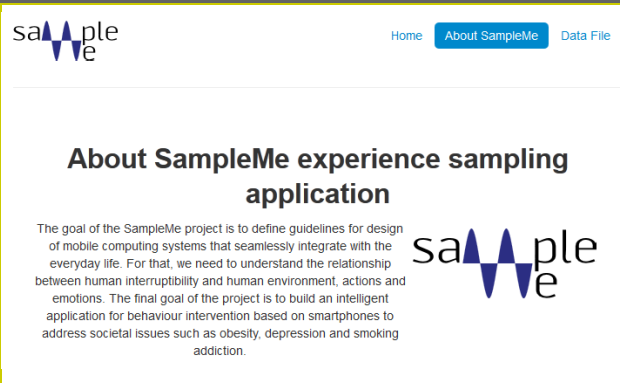| **iDialogPad**	
	IDIALOGPAD

The iDialogPad software developed by Gerhard Mutz of Cologne University (Germany) is iOS-based and, hence, only runs on Apple mobile devices. Rudimentary features for cognitive testing are available, and GPS is supported (if available for a given device). Compared to other recent software, the programming is done in an "old school" way using scripts fed into the mobile clients. The iDialogPad software is currently being used in Germany in a large, multicenter trial on computer-assisted treatment of panic disorder. |
Description	Rudimentary features for cognitive testing arte available, and GPS is supported (if available for a given device). Compared to other recent software, the programming is done in an "old school" way using scripts fed into the mobile clients. The iDialogPad software is currently used in Germany in large, multicenter trial on computer-assisted treatment of panic disorder. The iDialogPad software is developed by Gerhard Mutz of Cologne University Germany).
Comment	-
Price	n/a
OS	iOS
URL	n/a
Other sources of information	Conner, T. S.
Experience Sampling and Ecological Momentary Assessment with Mobile Phones
University of Otago, New Zealand, **2013**
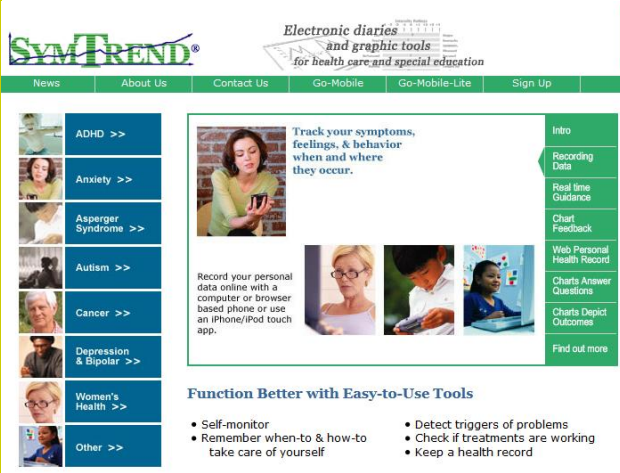
Handbook of Research Methods for Studying Daily Life

Survey Anyplace

Survey Anyplace	
Description	You can invite respondents to take your mobile survey or quiz a few different ways: • Invite people to take the survey or quiz using your device(s). Just add the survey/quiz icon to the home screen of the device(s), which can be smartphones or tablets, to enable direct and full-screen access. • Invite people to take the survey or quiz on their own devices. Publish or display the QR Code and an Installation Link in the vicinity or on a site where people are experiencing the product or service. • Or you can combine both approaches. For example you could offer tablets to audience members without smartphones. Respondent info including name, e-mail address, etc., and survey or quiz responses are received through mobile devices and sent to a secure Survey Anyplace web app for easy access. The tool runs on all types of mobile devices. There is even a special version with slightly reduced functionality for older, non-touch phone types. Off-line operation is supported on Apple iOS, except for video and audio. Respondents need to be connected to the internet to stream.
Comment	-
Price	price per month 29 USD (max. 400 responses)
OS	Android iOS
URL	PlayStore/AppStore
Other sources of information	-
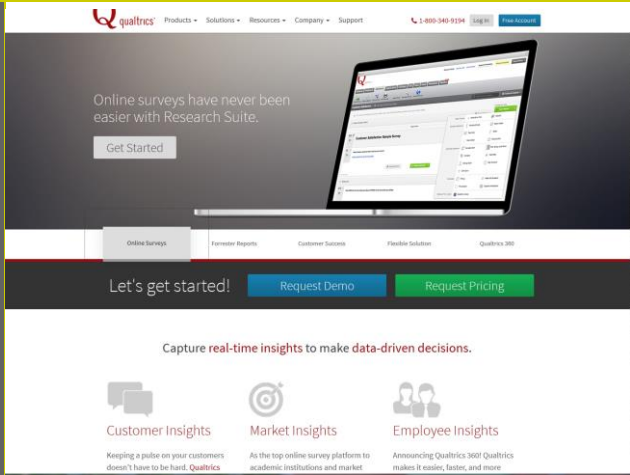
SampleMe

SampleMe	
Description	SampleMe mobile phone application prompts users to fill out a brief questionnaire at random time periods. At the same time that the questionnaire is prompted, the application logs the GPS location, phone's accelerometer, and the information about collocated Wi-Fi and Bluetooth devices. The questionnaire contains information about user's attitudes towards being interrupted, his/her emotions and actions. The questionnaire answers are paired with the sensed data and stored on a secured server. The analysis of this data will allow us to infer the best times to deliver a piece of information to an individual's phone. This application is primarily used as a research tool, and we **do not plan to release it on Google Play or support it as an open source project.**
Comment	Users interested in this software are directed to EmotionSense (see above).
Price	n/a
OS	Indirectly mentioned: Android (App)
URL	None dedicated to project.
Other sources of information	Source: http://www.cs.bham.ac.uk/~pejovicv/SampleMe/about.php and Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

SymTrend

SymTrend	
Description	Function Better with Easy-to-Use Tools • Self-monitor • Remember when-to & how-to take care of yourself • Detect triggers of problems • Check if treatments are working • Keep a health record
Comment	-
Price	11 USD / year
OS	iOS
URL	AppStore
Other sources of information	https://www.symtrend.com/tw/public/index_standard and Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

Qualtrics

Qualtrics	
Description	Customer Insights

Keeping a pulse on your customers doesn't have to be hard. Qualtrics survey software makes it easy to track customer satisfaction, loyalty, and feedback.

- Customer Satisfaction Surveys
- Voice of the Customer
- Website Feedback Surveys |
| Comment | - |
| Price | n/a |
| OS | Android

iOS

Webapp |
| URL | http://www.qualtrics.com/ |
| Other sources of information | Conner,   T.   S.
Experience Sampling and Ecological Momentary Assessment with Mobile Phones
University of Otago, New Zealand, **2013** |

ilumivu

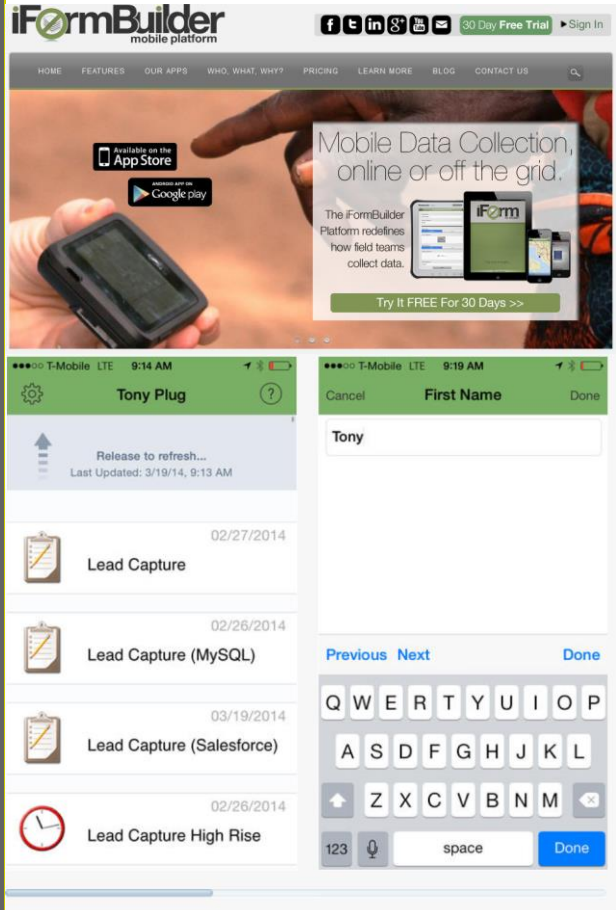| *ilumivu*	
Description	We can help you easily and quickly implement large, multi-modal, global surveys online. Whether you are using standardized measures or your own questionnaires, taking a one-time sample, following a cohort over years or providing a survey in multiple languages the ilumivu System makes it simple to quickly start gathering large datasets. Your ilumivu System will be customized for your specific needs and can be used for multiple projects simultaneously. Your logos and color scheme can be used to make the survey site appear to be seamlessly integrated with your own current site or as a stand-alone site specific to this particular project.
Comment	-
Price	n/a
OS	iOS
URL	http://www.ilumivu.com/index.php?section=1&chapter=2
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

iFormBuilder

iFormBuilder	
Description	iFormBuilder brings business grade, offline data collection to iPhones, iPads and iPod Touches. Key Benefits: • Quick turn-around with over-the-air form distribution • Real time data upload • Offline data collection (out of service, no Wi-Fi) • Ensures accurate data capture and eliminates redundancy • Immediately communicate changes and updates to your mobile workforce with server assignment and client-to-client assignment • Massively scalable • Maximum security (being used by HIPAA and FISMA regulated projects)
Comment	-
Price	2000 USD for 10 devices / 50 – 500 USD/month
OS	iOS
URL	https://itunes.apple.com/us/app/iform/id378502270?mt=8 http://www.iformbuilder.com/

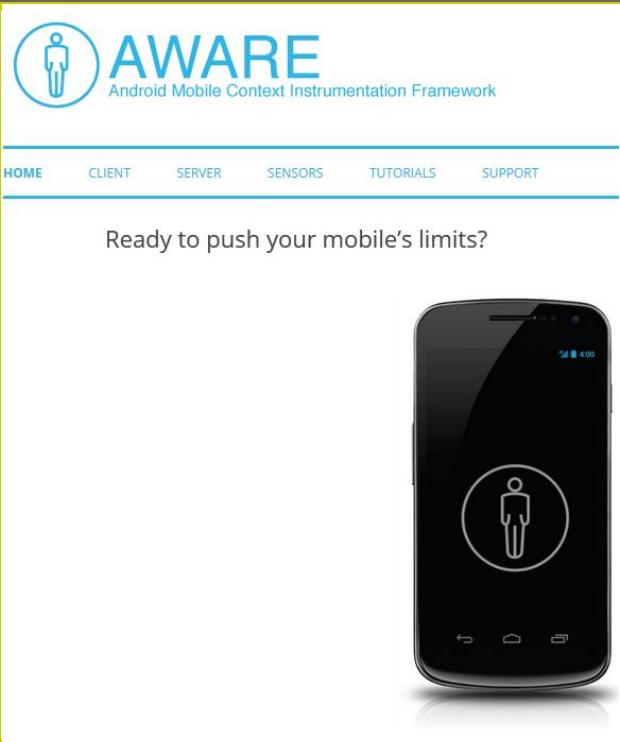| Other sources of information | Conner, T. S.
Experience Sampling and Ecological Momentary Assessment with Mobile Phones
University of Otago, New Zealand, 2013 |

AWARE

AWARE	
Description	AWARE is an Android framework dedicated to instrument, infer, log and share mobile context information, for application developers, researchers and mobile phone users. The framework is scalable, where **AWARE Add-ons** take form as Context Plugins and Context Sensors. The framework is event-driven and power-efficient. **Personal use**: No programming skills are required. A context dashboard allows users to enable or disable context information, for each context source individually. The data is saved locally on your mobile phone. Privacy is enforced by design, so AWARE does not log personal information, such as phone numbers or contacts information. You can additionally install AWARE Add-ons that will further enhance the capabilities of your device, built-in with the **AWARE Client**. **Researchers**: Running a mobile related study has never been easier. Install the **AWARE Client** on the participant's phone, select the data you want to collect and that is it. However we give you more: add **AWARE Server** to the mix, and you can request your participants' data, check participation and remotely request mobile ESM (Experience Sampling Method) questionnaires from the **AWARE Server Dashboard**, anytime and anywhere. **Application Developers**: Nothing is more stressful than to interrupt a mobile phone user at the most unfortunate moments. AWARE provides application developers with user's context using **Context Providers**, **Context Observers** and **Context Broadcasts.** AWARE is available as an Android library, where context is inherently **shared on the operating system** level, thus empowering richer context-aware applications for the end-users.
Comment	-
Price	open-sourced under GPLv3 copyright license
OS	Android

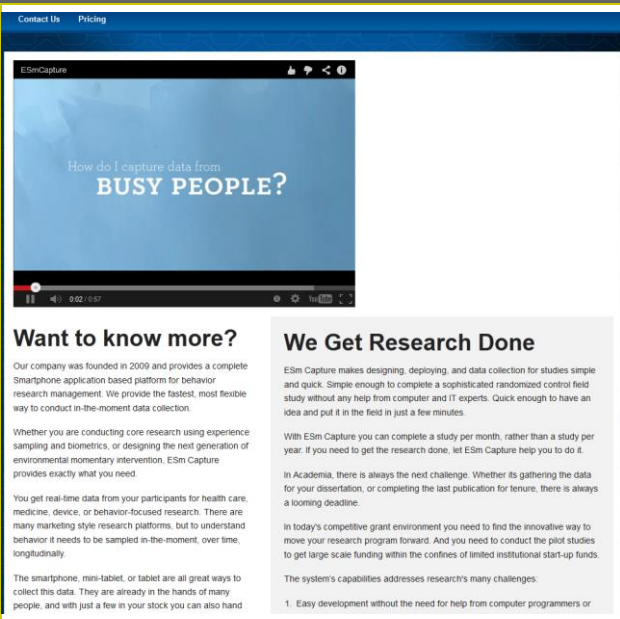| URL	http://www.awareframework.comhttp://www.awareframework.com
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

iHabit

iHabit	
Description	iHabit™ is an "Ecological Momentary Assessment" (EMA) application. It's like a survey—but better. Instead of asking people about their experiences days or weeks after they've occurred, iHabit ™ asks people about their experiences now. Instead of asking people "How much do you smoke?", iHabit™ asks them: "Have you smoked in the last hour?" using their iPhone ™ to pose a few questions. It's a survey that asks people about their experiences in the moment, or close in time to the moment. It's the EMA way of doing things.
Comment	-
Price	Beginning with 2200 USD for 100 users (for colleges and universities)
OS	AppStore
URL	http://ihabit4life.com/
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones University of Otago, New Zealand, 2013

ESm Capture

ESm Capture	
Description	The system's capabilities addresses research's many challenges:
	Easy development without the need for help from computer programmers or Information Technology know-it-alls.
	Nearly effortless deployment of your survey onto nearly every smartphone, mini-tablet, and tablet available.
	Real-time data collection so you know every response recorded and every scheduled event missed.
	Flexible scheduling of data collection that can include self-triggered, scheduled, or randomized sampling.
	Cost effective with total costs well within local grant budgets.
	Easily create and compare interventions and controls.
Comment	-
Price	25 USD / user
OS	Android
	iOS
URL	http://esmcapture.comhttp://esmcapture.com
Other sources of information	Conner, T. S.
	Experience Sampling and Ecological Momentary Assessment with Mobile Phones
	University of Otago, New Zealand, **2013**

iSurvey

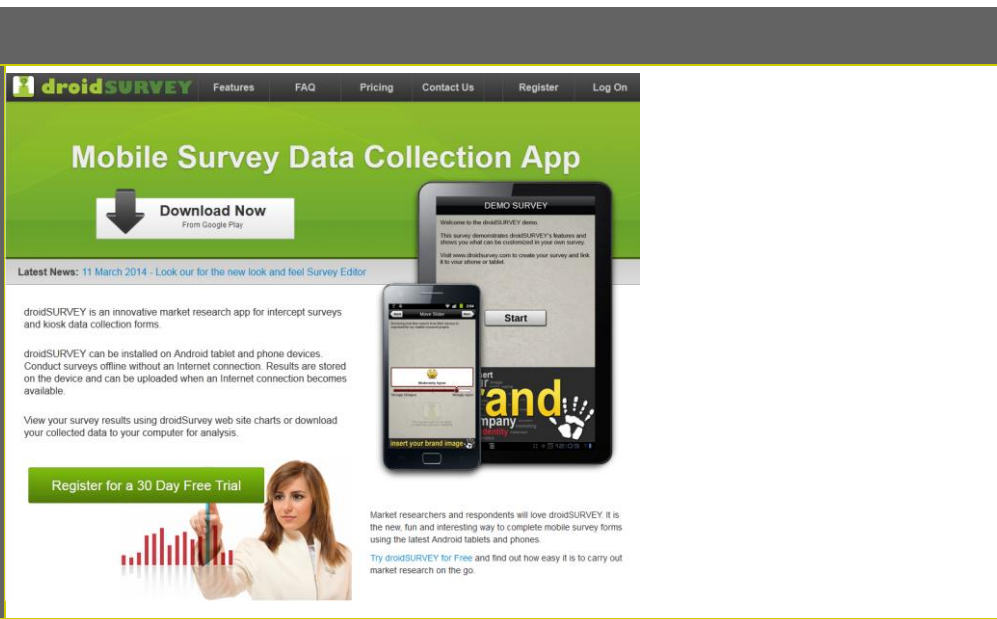| *iSurvey*	
Description	Description: • Step 1 - Register and create your survey online using our fast and intuitive survey questionnaire creation tool. • Step 2 - Download the iSURVEY app from the App Store on to your iPod Touch, iPad or iPhone. (Download droidSURVEY for Android devices) • Step 3 - Collect questionnaire survey results offline on your iPod Touch, iPhone, iPad or Android devices. • Step 4 - Export results and analyze data on your desktop using your favourite statistical program.
Comment	-
Price	65 EUR/month
OS	Android iOS
URL	https://www.isurveysoft.com/
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* 2013

droidSurvey

droidSurvey	
Description	• Step 1 - Sign up for a user account on the droidSURVEY website. Login and create your survey.
	• Step 2 Download the droidSURVEY app from Google Play on to your device and link your newly created survey to your Android device.
	• Step 3 - Conduct mobile surveys on one or multiple Android devices.
	• Step 4 -Download results from your Android device to your computer for analysis.
Comment	-
Price	65 EUR per month
OS	Android
URL	https://www.droidsurvey.com/
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones University of Otago, New Zealand, 2013

PACO

PACO	
Description	What is PACO good for?
	Many types of mobile experiments!
	Quantified Self
	Ever wonder how happy you are? Whether your weight is trending up or down? Do you want one place to manage the data and reminder scheduling for all your mobile exercise trackers, weight trackers, baby's bowel movement trackers, fuel consumption trackers?
	Mobile Population Studies - Wellness, Corporate environment, or Whatever
	Ever want to design, iterate, and deliver a social science experiment or mobile wellness intervention to a group of people on Android mobile phones in a matter of minutes? (You social and behavioral scientists out there know who you are.)
	User Control of Data
	Do you want to be able to correlate your data across multiple trackers?
	Do you want your data kept private and under your control? With informed consent about what you are sharing and with whom?
Comment	-
Price	free, Apache License 2.0
OS	Android
URL	https://quantifiedself.appspot.com/main.jsp
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

ESP

ESP	
	Home	About ESP	Download	Documentation	FAQ **ESP: The Experience Sampling Program** ESP is a FREE, open-source software package for running questionnaires, surveys, or experiments on a Palm Pilot or compatible handheld computer. ESP asks questions of your participants and records their answers and their response times. The data may later be uploaded to a computer for analysis. ESP is quite configurable. The expermenter determines the questions, their order, how often to run trials, whether trials occur at predetermined or random times, and so forth. All these changes (and more) are possible without doing any computer programming, just by running our configuration tool, ESP Desktop. The current version of ESP is **4.0**.
Description	ESP, the Experience Sampling Program, is a FREE, open-source software package for running questionnaires, surveys, or experiments on a Palm Pilot or compatible handheld computer. ESP, the Experience Sampling Program, is a FREE, open-source software package for running questionnaires, surveys, or experiments on a Palm Pilot or compatible handheld computer.
Comment	-
Price	Free
OS	Palm
URL	http://www.experience-sampling.org/
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

Purple Robot

Purple Robot

Description	Purple Robot is a sensing and scripting application that enables the creation of context-aware behavioral interventions and experiences.
	Purple Robot includes a full on-device sensor suite as well as embedded scripting environment exposed via an HTTP API that allows companion apps (native and web-based) full access to the sensor and trigger functionality.
	OS:
	Android
	Price:
	Open source: https://github.com/cbitstech/Purple-Robot-Manager
Comment	-
Price	Open source
OS	Android
URL	https://github.com/cbitstech/Purple-Robot-Manager
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones University of Otago, New Zealand, 2013

SurveySignal

SurveySignal	
Description	SurveySignal is a powerful study management and messaging (SMS /EMAIL) application. Registering an account is free, no monthly costs. Numerous study and panel administration tools. Unlimited Number of survey projects.
	Distribute your survey via SMS. Works on all smartphones with text messaging (SMS) capability and internet access. Built-in phone registration and verification process.
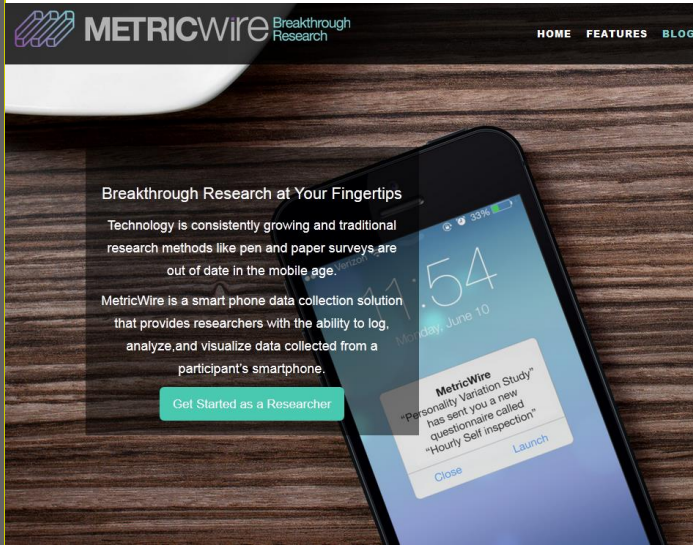
	OS:
	smartphone with internet access
	Price:
	10€ / signal
Comment	-
Price	10€ / signal
OS	smartphone with internet access
URL	http://www.surveysignal.com/
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

Funf Open Sensing Framework

Funf Open Sensing Framework	
Description	The Funf Open Sensing Framework is an extensible sensing and data processing framework for mobile devices, supported and maintained by Behavio. The core concept is to provide an open source, reusable set of functionalities, enabling the collection, uploading, and configuration of a wide range of data signals accessible via mobile phones. - See more at: http://www.funf.org/about.html#sthash.EBO3vpqJ.dpuf Study Managers/Researchers Use Funf as a ready-made platform for conducting data collection experiments ranging from health and wellness, social and psychological studies, tracking what apps users are running on their phones, or testing the battery effects of your Android app. Install Funf as a pre-compiled app on the phones you want to test. Set up the data-collection back-end server, remotely configure the desired sensors and data collection behavior, and set up optional components like user surveys.
Comment	-
Price	open software
OS	Android

	collected data via dropbox to users
URL	http://www.funf.org/about.html
Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

MetricWire

MetricWire	
Description	MetricWire gives researchers complete creative control over the design of their study. Our user-friendly interface allows researchers to design and deploy their study within minutes; no coding necessary. MetricWire makes smartphone research easy. In the moment insights MetricWire provides deep, qualitative, in-the-moment insights into the everyday activities of your participants: a distinct advantage over traditional research methods like pen and paper or online surveys. Multiple Question Types The platform allows you to add multiple question types such as: text, multiple choice, checkboxes, sliding scale, multimedia, e-mail, date, time, phone number, and more DIY Geofencing There's no need to work with a developer when you can point, click and set variables yourself with our easy to use geo-fence platform. Get the most advanced features in smartphone research, right at your fingertips!
Comment	-
Price	n/a
OS	Android iOS
URL	https://metricwire.com/

Datafield

Datafield	
Description	Datafield enables you to shift from paper-based forms to digital (mobile) forms. Create beautiful forms and surveys in seconds and have respondents instantly and remotely reply and fill-in the requested information on smartphone and tablet- even when they are offline. 3 simple steps to use Datafield: 1- Compose your forms and survey on Data-field website using any kind of questions, including text based or multiple choices but also media rich questions such as GPS location, pictures and more. 2- Your customers, prospects, field workers or targeted audience access and process your forms instantly 3- You'll receive responses in real time with a smart, web-based, dashboard allowing your to filter by location, profiles, pictures or else. Easy CSV import is also available.+
Comment	-
Price	10 - 200 USD/month
OS	iOS
URL	http://www.data-field.com/ https://itunes.apple.com/us/app/datafield/id470573506?ls=1&mt=8

Other sources of information	Conner, T. S. Experience Sampling and Ecological Momentary Assessment with Mobile Phones *University of Otago, New Zealand,* **2013**

4.4 Discussion of mood reporting service overview

The demand for mood reporting tools is reflected by the existence of different platforms either especially dedicated for mood reporting, or the broader social web services offer a mood reporting as integral part of their GUI.

In order to allow simplified comparison of the services found, Table 3 categorizes them based on:

- Type of user interface
  What device is used for reporting mood?

- Self-reporting
  Is it a service/tool which relies on the user to input her/his mood?

- Active reminder for reporting
  Is the device/tool actively asking the user to fill out a mood report?

- Resolution of mood scale
  Are there only 3 emoticons, or is there free text to be entered by the user?

- Frequency of reports
  How often are reports expected from the end user?

- Availability
  Is the project still alive, and if so, is it available?

  API for own extensions
  Is the service open for 3rd party modifications through APIs?

Table 3 - Overview on mood reporting tools

Name	(End-) user-interface	Self reporting?	Active reminder for reporting?	Resolution of mood scale	Frequency of reports	Availability	API for own extensions?
Mood 24/7	Mobile / Text	Y	Y	Scale 1-10, plus annotations	daily	US market, free (phone bill?)	-
Moody Me	Mobile / App	Y	N	Emoticons and photo annotations	Det. by end user	iPhone only, free	-
LinkMood	Webservice	Y	N	Text	Det. By end user	URL not available	-
MoodJam	Webservice	Y	N	Colours, text annotations	Det. By end user	Available, free	-
Skype	Webservice	Y	N	Text, Emoticons	Det. By end user	Available, free	Y
Twitter	Webservice	Y	N	Text, Emoticons	Det. By end user	Available, free	Y
Facebook	Webservice	Y	N	Text, Emoticons	Det. By end user	Available, free	Y

Happiness	Mobile/App	Y	Y	Text	Det. By end user	Available abt. 5 USD	-
MyMoodTracker	Mobile/App	Y	-	Scales	Det. By end user	Available abt. 5 USD	-
T2 Mood Tracker	Mobile/App	Y	-	Scales	Det. By end user	Available, free	-
Emotion Sense	Mobile/App	Y	Y	Survey	Several times a day or det. by end user	Available, free	-
movisensXS	App	Y	-	Scales, Text	-	Available 0 – 1000 EUR	-
Open Data Kit (ODK)	Webservice	Y	N	Survey	Det. By end user	Available, free	Y
iDialogPad	App	-	-	-	-	Not available	-
Survey Anyplace	WebApp	Y	N	Survey	-	Available, 29 USD / 400 responses	N
SampleMe	Mobile/App	Y		-	Random	Not supported anymore	-
SymTrend	Mobile/App	Y	-	-	-	Available, 11 USD/year	-
Qualtrics survey	WebApp	Y	-	Survey	-	Available	-
mEMA	App	Y	-	Survey	-	Available, free	-
iFormBuilder	App	Y	-	Survey	-	Available, 50 -500 USD/month	-
AWARE	Framework	Possible	Possible	-	-	Available, free	Y
iHabit™	App	Y	Y	Survey	Scheduled, or random	Available, free	-
ESm Capture	App	Y	-	-	-	Available, 25 USD / user	-
iSURVEY	App	Y	-	-	-	Available, 65 EUR / month	-
droidSURVEY	App	Y	-	Survey	-	Available, 65 EUR / month	On request
PACO	App	Y	Y	Survey	Scheduled, or random	Available, free	-Y
ESP	App (Palm)	Y	-	-	-	Available, free	Y

Purple Robot	Android sensor Framework	Possible	Possible	-	-	Under development, available	Y
SurveySignal	Mobile	Y	Y	SMS/email	Scheduled, or random	Available, 10 €/SMS	N
Funf	Android sensor Framework	Possible	Possible	-	-	Available, free	Y
MetricWire	App	Y	-	Survey	-	Available, price ?	N
Datafield	App	Y	-	Survey	-	Available, 10 USD/month	N

Privacy must be considered in ambient assisted living applications. Therefore, Table 4 lists whether the services provide data encryption preventing the provider from using the data, whether there is end to end encryption (in the context of RelaxedCare, end2end means: from assisted person to care giver(s)) and whether the data access can be limited to certain other end users by managing the granting access rights.

Table 4 - Overview Data protection related to overview on mood reporting tools, data protection

Name	Data encryption prevents provider from using data	End to end encryption	Data access rights grantable for specific users
Mood 24/7	-	N	Y
Moody Me	-	N	Y
LinkMood	-	N	Y
MoodJam	-	N	-
Skype	-	Y	Y
Twitter	N	N	Y
Facebook	N	N	Y
Happiness	-	-	-
MyMoodTracker	-	-	-
T2 Mood Tracker	-	-	-
Emotion Sense	N	-	N
movisensXS	N	Y	N
Open Data Kit (ODK)	-	-	-
iDialogPad	-	-	-
Survey Anyplace	-	?	-
SampleMe	N	?	N
SymTrend	-	-	-
Qualtrics survey	-	-	-

mEMA	-	-	-
iFormBuilder	Y	Y	Y
AWARE	Possible	Possible	Possible
iHabit™	-	-	-
ESm Capture	-	-	-
iSURVEY	-	-	-
droidSURVEY	-	-	-
PACO	N	-	-
ESP	-	-	-
Purple Robot	-	-	-
SurveySignal	-	-	-
Funf	Possible	Possible	Possible
MetricWire	-	-	-
Datafield	-	-	-

However, there are several self-reporting services, or perhaps a beginning culture of mood self-reporting on social networking services, no application is standing out as appropriate platform for RelaxedCare. Limitations are closed source codes and questionable implementation of privacy aspects in finished applications, or low level frameworks are available, which require a considerable amount of implementations work.

4.5 Summary on existing mood reporting services

Although self-reporting methods to detect mood (SRM) have known limitations, (see. Deliverable 4.1), they have the advantage to be relatively simple to implement. As the search for existing self-reporting tools shows, the smartphone is identified as very valuable human-machine interface for self-reporting. At least from the technical perspective it offers the possibility of being able to distribute questionnaires to a great number of participants instantaneously. Additionally, the participants can be surveyed not days or hours after an event (e.g. mood swing), but they can report as it happens, which could increase the quality of their assessment of the situation.

A very interesting opportunity for the RelaxedCare system would be the ability to detect the mood of the AP. Since a literature research could not convey a reliable method for mood detection into the focus – other than self-reporting. Consequently, in this deliverable the existing self-reporting tools are surveyed.

Software for that purpose is available. Depending on how to define software for SRM, the options range from smartphone apps (e.g. Moody Me,Happiness, My Mood Tracker, etc.), over tools for surveys (ilumivu, EsmCapture, iSurvey, etc.), to software-development-kits allowing own development of survey tools (sometimes including the readout of smartphone's sensors (e.g. Open Data Kit, AWARE, Purple Robot, etc.). Even websites such as Facebook, Twitter or software like skype could be utilised as infrastructure for exchanging mood.

The vast number of available software for experience sampling and ecological momentary assessment renders a complete survey of all tools as impracticable. The list of software provided in a previous chapter can only be a sample of the whole SRM software population. Therefore the software from the survey is grouped in Table 3. It shows, on what user interface a particular software relies, whether self-reporting is possible, if active reminders are featured (i.e. the end user is

reminded by means of sound and/or vibration/text/etc. reminded to report her mood), the resolution of the mood scale, how often self-reports are possible, availability of the software and whether APIs are offered. Based on the information provided in the table, the software platform PACO is rated very high. Their developer claims to be able to provide a mobile platform for behavioural experiments without the need for programming. Since it is an ongoing development project based on GitHub, it is also open-source and free. Although the information available on PACO does not focus very much on data protection or privacy (see Table 4) it makes comparison to other tools (which lack the same description) hard. However it is unclear how PACO handles data, the freely available server and client software could be integrated in the RelaxedCare system as follows: The PACO-server should be installed on the hardware for the local HOMER server. In that case the data gathered at home would be sent to the local server, where it could be accessed by an API from HOMER. While this seems feasible from a technical standpoint of view, the effort to set up the PACO platform and develop an API must not be underestimated. Furthermore, the data security on the smartphone is still unclear and its verification will cost additional effort. Still, the risk of finding not acceptable data handling on the side of the smartphone must lead to the question, whether the know-how available in the consortium would make an own development less demanding in terms of efforts to invest.

5 Existing systems/products (combined platform and service)

5.1 Overview

In this chapter we are introducing some of combined platforms and services which are already on the market. They provide a holistic approach and offer a whole service to user, regardless of the user role: AP, IC (formal, informal), Medical.

5.2 Available systems/products on the market

5.2.1 BeClose

BeClose	
Description	BeClose is an innovative aging in place technology that helps residents, families and caregivers stay in touch. Using discreet wireless sensors placed in the home, including a wearable alert button, BeClose tracks your loved one's daily routine. You'll know they are okay because you will be able to check on them at any time using a private, secure web page. And, if there are any disruptions, you will be alerted in real time by phone, email, or text message. Because everything is wireless, the system is extremely easy to set up - just plug in the base station and place the battery operated sensors around the home. There is no need for a second phone line or a broadband connection in your loved one's home. Included with your service is unlimited access to your private dashboard, unlimited notifications and reminders, and an unlimited number of caregiver accounts.
Equipment	Base station, Motion sensor, Door sensor, Bed sensor, Toilet sensor, Chair sensor, Emergency sensor, Water sensor
Comment	
Price	99US$/Month, 830 UUS$/Year
URL	http://beclose.com
Other sources of information	

5.2.2 Comfort Keepers

Comfort Keepers	
Description	In-Home Companionship and Care Services

Conversation and Companionship

Comfort Keepers are available to provide clients company and engage in conversation, or to sit down to share a meal together. Social contact such as this is proven to enhance the health, happiness and quality of life of seniors. |

Meal Preparation

Comfort Keepers prepare hot, delicious, and nutritious meals, allowing clients to help with preparation according to their ability. Many seniors do not have the opportunity to eat a well-balanced meal, so this service helps seniors get the nutrition they need to enjoy healthier living.

Laundry

These home care services can be done in either the client's home or the Laundromat and include washing, drying, ironing and putting things away. *Comfort Keepers* involve clients to make sure laundry is done according to their preferences.

Light Housekeeping

Comfort Keepers light housekeeping services include vacuuming, dusting, sweeping and mopping floors, cleaning bathrooms (sinks, tubs, showers, and toilets), cleaning kitchens (sinks, appliances, counters, taking out trash), straightening all rooms, organizing closets and drawers, and cleaning any interior windows that can be reached without a ladder. Comfort Keepers does not provide outdoor cleaning or maintenance.

Grocery Shopping/Errands

Comfort Keepers shop for groceries at stores of their clients' preference and run errands, such as picking up prescriptions or going to the post office. Clients may choose to stay home or help with the shopping and errands as an excellent way to stay active and engaged. *Comfort Keepers* will use any coupons provided.

Incidental Transportation

Comfort Keepers provides transportation incidental to other care services, such as taking clients to medical appointments, barbershops, beauty salons, shopping, or wherever else a client wants to go. Getting seniors out and about is good for their mind, body and spirit—and an integral part of Comfort Keepers' Interactive Caregiving®.

Medication Reminders

Although *Comfort Keepers* cannot administer medications, they can help ensure that clients take their own medication as prescribed as part of our list of senior care services. *Comfort Keepers* can assist with opening medication containers, reading labels and reminding the client when it is time to take a dose.

Grooming Guidance

Comfort Keepers assist clients with washing and combing their hair and other grooming tasks to enable them to feel good about their appearance.

Live-In Services

Comfort Keepers tailors home care to each client's needs—from a few hours a week to full-time senior care. Through our live-in home care services we provide full-time caregiving by *Comfort Keepers* who live in the client's home to provide in-home care on a daily basis. The client and family may designate the types of non-medical in-home care services that are to be provided.

This service gives family members peace of mind, preventing gaps in coverage for individuals who may be at risk when unattended, such as those with Alzheimer's disease or other dementia-related conditions.

24-Hour Care

Depending on each client's needs, Comfort Keepers can provide from just a few hours of service a week to full-time in-home care. Through our 24-hour senior care service, a team of *Comfort Keepers* coordinates caregiving responsibilities in shifts around the clock. This offers clients and their families full-time peace of mind.

Specific non-medical home care services can be tailored to meet each client's needs. This type of continuous elder care service is ideal for clients who are at risk when

unattended, such as persons with Alzheimer's disease and other dementia-related conditions.

Respite Care or Relief for Family*

Caregiving can be rewarding and often strengthens bonds within a family. At the same time, senior caregiving can be demanding amidst life's other responsibilities.

Family caregivers and those in their care can benefit from a little time off now and then. That is why Comfort Keepers offers respite caregiving. This elder care service can be scheduled as needed to provide family caregivers time to run errands, go shopping or get some much-needed rest.

Equipment	Depend on type of care provided (Medical Alert Bracelets, Necklace, Consoles; Dispensers, Medical Minders; Alarms, Detectors)
Comment	
Price	Depends on type of care provided
URL	http://comfortkeepers.com
Other sources of information	

5.2.3 ConnectedLiving

ConnectedLiving	
Description	The Connected Living program complements focus on person-centered care which reinforces individual strengths and abilities. Seeing residents come together for Connected Living programming, delivered by Ambassadors.

Solution for:

- Resident
    - Personal home base for each resident
    - Simple, safe and secure network
    - Picture based email
    - Senior-friendly language, images and design
    - Seamless communication, browsing and sharing
    - Community news and events
- Staff
    - Comprehensive administrator dashboard
    - Critical tool to manage and share your community information from one location
    - Staff and resident directories

	o Community resources
	o Community photos and bulletin board
	o Polls and surveys
	- Family
	o Increased family engagement
	o Peace of mind
	o Virtual window into the community and the lives of residents
	o Access to the secure Community Page
	o Community menus, calendars
	o Easy email and photo sharing between residents and family
Equipment	/
Comment	The solution is similar to MOB InvisibleCare, the main difference is that MOB solution is fully mobile, which is more suitable for AP which are not only in-house.
Price	/
URL	http://www.connectedliving.com
Other sources of information	

5.2.4 Healthsense Advantage™

Healthsense Advantage	
Description	Healthsense Advantage, a hosted solution, delivers powerful data to caregivers. Advantage simplifies care and maximizes the benefits of the technology investment by turning raw sensor data into proactive, usable information that's delivered how and when it's needed most.
	• Custom system reports for clinical, business and maintenance needs
	• Automatic system updates
	• Ease the burden of maintenance on community resources
	• 24/7 device supervision
	• Lowered costs through hosted services
	• Eliminate need for on-site data storage

- Supports: emergency call, remote monitoring, vital sign monitoring, and more

Hosted Solutions (SaaS)

Senior care providers choose Healthsense to meet their technology-enabled care needs. With a shared vision of modernizing care delivery, enabling aging in place and reducing costs, Healthsense and senior care providers partner every day to achieve these goals. Healthsense Advantage, a hosted solution, delivers powerful data to caregivers. Advantage simplifies care and maximizes the benefits of the technology investment by turning raw sensor data into proactive, usable information that's delivered how and when it's needed most.

Real Time Data Access

Care providers need detailed, accurate and timely information in order to shift from reactive to proactive care. The Advantage portal gives clinicians access to real time data from the Healthsense systems. Clinical staff can configure each system to monitor risk behaviors like wandering, nighttime bathroom use and general lack of activity. Care providers choose from a library of monitors to customize each system based on the individual's care needs.

Analytics and Reporting

All readings, alerts and system events are automatically stored in Advantage to track long-term health trends and benchmark system and staff performance. Time stamps on every alert simplify tracking response times and help care providers manage staffing levels and identify bottlenecks in staff workflows. The wealth of reporting and analytics capabilities provides improved information to enhance care plans.

Communication and Care Coordination

Advantage improves care providers' ability to send the right information, to the right caregiver, at the right time. With the Advantage portal care providers can share system information from every Healthsense system. Including: activity of daily living summaries, vital sign readings and alert summaries. Advantage delivers flexibility to integrate Healthsense technology into the community. Care providers can customize alert responder lists for each resident, care setting and shift.

Hosting and Data Storage

Advantage gives communities access to a world class IT infrastructure for data storage and solution hosting. The community no longer needs to devote expensive resources to system security, maintenance and backup.

Advantage also supports seamless over-the-air software upgrades, system diagnostics and online system configuration to protect communities from early obsolescence of their technology solutions and shift maintenance obligations away from the end user.

Benefits:

- Custom system reports for clinical, business and maintenance needs

- Automatic system updates

- Ease the burden of maintenance on community resources

- 24/7 device supervision

- Lowered costs through hosted services

- Eliminate need for on-site data storage

- Supports: emergency call, remote monitoring, vital sign monitoring, and more

Supervision

	Advantage monitors every Healthsense device 24/7/365 for signal strength, device battery levels and connectivity. Each device status can be viewed in the Advantage portal and reports can be generated to manage routine system maintenance.
	Similarly, the E-Neighbor System is programmed to detect unusual activity in the home. A shower left running or a fridge that goes unopened for a day could trigger a phone call to you or a caregiver. Such devices cost about $300 plus $20 per month for emergency call center service.
Equipment	
Comment	-
Price	
URL	http://www.healthsense.com
Other sources of information	

5.2.5 Live!y

Live!y	
Description	Live!y measure healthy living patterns while giving family members insight when help may be needed. Taking medication on time? Eating regularly? Being as active as possible? When something is amiss, Lively makes sure you're connected.
Equipment	SafetyWatch, Hub, Sensors
Comment	-
Price	Lively's pay-as-you-go service costs $19.95/month.
URL	http://www.mylively.com
Other sources of information	

5.2.6 *American TeleCare*

American TeleCare	
Description	It combines the patient's supervision and the interactive video that allows to professionals of medical assistance to supervise the patients' status. The information is gathered from peripheral devices and the Patient's Monitors LifeView, which are transmitted by telephone line or broadband connection. A bidirectional communication of audio and/or video allows to medical staff and patients to communicate.

Equipment	Peripheral Devices include: stethoscope, scales, blood pressure meter, glucometer, oximeter, and thermometer.
Comment	-
Price	/
URL	http://www.americantelecare.com
Other sources of information	

5.2.7 Healthanywhere Inc.

Healthanywhere Inc.

Description	It provides solutions addressing the complete continuum of care, wellness promotion, self-managed care and chronic disease management. Our innovative, simple-to-use solutions allow professional caregivers to remotely monitor vital signs including blood pressure, O2 saturation, weight, lung capacity and blood sugar. Two-way communication capabilities allow nurses to send patients medication reminders, exercise plans, health-related videos & information, nutrition plans, and much more. Peripheral devices include: blood pressure meter, glucometer and scales. With a user-friendly graphical interface and touch screen technology, the Health-At-Home interface provides a rich user environment for data capture, access to educational or nutritional content and interactive healthcare information exchange between patients and providers. Health-At-Home offers the flexibility to customize care plans to individual health needs, choice of language and mode of delivery, thus enabling a personalized health experience. This product provides very cost effective management of chronic diseases, supplies freedom for seniors living at home and is a much needed tool for the continuum of care from wellness, to post-acute, to long term, to palliative care.
Equipment	
Comment	Bought by Biosign
Price	
URL	http://www.biosign.com/
Other sources of information	

5.2.8 Honeywell

Honeywell

Description	System based on a Website with questions for patients on a customizable subjective disease. A bidirectional communication of audio allows healthcare professionals and patients to communicate. Peripheral devices include: blood pressure meter, glucometer and scales, and thermometer of peak of flow.
Equipment	
Comment	
Price	
URL	http://honeywell.com/Products-Services/Pages/healthcare-medical.aspx
Other sources of information	

5.2.9 Ideal Life

Ideal Life	
Description	Data are gathered by peripheral devices Ideal Life's yelipod which transmit information through an analogic telephone line. Peripheral devices include: blood pressure meter, glucometer, oximeter, scales, thermometer of peak of flow and pedometer.
Equipment	
Comment	
Price	
URL	http://www.ideallifeonline.com/
Other sources of information	

5.2.10   Intel

Intel	
Description	It combines a home device for patient with a telephone line interface. The patients and the healthcare staff speak for bidirectional communication of audio and video. A library of multimedia training can be activated by the system. Peripheral devices include: blood pressure meter, glucometer and scales, and thermometer of peak of flow.

Equipment	
Comment	
Price	
URL	http://www.intel.com/content/www/us/en/healthcare-it/healthcare-overview.html
Other sources of information	

5.3 Summary of the chapter

There are several combined platforms and services on the market – we mentioned just few of them. Solution providers are from two different areas. Some of them are from "care" industry and based on their internal or outsourced IT support has their own solutions. Others are from IT industry. Some of them have a market and some of them technology. Therefore it is difficult to compare solutions and only future will show who will succeed. As these platforms are not open for developers, they appear not as attractive for utilisation within the RelaxedCare project. Though they can serve as inspiration and affirmation for showing that RelaxedCare is on the right track.

6 Available platforms and services within the consortium

Several members of the consortium have developed platforms and/or services. However, the solutions are not necessarily products ready for deployment, even the experimental prototypes could be of value for the RelaxedCare project. Therefore, the platforms and services available within the consortium are listed in this chapter. This chapter has not the task to evaluate the usefulness of the developments for this project.

6.1 AIT

6.1.1 Introduction to HOMER

The following chapter explains the HOMER OSGi framework. This framework is an OpenSource project and can be used to integrate sensors and devices from different vendors and with different communication protocols via an international standard. This home platform already provides basic rules for pattern recognition.

6.1.2 Description of HOMER

The <u>HOM</u>e <u>E</u>vent <u>R</u>ecognition System (HOMER) integrates local (off-the-shelf) sensors and performs pre-processing. This OpenSource platform is based on an Apache Karaf OSGi framework and encapsulates its functionalities in terms of OSGi bundles, which enables modularity. The bundles are executed in a Java Runtime Environment (JRE), which can be installed on various operating systems, hence providing hardware independency. The usage of an OSGi framework provides remote maintenance and individual adaptability of the system. The components, coming in the form of bundles for deployment, can be remotely and during runtime installed, started, stopped, updated and uninstalled without requiring a reboot of the system. Thus, the framework is flexible in terms of expanding its functionality and updating single modules during runtime. The interactions and dependencies between bundles are handled by the framework itself. It manages searching and binding of required services, which are exposed functionalities within OSGi bundles, even when the service is activated at later time. Fine grained configuration options allow detailed access to functionalities in each OSGi bundle. Along with OSGi several supporting technologies, like Apache Maven[5] and Apache Aries (for Blueprint)[6] are used. Standards for medical device communication and home automation networks are integrated to enable communication to appropriate devices. All of these technologies are used to realize important aspects for an AAL service platform, namely security, modularity, extendibility and interoperability. Furthermore HOMER makes use of several standards, namely:

- Independent Living Activity Hub specialization ISO/IEEE 11073-10471.
- ISO/IEC 14543-3: KNX is a standardized OSI-based network communications protocol for intelligent buildings[7] .

Applied to all connected sensor technologies is a mapping within HOMER components to one central, standardized data model. This is essential for further data processing in terms of event recognition and reasoning. Here are a few examples of scenarios you can use HOMER for:

- Changing status of devices (on/off)
- Energy consumption monitoring
- Warnings on open doors or running devices when leaving home
- Calendar and reminders
- Person tracking
- Activity index
- ...and many more!

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[5] http://maven.apache.org/
[6] http://aries.apache.org/
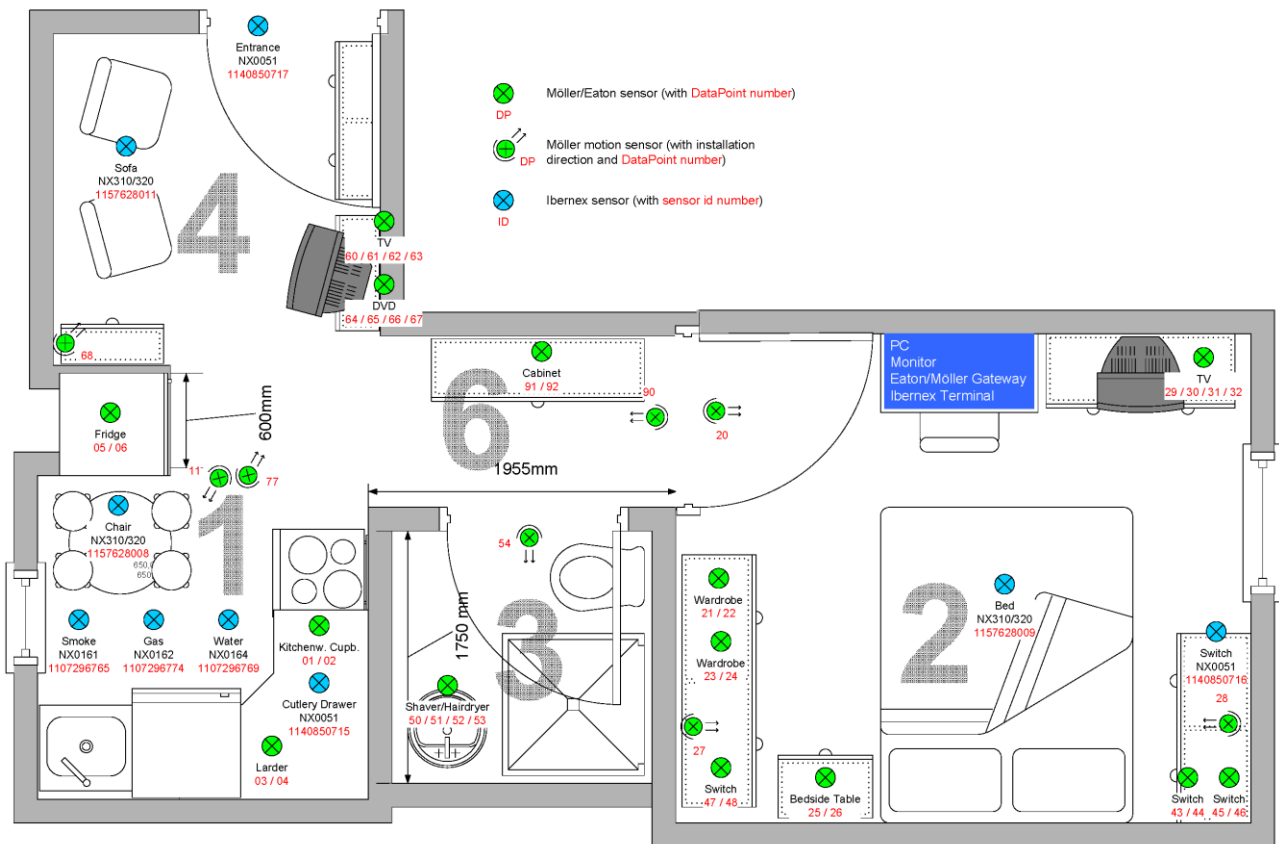[7] http://en.wikipedia.org/wiki/KNX_(standard)

Figure 6 - Example flat used with sensor locations

6.1.3 License

HOMER Core is an OpenSource project, licensed under the GNU LESSER GENERAL PUBLIC LICENSE V2.1. The Homer OSGi framework can only be used in compliance with this License. A copy of the license can be obtained at http://www.gnu.org/licenses/lgpl-2.1.txt. Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License.

6.1.4 HOMER architecture

HOMER is developed in Java, following the OSGi specification and runs within an Apache Karaf container. The advantage of OSGi is the modularization of the whole application into a number of smaller bundles, which can provide services to each other. You can start/stop/update/exchange modules during runtime.
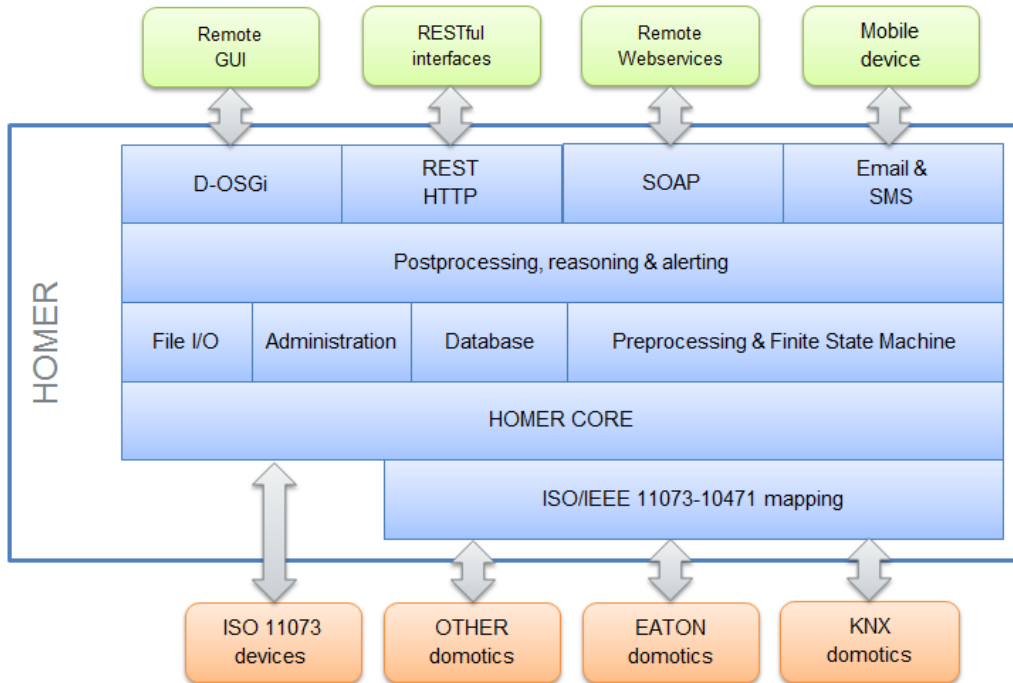
Figure 7: HOMER system architecture

The HOMER binary distribution is able to run on any platform that supports Java SE and was tested on the following platforms:

- Windows:
  - Windows 7 (Windows 8 is currently evaluated)
  - Windows Vista
  - Windows XP SP2
- Unix:
  - Ubuntu Linux
  - Debian Linux

In order to run HOMER the Java SE Development Kit (Version 7) has to be installed. Furthermore the JAVA_HOME environment variable must be set to the directory where the Java runtime is installed.

6.2 IBE

Ibernex has been working for several years on the nurse call systems. They developed two types of hardware platforms. The first is an analogue telephony platform and the other is a VoIP solution.

These systems use different kind of electronics. The first one uses a small processor (ARM Cortex-M3), but the second one (VoIP) is based on a powerful Linux based platform. It uses an ARM Cortes-A9 microprocessor (the same used by the popular BeagleBone board) at 720MHz.

Both platforms consist of a terminal and some peripherals, which could be wired or wireless, that allow the user to interact with the system. These platforms can be easily adapted to other uses, as sensor network control and data logging.

All the electronics has been specifically designed by our company.

Analog telephony terminal features inputs (the number of inputs depends on the type of terminal) that allow to plug in simple devices, such as: switches or push buttons. These inputs are able to change into outputs to control LEDs, relays or transistors.

There is a RS-485 bus that expands the behaviour of the system, and let connect smart devices, such as: RF module, RFID readers, lights, I/O expansion...

The RF communication provides another way to communicate with other devices.

This platform is able to supervise the state of a phone line as well:

- Phone use: when the phone is picked up and hung up and the duration of the calls.
- Ring signal: number of rings and time until the phone is picked up.
- Caller identification: who is calling?
- Number dialed: the number that the user is trying to call, it is identified by the DTMFs that each key produces.

This platform can communicate with other systems through several ways:

- analogue phone line (using FSK modulation)

- serial port (which can be easily translated to USB)

- TCP/IP interface using a peripheral that send the information received from the RS-485 bus to its IP connection.

6.2.1 VoIP terminal features

This terminal is a small computer platform with a Linux operating system. It has a good computational power and enough RAM and storage memory.

There are two Ethernet ports with internal switch function. One of the connectors allows PoE supply.

This terminal also has inputs (the number of inputs depends on the type of terminal) that allow plug in simple devices, such as: switches or push buttons. These inputs are able to change into outputs to control LEDs, relays or transistors.

There is a RS-485 bus that expands the behaviour of the system, and let connect smart devices, such as: RF module, RFID readers, lights, I/O expansion...

The RF communication provides another way to communicate with other devices.

This platform uses Ethernet 10/100BaseT for communication with other systems.

6.2.2 Wireless devices

Our radiofrequency devices use the 868 MHz band (free use in Europe) and a proprietary protocol to communicate.

The communication is bidirectional and it includes the re-sending of not listened packets, periodic keep-alive messages and battery status notification.

The main wireless devices are:

- Bed/chair sensor: This sensor measures the vibrations that the user produces (movement, breath, heartbeat…). This sensor can be installed in a sofa or in a bed in order to know if the user is there of have gone.

- Input sensor (PIR, door contact, buttons…): These sensors send a message each time an event happens, i.e., if a PIR sensor detect movement or the door has been open or closed.

- RF interface module: These are the devices which allow the communication between the wireless devices and the terminals. The power supply and the communication with terminal are done via RS-485 bus.

6.3 IHL

6.3.1 Software Platforms

In past projects between industrial partners and the iHomeLab, we had to use the platforms of the industrial research-customer. Those platforms cannot be made available due to property rights. Experience in the following development platforms is given:

- Java for Enterprise

- Maven

- Eclipse

- OS: Windows, Linux, Contiki, Android, iOS

- In the project MEGA, we have a visualization tool, which make information transfer very easy to perceive: By offering a frowny/smiley face, rotating circles which vary their speed of spinning depending on a underlying value. All objects float on the screen. See picture below

Picture 6 - Project MEGA screenshot

6.3.2 Hardware Platforms

Below is a list of hardware platforms we have experience in. The platforms can be used as infrastructure for all kinds of sensors (or sensor networks). Fast prototyping of embedded low power systems allows keeping our developing times low.

- Credit card sized Computer platforms (Beagle Bone, Raspberry Pi (AM335x 1GHz ARM Cortex A8, 512 MB RAM, HDMI, 3D graphics accelerator, USB, Ethernet)

- Low Power TI-MSP430 (up to 25 MHz CPU speed, 0.5 kB to 512 kB flash, 128B to 64 kB RAM, idle mode < 1 µA)

- 6lowpan ("IP over 802.15.4", Econotag mc13224v)

- 802.11 ("WLAN" Networks) (Also Mesh networking, OLSR)

- PLC (Power Line communication (IEEE 1901, GreenPHY ISO/IEC 15118-3)
- Low Power Wireless Sensor Mesh Networks (based on 802.15.4, ZigBee), CC243x, CC2520, CC2520, MC13224, EM250, EM357, NXP JN5148
- Simple wireless switch signals on 868 MHz
- KNX bus sensors/actuators

We have the following custom made sensors available:

- Inactivity sensing (PIR)
- Fall detection
- Indoor localization
- Smart Plugs (non-intrusive load monitoring/switching)

Last but not least we have the iHomeLab Living Lab at our service, which can be used for trials and presentations.

6.4 MOB

6.4.1 Service - InvisibleCare

The InvisibleCare lets seniors live independently at home or outside. InvisibleCare puts seniors in the middle and draws around everyone who they contact with and everyone they can get help from. Invisible care thus represents an additional mobile technologies based layer in the caregiving network.
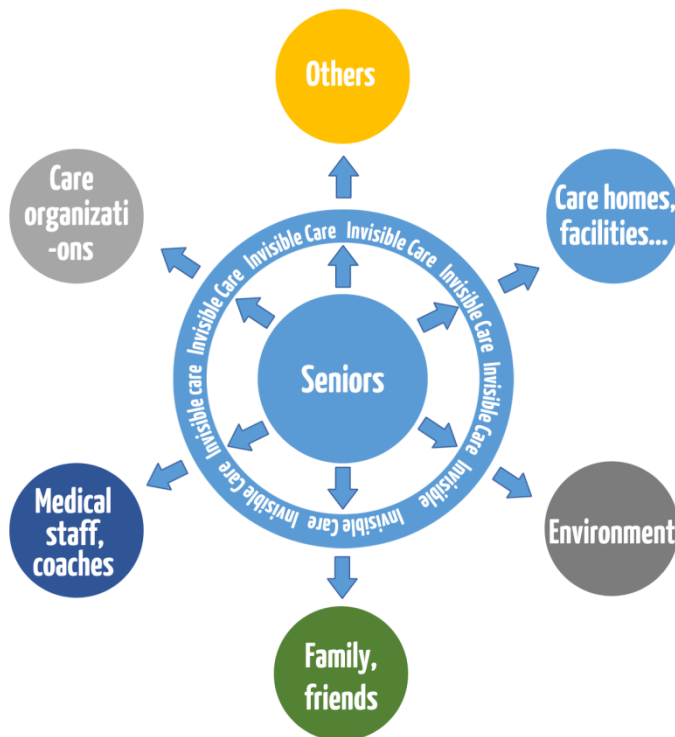

Figure 8 - InvisibleCare stakeholders

The InvisibleCare solution supports caregivers when caring for their active and mobile senior relatives/friends. For the senior user it is also an easy-to-use means of communication through calls and text messages. InvisibleCare securely provides the information about the overall status, location,

health etc. of the seniors. It can also be used by the professional caregivers to monitor the users remotely and avoid hospitalization when possible, thus driving down costs for both patient and caregiver. InvisibleCare can also be used in institutionalized care to ease the access to the information about the patients.

The technology behind is "invisible" to the senior users as well as to the informal caregivers as long as everything is OK. The users are only asked for attention when necessary. To disburden the senior users of the myriad of features the smartphones provide, InvisibleCare offers simplified user interfaces that include all important things but are still very easy and intuitive to use.

All-in-all Invisible care is an improvement of the quality of life for seniors and their caregivers.

Technical description

InvisibleCare is based on the smartphone technologies. Why a smartphone solution? A smartphone:

- is used by an ever increasing number of people,
- is a universal tool, just as useful outdoors as it is indoors,
- can serve as a home gateway, replacing unrealistically expensive home integrated SOS systems,
- does not require setting up or costly adaptation to different infrastructures; it is part of an established network,
- is affordable and can communicate using the 3G network only when needed, when the user is at home the device can connect to the home WiFi network and greatly reduce costs.

Furthermore, InvisibleCare includes:

- safety modules: locations services, SOS,
- non-invasive wearable bio-sensors which allow to track the health, overall status, location etc. of the seniors,
- environmental sensors: weather, air pressure, cameras, microphones, weather information,
- connection to various other services.

Phases

InvisibleCare is divided into three phases:

- phase 1 – SimplePhone for seniors
- phase 2 – CarerPhone for caregivers
- phase 3 – SensorPhone, adds biosensors, includes phase 1 and 2)

Phase 1

In the first phase we make sure the seniors are given a proper smartphone suited to their needs, including all the needed functionalities with big buttons, modified UI, colour coding, haptic interfaces, pre-defined contacts, location and SOS services etc. For the advanced users there is the possibility to include optional modules such as camera, magnifier, radio player etc. Seniors get more and more acquainted with their phones, they use it to communicate, take pictures, and stay safe. The application works on all Android smartphones.
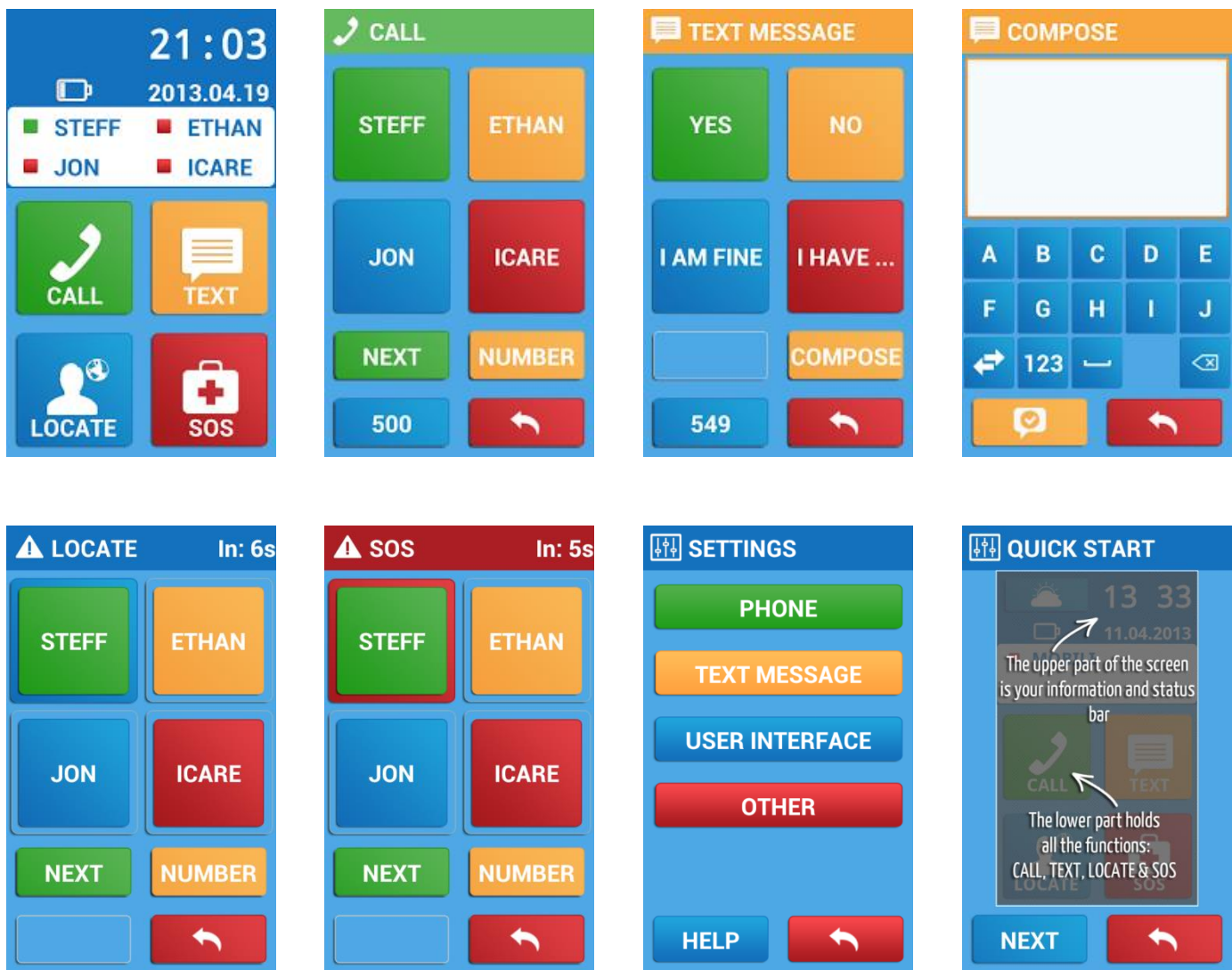
Figure 9- SimplePhone and CaregiversPhone screens, examples

Android smartphones were chosen due to the open and accessible nature of the system and many different manufacturers which make affordable devices. Switching to or adding additional OS is always possible.

Phase 2

The second phase includes the formal and informal caregivers. InvisibleCare helps seniors by opening a simple communication channel, while offering their caregivers to be informed about the sensor and share their caregiving (services) amongst each other. The full version of the application works on Android smartphones to allow the caregivers to get alerts, react to them or direct them to other caregivers – with a single button tap. One senior can get up to 4 caregivers and they in turn give care to one or more seniors. The seniors are always aware of who is currently on call and have complete control over their privacy. InvisibleCare enables most of the phase 2 features to be used on the non-Android phones via text messages.

Institutionalized caregivers can be included in this phase, by expanding the amount of services offered, first as backup service and later on as a primary service.

Phase 3

The third phase includes sensor modules using internal phone sensors, wearable bio-sensors and fixed ambient sensors using wired or wireless communication (WiFi, BT, BT smart, Ant, ZigBee).

The system accounts for adding sensors easily and quickly, being able to adapt to any changes in the users condition, medical or otherwise. Currently supported are over 80 different sensor readings using devices from various manufacturers. For example, the solution allows for remote monitoring of the body's vital health signs. This includes heart rate, breathing, ECG, temperature and other critical parameters. The sensors can also measure posture and thus can detect when somebody falls or slips. Further parameters are breathing rate, posture, accelerations, ambient light, magnetic field, GPS data, etc. a new sensor (with decent documentation) can be fully integrated in short time.

Additionally, the system supports the virtual sensors (for example: step counter, fall detection, arrhythmia detection, etc.), which can be developed and integrated by partners.

InvisibleCare includes an (out of the box) server solution (www.mobili.si/products/sensor-server), which allows other users (for example doctors) to connect to the system as well as a workstation (www.mobili.si/products/sensor-workstation).

6.4.2 Platform - Mobilis framework

Phase 3 is based on the Mobilis framework, which allows for the construction of different mobile (bio-) sensor solutions. Two examples of this practice are:

- InvisibleCare: www.invisiblecare.net
- InvisibleGuard: www.invisibleguard.net

Mobilis framework (http://www.mobili.si/products/mobilis-framework) is a bio-sensor development tool, which helps Mobili and the clients (developers, partners, research institutes) to create a flexible solution for a variety of uses, such as eHealth, telehealth, telecare, seniorcare, wellness, first responders use, and many more. Mobilis framework allows for complete and simple adaptation to the clients wishes. Our solution is a completely functional building base for any and all of your bio-monitoring needs, it allows almost infinite choices and combinations of various sensor equipment and is fully modular.

6.5 **Summary of the chapter**

Consortium technical partners have their own platforms and services which will be used in a project. They are not overlapping because IBE main expertize and work is concentrated on in-home equipment, MOB works strictly on mobile platforms (out-of-home and in-home mobile equipment, AIT will combine both client side solutions from IBE and MOB to HOMER server and IHL will visualize and add different (not necessarilyIT / mobile) user interfaces. The main work will go to develop specific modules and integrate 4 systems into one out-of-the-box solution.

7 Further Work

Sensor and mobile technology is changing so fast and drastic that D 3.1 is just a cut-off based on time D3.1 was made. Every day companies make new sensors and tools which could help AS,[BM3] however we need to be aware that only the market will tell us what is acceptable and what not.

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