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CAALYX-MV

Complete Ambient Assisted Living Experiment – Market Validation

D2.1 CAALYX-MV Services Description

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Executive summary

This document describes all the potential e-health services that CAALYX-MV could provide to healthcare organizations, both public healthcare systems and private hospitals. The main idea of D2.1 is to describe the system and its services and use as an input for D2.2, where the most suitable services will be chosen to be commercialised. Before listing potential e-health services provided by CAALYX-MV, the system is explained in detail by providing an overview of the platform, showing its architecture, the different users that might use the system, the different parts that made out CAALYX-MV, explaining its basics services that will be tested throughout the project in the different established pilots-sites and eventually defining how the final e-health services should be presented on the market. Thus, the main outcome of this deliverable is proposing a set of services that will be filtered in D2.2 applying market analysis.

CAALYX-MV is a tele-health platform that provides a web tool for clinical professionals to follow-up their patients. On the patient side - at home - CAALYX-MV provides a way to take different kinds of measures (i.e. weight, blood pressure, pulse, and oxygen saturation), filling out questioners, checking the medical agenda (e.g. appointments, times for drugs) and even having videoconferences with doctors. Furthermore, patients' homes are setup for being smart-homes (e.g. sensors at beds, doors) in order to provide doctors with more information about their patients' activity. A part from that, patients might wear a special t-shirt with different kinds of sensors (i.e. respiratory and heart rate, temperature) to have a continuous monitoring. This is intended for patients that need constant care and observation.

CAALYX-MV architecture is made out of a platform (i.e. caretaker server) where all the data is collected and processed. On the client side there are two main parts, the one coming from the t-shirt (i.e. mobile system) and the other one coming from the sensors that stays at patients' home (i.e. home system). Because the first one must send data continuously, a permanent Internet data connection is needed and that is why a mobile phone is used as a gateway to deliver the information to the platform. At patients' home, a Set-top box (STB) is used to collect all the different data coming from the sensors. The main interface for the patient in this case is the television, because most people already have these at home.

The system is intended to be used by clinical professionals (e.g. doctors, nurses, carers), patients' relatives and friends, and of course, the patients. Each of these users will have different roles on the system being able to access to specific data. For instance, doctors will be able to have access to all patients' information, but relatives and friends only to the public part of this information. Also, both patients and relatives will receive data from the clinical professionals and patients will be able to send feedback to them by using questionnaires and the videoconference service.

Main basic services provided by CAALYX-MV could be classified in three main categories: Emergency, Ambulatory and Social care services. While the first ones are focused on emergency situations, when something dramatic happens (e.g. patient falls, patient at be 20 h, etc.), the second ones are oriented to continuous data collection and observation. Social care services are all the facilities to improve communication between the different roles of the system (e.g. videoconference, questionnaires, etc.). Finally, the document ends providing a list of e-Health services that potentially could be provided to current Health Systems.

1 Introduction

The goal of this WP is to make a study of the state of the art in the European and global markets regarding the developments and already existing systems related to independent living platforms in order to define a successful marketing plan. Together with the study of the needs of this market and by comparing it with current existing solutions, the consortium will be able to understand what the opportunities are to sell CAALYX-MV services in the Healthcare market. Therefore the WP has the following objectives:

- Describe the CAALYX-MV services that will be validated at the different pilot sites throughout the project.
- Propose a list of potential e-Health services to feed D2.2.
- Define and analyse the overall market: study market developments and services, competence, market share.
- Work out market needs and figure out on what diseases CAALYX-MV could save more money to the current Health Systems.
- Apply marking strategies to deploy CAALYX-MV services in the Health market.

1.1 Purpose and content of this deliverable

D2.1 defines and describes in a fully functional way the e-health and social services provided by CAALYX-MV that eventually will be validated in at a number of pilot sites. CAALYX-MV solution has not been validated yet in the European market thus re-engineering of services process is needed [1] [2]. In this document also the interrelationships among the CAALYX-MV users' (doctors, older people, caretakers, relatives, etc.) will be described and finally, a list of potential marketable e-health services is provided.

1.2 Methodology

The main outcome of WP2 is the description of a set of marketable e-health services and the strategy to deploy them on the market. In order to do so, a description of the CAALYX-MV services is outlined in D2.1. Then a benchmarking study is done in D2.3. Both documents will feed D2.2 in the final marketing strategies. Thus, D2.1 is providing inputs to D2.3 and D2.2. In D2.3 this input is used to compare CAALYX-MV services with current market options, and in D2.2 to propose final e-Health services that will be filtered on D2.2 using a marketing logic. Next pictures show how this methodology works:

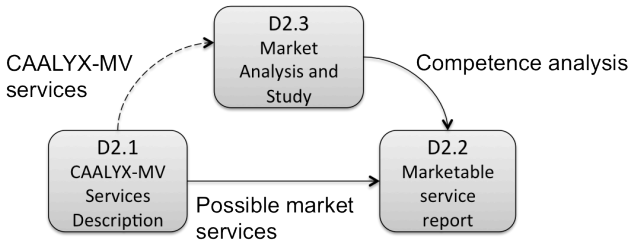

Figure 1 - WP2 methodology

1.3 Outline of this deliverable

In chapter two, an overview of the system is given as well as an explanation about its architecture. In chapter three the platform users' roles are listed. Chapter four describes the basic services provided by CAALYX-MV. Chapter five describe the most market-like e-Health services and a conclusion is provided in chapter six.

2 Description of the CAALYX-MV system

2.1 Mission and Vision

Mission: Strengthening Public and Private collaboration to reach a reliable social and health care service, that extends older people´s autonomy prolonging the time they can live in an independent way at home

Vision: Easy to handle, easy to install, reliable, affordable, standardized, health and social care.

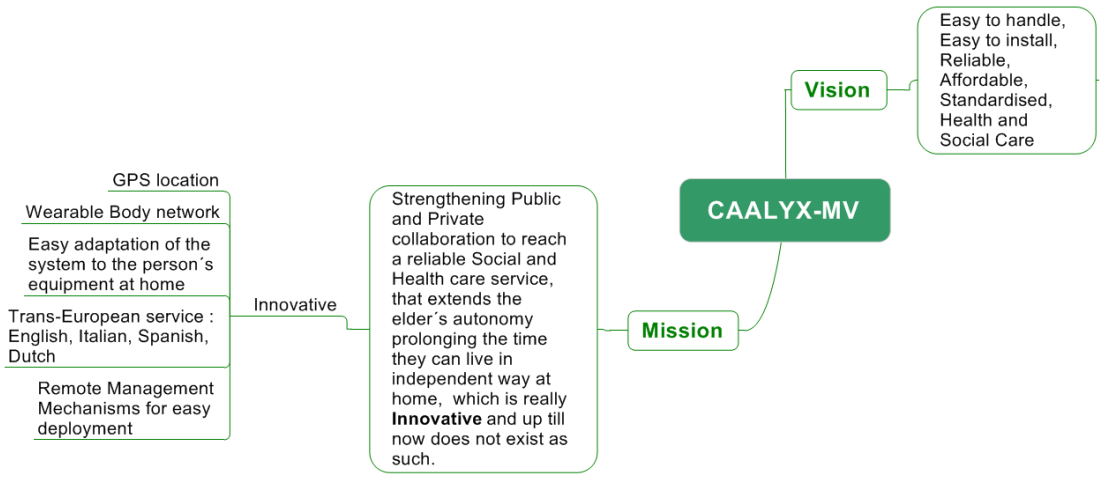

Figure 2 - CAALYX-MV mission and vision

2.2 Product Description

CAALYX-MV will provide a distributed and scalable system to allow monitoring of patients by multiple professionals (e.g. doctors and caretakers) simultaneously and will enable the provision of meaningful coordinated actions under the concept of a health agenda for prevention and self-management of their multiple chronic conditions. CAALYX-MV consists of a caretaker website, a home and a mobile system. Both systems have associated different kinds of sensors that transmit their information either through a mobile gateway or a TV STB as depicted in Figure 3.

The CAALYX-MV product aims at offering a set of innovative and user customisable elder and patient care services. Two levels are envisioned:

- Basic service – mobile and home monitoring of a user using the standard equipment
- Extended services – on top of the basic service one can add more sensors, both at home and to the garment. A TV STB at home improves user monitoring and other added value services for users without their own PC.

In both services the system should be used by a user without any advanced technological knowledge, thus the need for the full remote configuration of the mobile and home systems. The

system monitoring functionalities should be easily expanded by the seamless addition of new sensors both at home and the mobile system (not included in the garment).

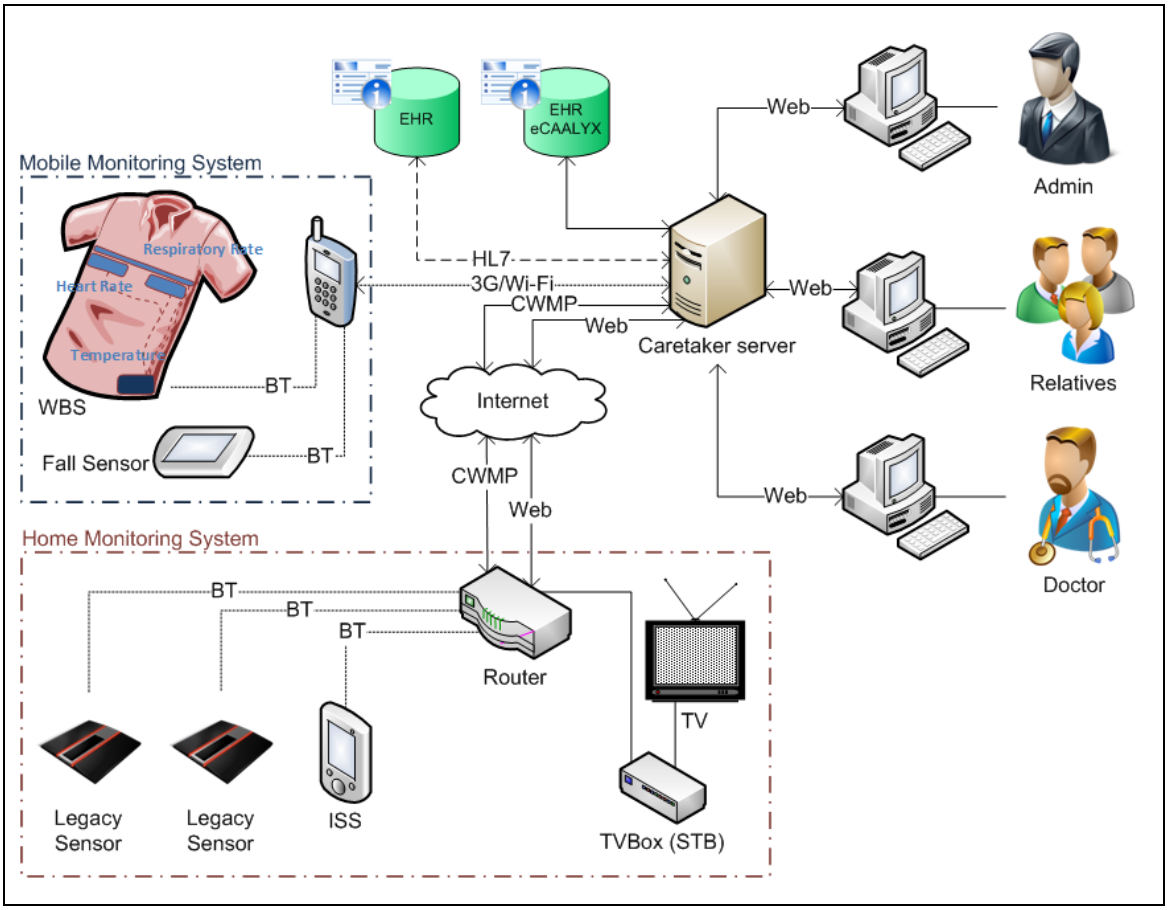

Figure 3 - System overview of the CAALYX-MV

2.3 CAALYX-MV Architecture

The available technology of CAALYX-MV consists of three main components:

- The caretaker system
- The mobile monitoring system (Mobile System – MS)
- The home monitoring system (Home System – HS)

The overall system architecture is depicted in Figure 4. The proposed architecture will be revised also later on, but no major change is expected.

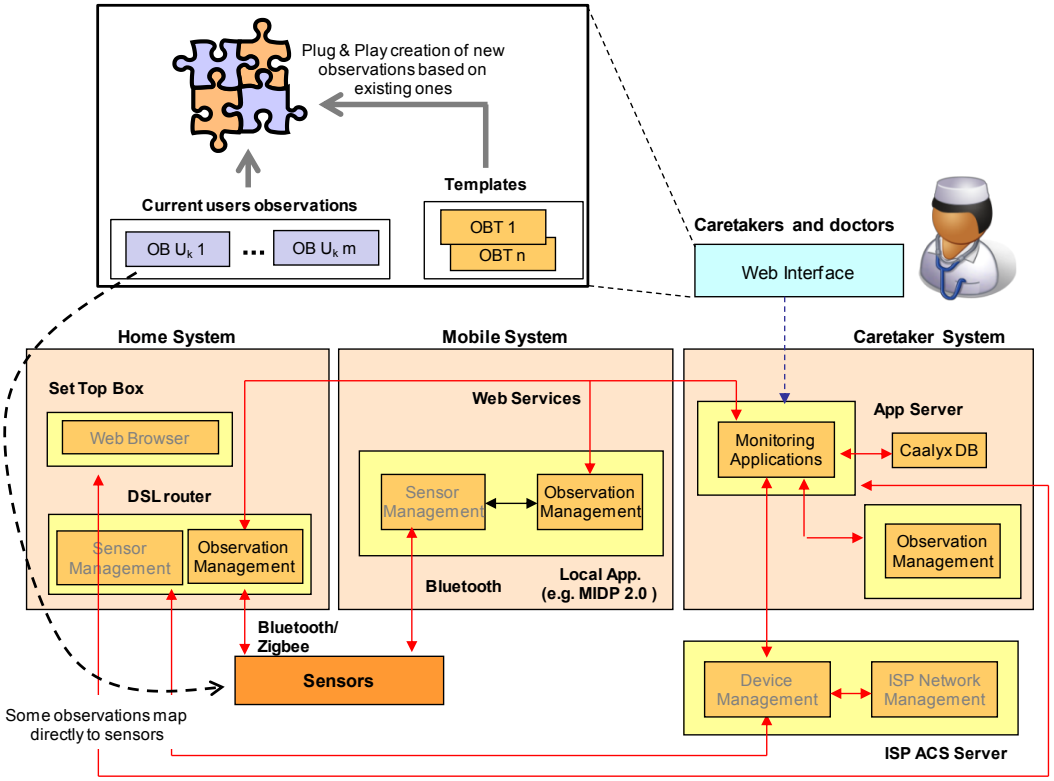

Figure 4 - CAALYX-MV Architecture

Caretaker System

Family/Caretaker/Doctor system

Family members, caretakers and doctors may access the system through any standard Internet enabled device, such as personal computers or mobile phone. Additionally, to be able to contact the patient through videoconference, a camera and microphone will be needed.

The way the family members, caretakers and doctors will see the web site presented by the caretaker server will depend on the role with which they are subscribed. Also, the caretaker server includes an ACS as a module, providing the devices with auto-configuration capabilities.

Mobile System

The mobile platform's purpose is to continuously monitor an older person while outside the home and report when medical attention is needed.

For that purpose, the mobile platform is connected with sensor devices that can measure older people's vital signs. These sensors constitute a sensor network, associated with a single individual's body, which are related between them directly or indirectly, following a networked architecture, where the only common point to all its nodes is the mobile system. In CAALYX-MV application context this network is denominated Body Area Network (BAN).

In the BAN there may be several kinds of sensors with different purposes, such as fall sensors, ECG sensors, thermal sensors, or even GPS devices. The criterion is that the provided data is useful to make a better assessment of the user's condition, in order to improve alarm situation reporting. A minimum set of sensors required for general monitoring will be integrated in a wearable garment, thus improving system usability.

The mobile platform is also capable of storing readings coming from the BAN's sensors, analyse medical data and report alarm situations to other CAALYX-MV components, namely the home system and caretaker site.

The **Wearable Body Sensor (WBS)** system is composed by a set of important biomedical signal sensors including heart rate monitor, respiratory rate monitor and temperature. The system continuously monitors the parameters during the daily life activities of the patients, at home and also outside. The word "wearable" means that the system is directly integrated in the garment, making it easy and comfortable to wear and its use nearly transparent to the patient. The WBS is able to continuously monitor the health status and communicate it to the mobile phone using wireless technology.

Home Monitoring System

The home system is composed by the following components (also depicted in figure 3):

- Home Gateway (HG): Bluetooth USB Adaptor (to enable Bluetooth communication) and USB flash disk (to store measurements and system debugging logs)
- Set-top box (STB): TV (to display the interface) Web-cam and Microphone (for video-conference)
- Home Sensors: Set of sensors that are wirelessly connected to the router.

DSL residential routers and STB's are cheap devices present in consumers' houses to enable broadband access and for TV viewing, respectively. Therefore, reusing these devices to implement the CAALYX-MV system functionalities allows the service providers to distribute the investment cost in equipment among different services.

The **Home Gateway (HG)** includes USB expansion slots in order to make it possible to add a Bluetooth USB adaptor and a USB flash disk. The Bluetooth adaptor enables the router to communicate with the health sensors. In order to allow the local storage of medical measurements as well as, a continuous system monitoring it is necessary to plug a USB flash disk into the HG. In addition, the HG includes a remote management module that enables auto-configuration of the system at home, releasing the user from system configuration tasks as well as reducing the need for on-site technical support.

The **STB** provides the user interface of the system. It acts as a renderer, connected to the TV, where the user is given the opportunity to follow his health condition, manage the health agenda (consultations, medication, etc.), and communicate with doctors and family as well as providing input to the system through questionnaires prepared by the doctors.

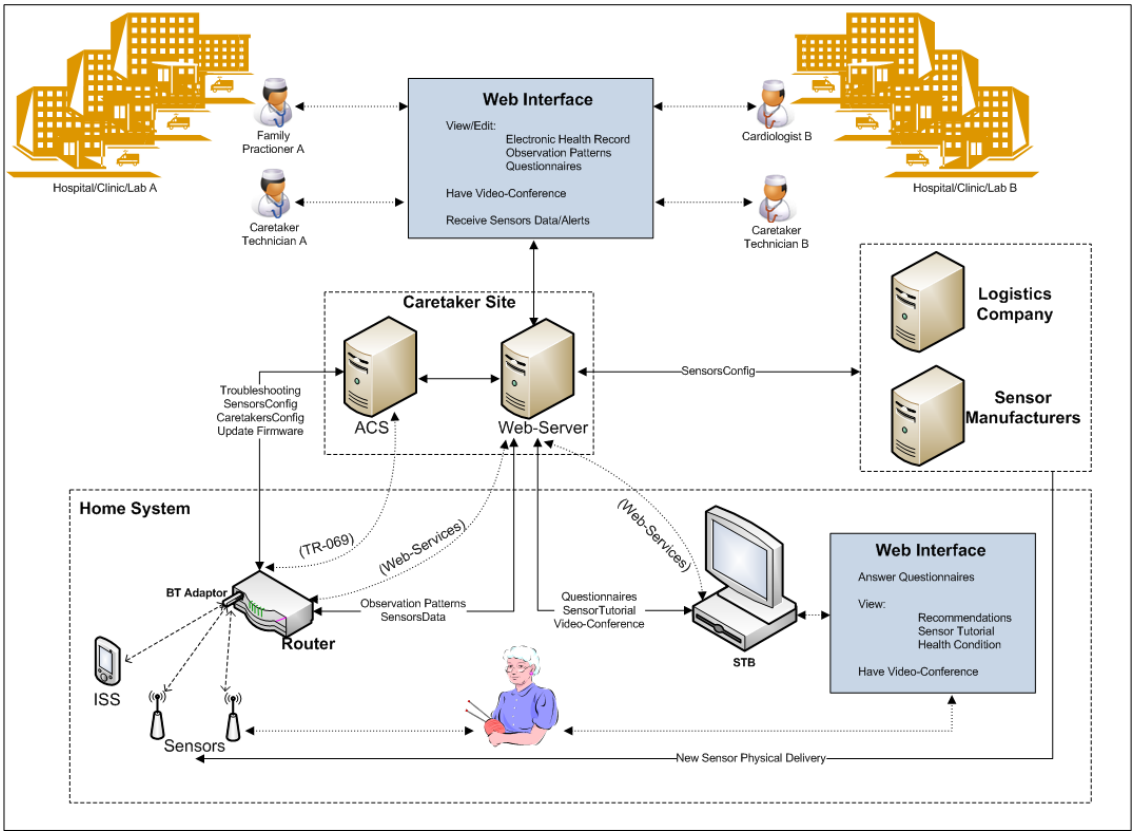

Figure 5 - Home System components

The **Home Sensors** used in CAALYX-MV can be classified into two groups:

- Vital Sign Sensors: Collect patients' e-health data
- Smart Home Sensors: Detect patients' activity

2.4 CAALYX-MV interfaces

This section gives an overview of the interfaces between the components.

Home Monitoring System

List of Interfaces

HG ←→ Caretaker Server

STB←→Caretaker Server

HG←→ ACS

STB←→ACS

Home Sensors ←→ Router

The home monitoring system has 3 main components: The router, the STB, and the ISS. The home router is the middle point of the home monitoring system. It interfaces with the health sensors present at home, with the caretaker Web-Server and the Auto-Configuration Server. The STB can be seen as both the interface of the system to the user and as another sensor for collecting data that is either more difficult to measure or even subjective (e.g. tiredness, pain...). The ISS is a multi-sensor device that enables the collection of the vital signs of the user.

One of the main requirements of the home system is auto-configuration. Auto-configuration is enabled by the creation of an interface between the home router and the caretaker Auto Configuration Server (ACS). This interface enables the ACS to share information with the router that enables the router to setup communication both with the home sensors and the caretaker Web Server automatically. This interface is based on the CPE WAN Management Protocol (CWMP) defined by the Broadband Forum's Technical Report 69 (TR-069). This protocol is already used by telecom operators to manage communication equipment such as routers and STBs. If desired by the CAALYX-MV service provider, this design choice will enable the provider to make use of the management infrastructure already deployed by telecom operators, reducing the initial investment in infrastructure. During this project, extensions to the CWMP protocol will be defined that enable the management of the health devices present at home. Such extensions, that will be part of the vendor-specific extensions allowed by CWMP, mainly include the definition of the parameters required for sensor communication (e.g. RFCOMM channel used, PIN code, driver software, etc.).

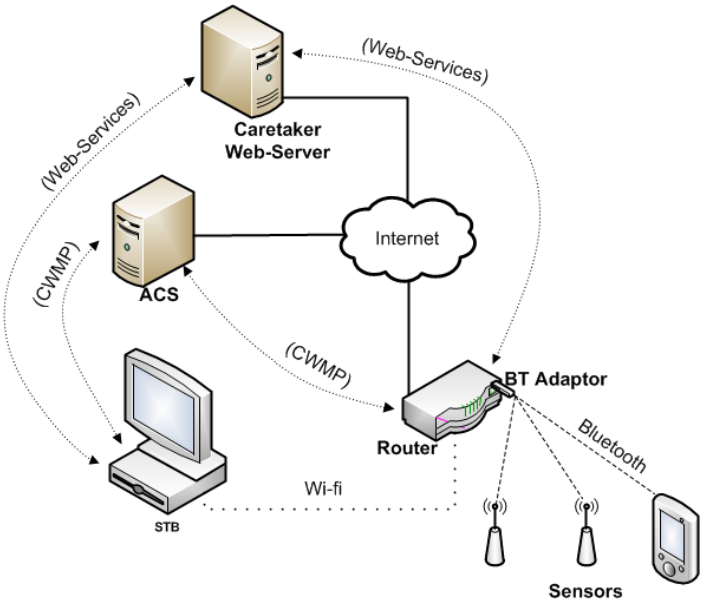

Figure 6 - Home Monitoring System interfaces

The router is responsible for collecting data from the sensors and sending it to the caretaker Web Server. The frequency with which the data is collected is defined by the observation patterns specified by the doctors. In addition, the router may apply some pre-processing to the data collected in order to raise alarms in the system. The pre-processing is also defined in the observation patterns. The router obtains the observation patterns dynamically through a set of web-service primitives supported by the caretaker Web Server.

The flow of data between the router, caretaker Web Server, ACS and the home sensors is the following:

- the home router performs the initial setup using the standard mechanisms defined by CWMP;
- after the initial configuration is established, the router receives the configuration parameters of the home sensors and the URL of the caretaker Web Server;
- the router uses this information to setup communication with the sensors automatically and also to establish a session with the caretaker Web Server;

- the router retrieves the observation patterns specified by the doctors from the caretaker Web Server and starts processing data from the sensors and sending the data/alerts to the caretaker Web Server as defined in the observation patterns.

Mobile Monitoring System

List of Interfaces
Mobile Phone ←→ WBS
WBS←→Fall Sensor
Mobile Phone ←→ Caretaker Server

The mobile system, as depicted in figure 1, connects only to the caretaker server either using the public 3G networks or the Wi-Fi network at the user's home. There are also two inner interfaces, one between the mobile phone and the WBS and another between the WBS and the fall sensor.

3 CAALYX-MV User's roles

The CAALYX-MV system works with the following users' roles:

Administrator

A person will play this role for configurations, such as adding, modifying, removing and linking elders, family members, caretakers and/or doctors. This role may be partially played by caretakers, family members and/or doctors. Elders may not play this role due to their lack of technological skill.

Doctor

Family practitioners or specialists play this role. They are allowed to access to their elder's electronic health record stored in the caretaker site so that they can identify medical conditions and require due attention for their patients. They can modify normal values for clinical parameters monitored and medical treatments.

Patients

Patients who are supported and monitored by the CAALYX-MV system play this role. It is assumed that the person has little technological skills but can perform simple technical tasks regarding the common use of a mobile phone, a TV and sensor devices (e.g. automatic blood pressure meter, weight scale, etc.).

Caretakers

System operators play this role with a human-oriented profile providing caring tele-services from the caretaker site. S/he attends alerts received and produced by the caretaker site; contacts elders to kindly show concern for their health state or remind activities.

Emergency Services

This role will be played by the responsible emergency system at the elder's location. The emergency service will provide help to the elderly person in case of an emergency.

Relatives

Family members providing a caring contribution according to their own circumstances from their own home/place play this role.

The next picture shows what each role's associated functions are:

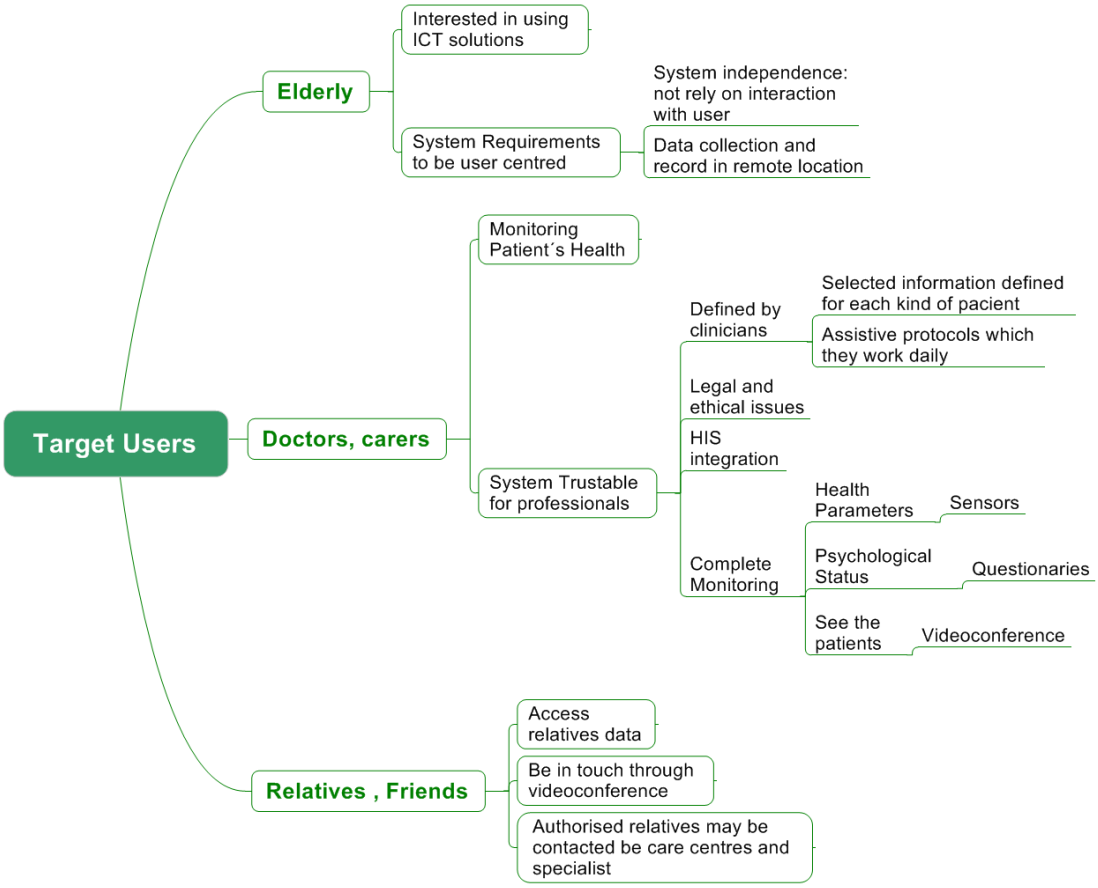

Figure 7 - Users' roles

4 CAALYX-MV Services

The CAALYX-MV services can be divided in three main categories of basic services:

1. Emergency care: patient falls, geo-localization when there is an emergency, flood detector, bed occupancy sensor, etc.
2. Ambulatory care:
   a. Remote vital sign monitoring: temperature, breath, possible heart failure or chronic respiratory disease exacerbation (the two last currently in developing).
   b. Specific questionnaires: depression screening, functional status monitoring.
3. Social care: live connections, calendar, history clinical access, and videoconference.

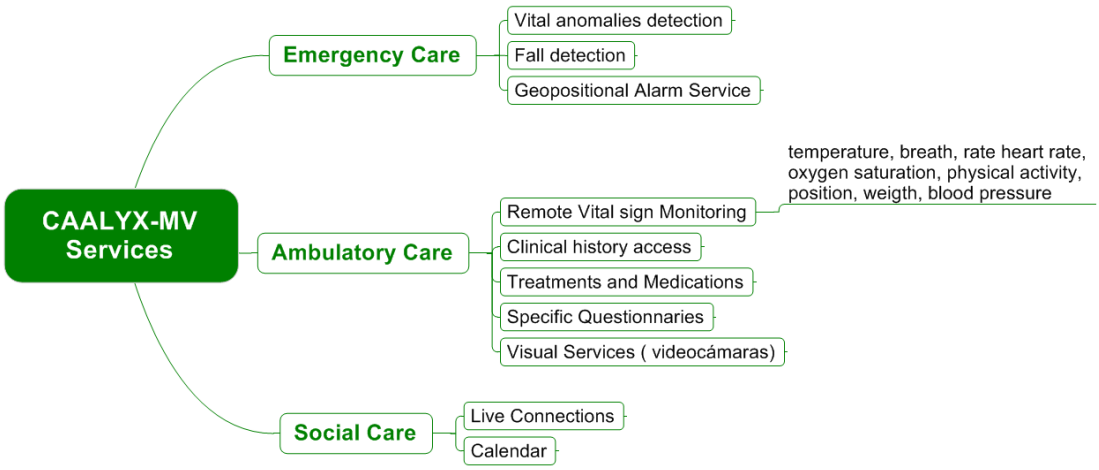

Figure 8 - CAALYX-MV basic services

The services that can be implemented with a central server will be described that receives medical data from the home and the mobile monitoring system, that offers a web interface accessible by every PC connected to the internet, where data display, configuration and other services are provided.

As innovators in health care services we want to identify best services, from a business point of view, to be Emergency Care Services offered in CAALYX-MV pilots.

Vital Anomalies Detection

The Home Gateway is able to communicate with the Caretaker Server through a set of web services methods, allowing the HG to obtain the treatments assigned to the patient. For each treatment, there are measurement scheduling and rules. Each rule allows validating a measurement by comparing values with a threshold defined by the doctors. If a measurement means value overpasses the threshold an alarm is raised on the caretaker server. Currently only simple comparison operators are supported, such as greater than > or lower than < for comparing the mean value of a set of measurement values.

Fall Detection

The system consists on a highly sensitive fall detector [3] incorporating an accelerometer and a specific fall detection algorithm, which performs a complex analysis of the inertial signal, combined with posture detection. This is complemented by a telecommunications layer involving wireless technologies, able to send alarms when the falls are produced both inside and outside the home via 3G or GPRS protocol. The

system is designed to be worn all day except during sleeping hours, during this time the battery is recharged. A standard commercial Li-ion battery powers the system with a capacity of 650-700 mAh.
The fall detector device involves tri-axial accelerometry [4] and incorporates a microcontroller (µC) that manages the different measuring components and therefore guarantees computation capacity in order to manage the specific on-line algorithms. This µC acquires orders, performs calculations and transmits the sensor data. The size of the complete device with battery, communications and plastic box is 58 x 93 x 17 mm and its weight is 52 g.
The device is thought to be worn near waist level and beneath clothing in a comfortable customized neoprene belt in direct contact with the skin. The sensor is water-resistant so it can also be worn in the bathroom, where the risk of falls is particularly high. A panic button may be optionally included in order to allow user sending a help requirement voluntarily. Additionally, a reset button can be included.

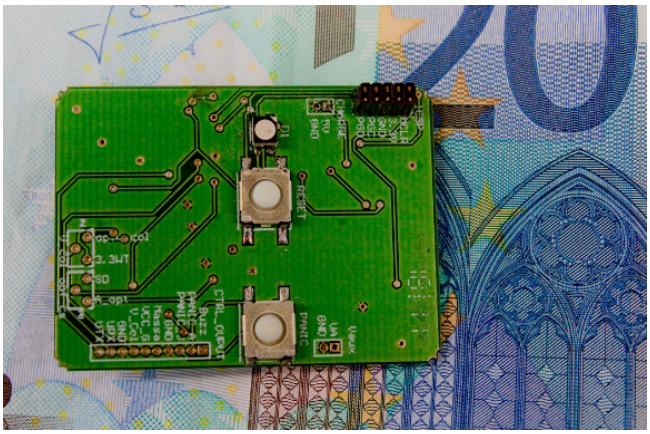

Figure 9 - PCB fall sensor

These fall detector will be included into the smart shirt developed by CETEMMSA, with some changes (it is not necessary to include the communications layer and the battery). Thus, only the PCB is needed, whose size is 43,7 x 32,5 x 5 mm and its weight is 8 g.
Whenever fall detection occurs, the alarm will be transmitted from the sensor to the smart shirt processor through a UART serial communication, in the same way that the previous sensor performed.

Geo-positional Alarm Service

The geo-position of the user is paramount for context awareness. In most situations, the exact position may not be needed, but only simpler information like being outside/inside, walking or travelling on a vehicle, etc. The context is then used by the observation pattern reasoning mechanism to use the suitable observations. For example, if the user is walking on an uphill road is quite natural an increase in the heart rate, thus the alert threshold must be higher than the rest one.
The mobile phone's geo-positioning capabilities will also be used to implement a simple geo-positional alarm service to help users with memory lapses or prone to get lost in their neighbourhood. The use of computational intensive reasoning mechanism and heavy GPS usage would lead to a huge increase in power consumption in the mobile phone, dangerously reducing its power autonomy. Thus, the monitoring will be applied only to walking users, relying whenever possible on the intermittent use of assisted GPS (A-GPS) and switching to full GPS only occasionally to increase the accuracy.
The geo-positional alarm service is based on the definition of "safe" areas the user usually uses when leaves home walking (to go shopping, etc.). The areas are polygons defined by the caretaker on a map (caretaker server). When the user leaves the area an alarm is sent to the caretaker server so that the caretaker can phone the user and assess the situation.

Emergency Smart Services

These services are intended to control patients' activity and create a behavioural pattern that is complemented by the e-health information sent by the tele-health part. The information combined provides a more complete picture of the patient condition. The next bullet points describe the different sensors that CAALYX-MV will use to create smart-homes on patients' homes:

- The flood detector provides home safety to a person who is likely to be at risk from leaving taps turned on.
- The bed/chair occupancy sensor can automatically raise an alarm whenever a person is getting out of bed before a predefined time, is not going to bed before a predefined time or does not return to bed during the night within a predefined time period.
- The Personal Trigger, which is worn round the neck, on the wrist or attached to an item of clothing (Figure 1: 6). It can enable a call for help anywhere in the home or garden within a 50m range of the Lifeline home unit. Both operate on the 173MHz frequency.
- The fall detector detects both the impact and angle of a fall and can automatically raise an alert after a fall.

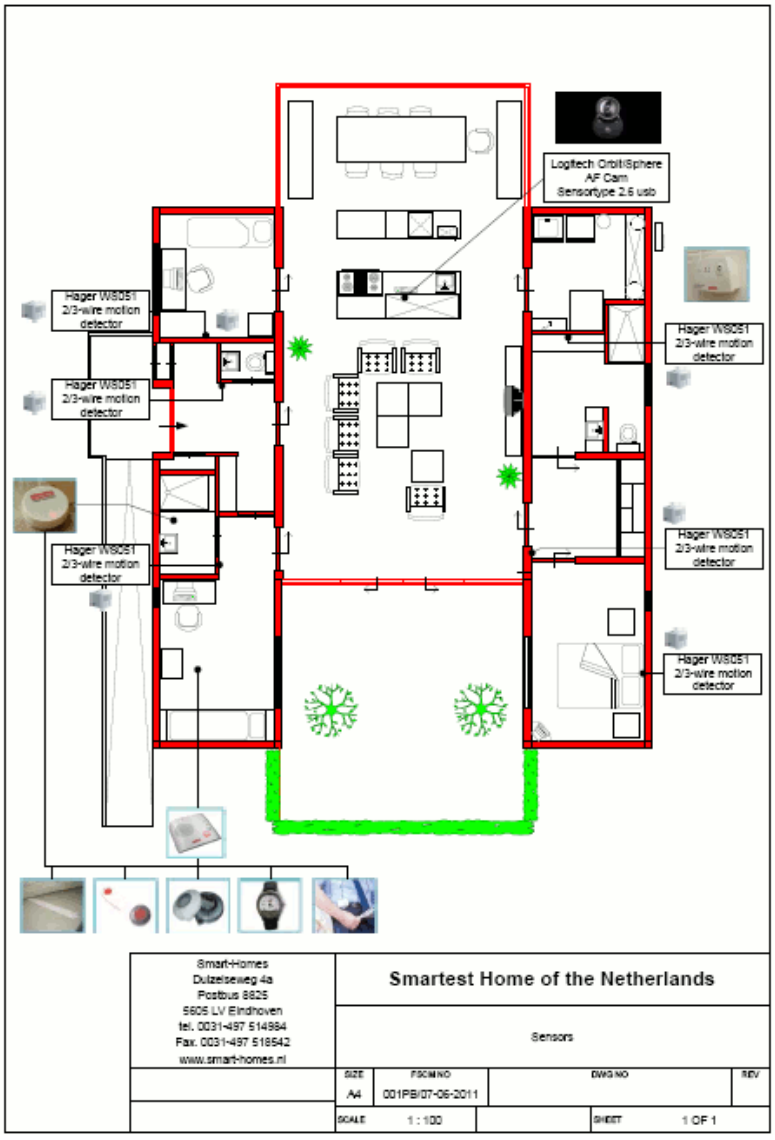

Figure 10 - Smart home

4.1 Ambulatory Care Service

Remote Vital Sign Monitoring

1. The clinical parameters which may be controlled by the system are the following: heart rate, respiratory rate, temperature, blood pressure, weight, oxygen saturation, electrocardiogram, glucose levels, physical activity, functional status and affective status.
2. Monitoring is performed according to "Observation Patterns". So, the system have absolute values for normality and abnormality for each clinical parameter evaluated:
   - **a.** When the clinical parameter evaluated is into "normal" range, the system doesn't send any alarm nor other parameters are evaluated (Observation Patterns don't work).
   - **b.** When the clinical parameter is into "abnormal" range, the system sends an alarm to caretaker centre even if other clinical parameters are in normal range.
   - **c.** When the clinical parameter is into "grey zone" (not normal, not abnormal), the Observation Patterns are performed. It means other clinical parameters are taken in account and then the system takes a decision:
     - **i.** Send an alarm to caretaker centre.
     - **ii.** To repeat the measures some time after (15 minutes, 30 minutes, etc.)
     - **iii.** The measure is rejected.

In addition to other clinical parameters evaluated, the system takes in account the activity level of patient and the duration of measure alteration.
The objective of using Observation Patterns is to avoid sending "false alarms" or alerting from clinical measures without clinical significance.

EXAMPLE
Below, clinical parameters of a patient at rest in different clinical situations are described and interpreted according to system configuration.
Values for normality and abnormality for these parameters are shown in the following figure:

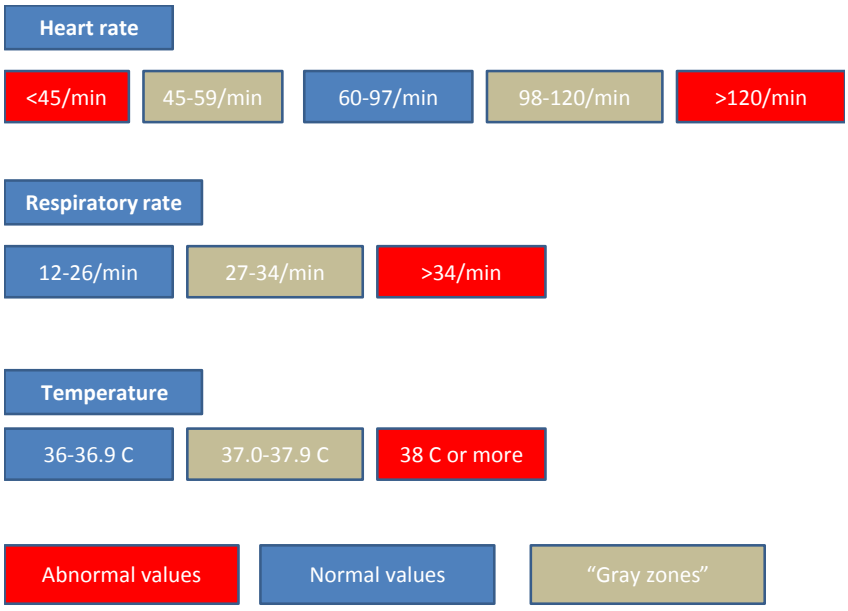

Figure 11 - Vital sign monitoring example

Clinical situation 1:
Heart rate: 140/min (at rest)
Respiratory rate: 16/min
Temperature: 36,5 C
In this situation heart rate is into abnormal range, then the system send an alarm to caretaker site regardless of the values for other clinical parameters. The diagnostic is taquycardia.

Clinical situation 2:
Heart rate: 80/min
Respiratory rate: 16/min
Temperature: 37,6 C.

In this situation temperature is neither normal nor abnormal ("gray zone"). That is why observation patterns are applied (other clinical parameters are considered to define a diagnostic or decision). The observation pattern for this situation is the following:

Combination of findings with clinical sense			**System sequential responses**		
Temperature (C)	**Hear Ratio (bpm)**	**Respiratory Rate (rpm)**	**Action 1**	**Action 2**	**Action 3**
Normal	Normal	Normal	No alarm necessary		
37.5-37.9	Normal	Normal	repeat in 10 minutes	repeat in 30 minutes	alarm: FEVER
37.5-37.9	97-119	Normal	Alarm: FEVER		
37.5-37.9	Normal	27-34	Alarm: FEVER		
37.5-37.9	97-119	27-34	Alarm: FEVER		

Table 1: Observation pattern

As we can see in according to this Observation Pattern, the clinical decision from the system is to repeat the measurements in 10 min. At the other hand, if heart rate and/or respiratory rate are elevated (for example 110/min and 29/min, respectively) the system will send an alarm with diagnostic as FEVER.

Currently, the system has Observation Patterns for evaluation of temperature, heart ratio, oxygen saturation and respiratory rate. Observation Patterns for heart failure, chronic obstructive pulmonary disease and other diseases are in progress (these will consider other clinical parameters like weight, reaction from heart rate and respiratory rate to effort, and others.

3. The most important diseases for monitoring (because functional impact, hospitalizations, mortality and institutionalization caused by them) in elderly people with comorbidity are the following:
    - **a.** Heart failure
    - **b.** Chronic respiratory disease, mainly COPD.
    - **c.** Osteoarticular diseases.
    - **d.** Cardiovascular risk factors: mainly hypertension and diabetes mellitus
    - **e.** Stroke

The diseases or clinical situations that may be controlled by the system are the following:
- **a.** Heart failure.
- **b.** Chronic respiratory disease:
    - **a.** Chronic obstructive pulmonary disease (COPD).
    - **b.** Asthma
- **c.** Cardiovascular risk factors:

- Hypertension,
- Diabetes mellitus,
- Obesity.

d. Stroke (secondary prevention): functional status and cardiovascular risk factors monitoring.
e. Hipoxemya situations [5]
f. Depression
g. Osteoarticular disease: pain, functional impact.
h. Geriatric syndromes:
    a. Falls
    b. Constipation
    c. Urinary incontinence
    d. Cognitive impairment (geographic monitoring)

4. Videoconference

The physicians can contact to patients by videoconference through the system. Videoconference sessions may be performed in according to physicians or caretaker demand. The system sends an alert to patient (or relatives) when the physician or caretaker asks to contact with them.

Treatment and Medications

Give physicians the ability to prescribe medications, order exams, change charts, on mobile devices.

Specific Questioners

1. For monitoring elderly people with comorbidity, the physicians need information about physiological parameters (heart rate, respiratory rate, etc.) and information about functional status, symptoms intensity, mood status, which cannot be measured by medical sensors but by other instruments like clinical scales, medical questionnaires (often used in clinical practice). These may be applied by remote way by CAALYX-MV system (home system).

2. Physicians can apply the medical questionnaires and they have the following capabilities:

a. Physicians can choose medical questionnaires for patients from a list of them.
b. The questionnaire has a threshold level for alarm (example: alarm if the index [6] decreases 30% from last measure). Physicians may modify this threshold values.

3. Medical questionnaire currently available:
    a. Functional status:
        i. Basic activities: Barthel index.
        ii. Instrumental activities: Lawton index.
    b. Affective status or depression screening:
        i. Yesavage questionnaire [7] (5 items version).

Visual Services

The videoconference feature in the STB allows the user to call his doctor(s) and make a live consultation while staying at his home. The user is prompted with a list featuring the doctors that are following the patient and their specialty. The connection may also be in the reverse way, i.e. it can be the doctor to contact the patient. In CAALYX-MV, doctors are who call patients for videoconference. Patients will not call the caretaker.

Clinical History and Access

The system organizes clinical data collected from patients in five sections:

- Pathological background
- Basal situation: functional, mental and social status when the patient is stable.
- Clinical course: medical annotations introduced by physicians.
- Medical treatment.
- Assessments performed by the system trough medical questionnaires (about functional or mental status, depression screening, etc.).

Physicians can access to clinical history from personal computer or mobile phone with connection to the Internet (website system).

4.2 Social Care Services

Live Connections

Depending on the caretaker service policies, the user may also select between a list of friendly contacts and establish a video call with any of them. If the remote end doesn't support video, at least an audio call is started. The user may also use this service to contact a doctor out of the pre-scheduled appointments.

Calendar

The user is able to check his medical agenda through the STB user interface. He can check all his forthcoming appointments, as well as all information regarding his medical prescriptions and vital sign measurements using the provided sensors. A reminder service is also available, which will immediately warn the user when a new medical appointment is assigned and when the time of the next appointment, medication or measurement is approaching.

Social Smart Services

Smart Home components are already available and affordable. Older people could benefit from the integration of Smart Home components. User requirements analysis and evaluations, in situ, should shed light on the components that suit the users' needs (i.e. integration of webcam, KNX).

5 Potential CAALYX-MV services portfolio

Once the CAALYX-MV system has been explained and its basic services described, the time has come to develop a bit more how these services will be presented in the real Health Care market. That is why we need to process a little bit more how these basic services (i.e. emergency, ambulatory, social care services) will be combined to create a portfolio of marketable e-Health services. D2.1 is not intended to provide how these services will fit in the market, which is the task of D2.2 and D2.3. However, the main outcome of D2.1 is to propose a portfolio of e-Health services that eventually will be adapted to meet the expectations of the selected market segments.

In order to elaborate this portfolio, a nested list of services packages is presented according to the severity of patients' care needs. The same kinds of diseases can be develop in different stages on different patients and while ones will need continuous monitoring and care, others in previous stages of the disease only will need to have a soft care system which allow them to give feedback to the doctors about their condition. This distinction is remarkably important when considering saving money, and nowadays, that is the most important consideration when designing these kinds of portfolios. Next table describes how this portfolio looks like:

Commercial Service Name	Service Description	Rationale	Outcome
Soft care service	Patient agenda (i.e. appointments, drugs) Questioners Videoconference	For patients that only need to be follow-up and reminded to take their drugs	In all the different services it has been seek to reduce the number of visits to health care centres while increasing patients independence
Primary care service	**Home monitoring** Patient agenda (i.e. appointments, drugs) Questioners Videoconference	For patients that constantly need to attend the hospital for checking ups	
Extra Primary care service	**Smart home services** ***Home monitoring*** Patient agenda (i.e. appointments, drugs) Questioners Videoconference	For more fragile patients that constantly need to attend the hospital for checking ups and need to be	
Continuous care service	**T-shirt: Constant monitoring** ***Smart home services*** ***Home monitoring*** Patient agenda (i.e. appointments, drugs) Questioners Videoconference	For patients who need very frequently care and monitoring to avoid clinical exacerbations (heart failure, respiratory diseases, etc.).	

Table 2 - Services Portfolio

This categorisation of services is broad enough to be adjusted to specific situations related to different kinds of disease. The most important thing is having a service portfolio that can offer gradually different solutions depending on the severity of the patient. Next picture shows a different way to represent this portfolio of services.

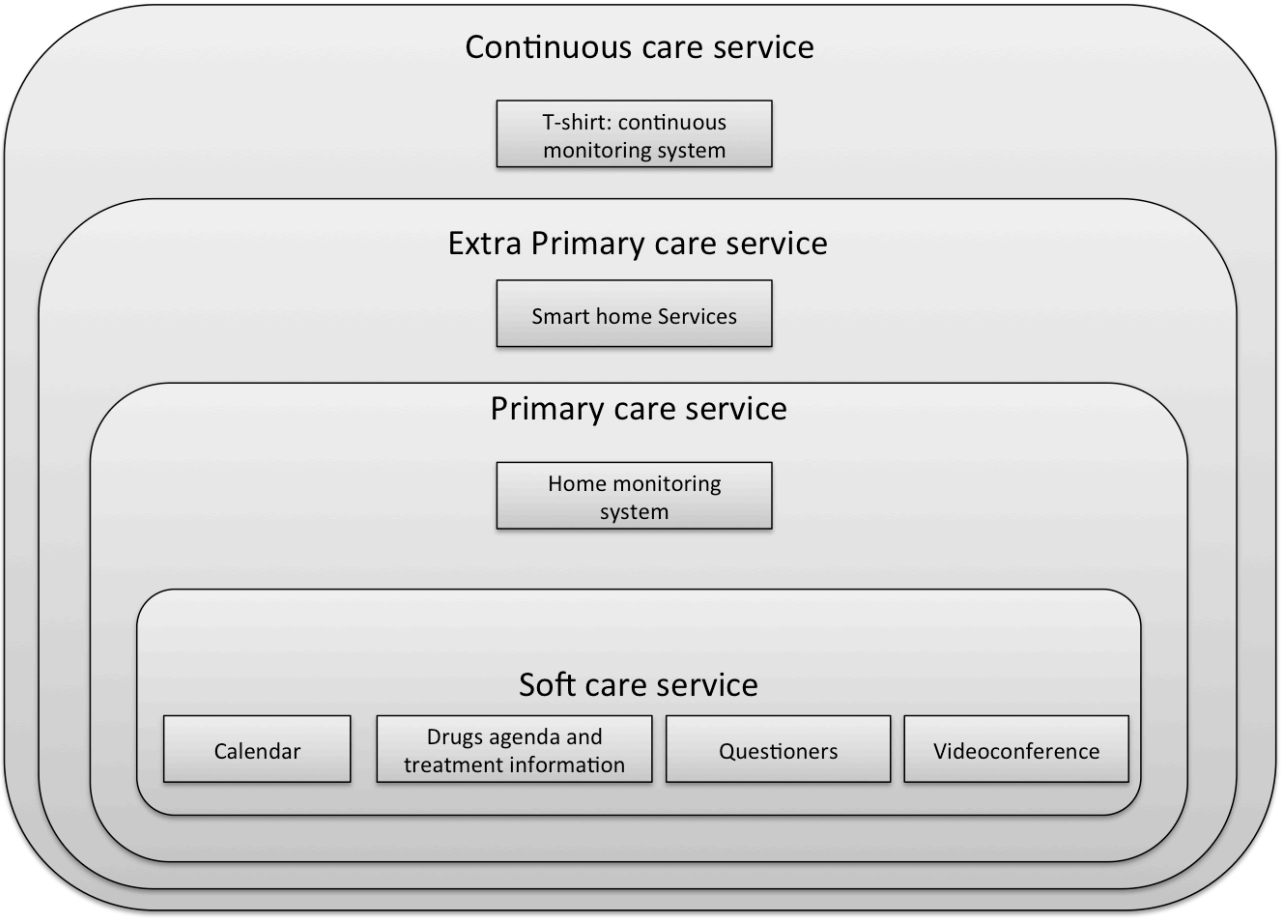

Figure 12 - CAALYX-MV services portfolio

6 Conclusions

In this deliverable, a portfolio of services has been indentified that could be commercially offered with the CAALYX-MV platform. D2.2 will describe the AAL market and opportunities for CAALYX-MV. The services have been already validated from the technical and medical point of view, but a market validation is needed in the pilot sites to ensure a successful deployment of CAALYX.

Next steps to be done in deliverables D2.2 and D2.3 are:

1- Update the state of the art in tele-health and tele-care markets. Services that users are demanding.
2- Bench marketing to know what is offered right now
3- Study the CAALYX-MV opportunities
4- Market segmentation
5- Business models to understand how to commercialise services and how the companies forming CAALYX-MV could make a sustainable and profitable business
6- Marketing strategies
7- Final list of marketable services

7 References

[1] eCAALYX project; funded by the European Commission under the Ambient Assisted Living (AAL) Joint Programme, “Deliverable D3-M15 -Scenario description”
[2] eCAALYX project; funded by the European Commission under the Ambient Assisted Living (AAL) Joint Programme, “Deliverable D4-M27 Requirement Specification”
[3] Noury N, Rumeaua P, Bourke AK, ÓLaighin GM, Lundy JE. A proposal for the classification and evaluation of fall detectors. IRBM doi:10.1016/j.irbm.2008.08.002 2008.
[4] Lyons GM, Culhane KM, Hilton D, Grace PA, Lyons D. A description of an accelerometer-based mobility monitoring technique. Med Eng Phys 27(6): 497-504, 2005.
[5] Internation Liaison Committee on Resucitation (1997). Special resuscitation situations, 34:129-149
[6] Tibaek, S. (2011). Is Barther index a relevant measure for measuring prevalence of urinary incontinence in stroke patients? PubliMed.gov, PMID: 22038557
[7] Counselling Resource Research Staff (2011). Geriatric Depression Rating Scale, A screening test for depression. Counsellingresource.com

8 Glossary

AAL: Ambient Assisted Living
ACS: Auto-Configuration-Server
ADL: activities of daily living
BAN: Body Area Network
BP: Blood pressure
BT: Bluetooth
COPD: chronic obstructive pulmonary disease
CPE: Customer Premises Equipment
CV: cardiovascular
DSL: Digital Subscriber Line
eCAALYX: Enhanced Complete Ambient Assisted Living Experiment
ECG : Electrocardiogram
EHR: Electronic health Record
GPS: Global Positioning System
HR: Heart Rate
ISS: Intelligent Sensor System
NIBP: Non-invasive blood pressure
OTS: Off-the-shelf
PPG: Photoplethysmograph
PTT: Pulse Transit Time
RR: Respiration Rate
SpO2: (Peripheral) Blood Oxygen Saturation
STB: Set-top box
USB: Universal Serial Bus
WBS: Wearable Body Sensor
WP: Work package