AAL-2011-4-078

Deliverable D-2.1
State-of-the-Art and Requirements Analysis

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***** Nature of the Deliverable****: P= Prototype, R= Report, S= Specification, T= Tool, O= Other*

Abstract: This deliverable presents use cases and application scenarios defining the MOBILE.OLD services, as well as state-of-the-art technology candidates for their implementation. The former are influences by the results of interviews on the pilot sites, which are summarized in this document. All of the above results in a number of technological- and user requirements.

The MOBILE.OLD Consortium consists of:

Participant no.	Participant organization name	Country
1 (Coordinator)	LIFEtool gemeinnützige GmbH	Austria
2	National Foundation for the Elderly	The Netherlands
3	Madrid Health Cluster	Spain
4	Ana Aslan International Foundation	Romania
5	SIEMENS PROGRAM AND SYSTEM ENGINEERING SRL	Romania
6	SEPROTRONIC GmbH	Germany
7	SAFEVIEW	Spain
8	BLUE POINT IT SOLUTIONS	Romania
9	AdvTEC Ltd.	United Kingdom
10	Upper Austria University of Applied Sciences	Austria

DOCUMENT REVISION HISTORY

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		Modification reason	Modified by
v.01	2012-07-16	First draft version of the deliverable	UoAS
v.02	2012-10-22	Integration of Inputs	UoAS
v.03	2012-10-23	Formatting and ready for review	UoAS
v.04	2012-10-25	Integration of Inputs from Review	UoAS

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Glossary

A

AAL	Ambient Assisted Living
ADT	Android Developer Tools
AIR	Adobe Integrated Runtime
AJAX	Asynchronous JavaScript and XML
ANE	AIR Native Extension
API	Application Programming Interface
APNS	Apple Push Notification Service
AS	Application Server

B

BMI	Body Mass Index

C

C2DM	Cloud to Device Messaging Service; deprecated push notification technology for Android
CDO	Care Delivery Organisation
CE-HTML	Consumer Electronics HTML; a HTML dialect for Smart TVs
CGI	Common Gateway Interface
CLI	Command Line Interface
CSS	Cascading Stylesheet
CURE	Center for Usability Research and Engineering

D

DAL	Data Access Layer
DOM	Document Object Model
DRM	Digital Rights Management

E

ECMAScript	Standard on which JavaScript and ActionScript are based

F

Flex	GUI Toolkit for the Flash platform by Adobe

G

GCM	Google Cloud Messaging; push notification technology for Android
GDP	Gross Domestic Product
GnuPG	GNU Privacy Guard, an implementation of OpenPGP
GPS	Global Positioning System; component present in most Smartphone permitting access to the device's location.
GUI	Graphical User Interface
GUID	Globally Unique Identifier
GWT	Google Web Toolkit

H

HDMI	High-Definition Multimedia Interface
HTML	HyperText Markup Language
HTML5	New version of the HTML standard with improved Web 2.0 feature standardization process not yet complete.

I

ICT	Information and Communication Technologies

IDE	Integrated Development Environment
I/O	Input/Output

J

JS	JavaScript
JSON	JavaScript Object Notation

K

L

M

MAC Address	Media Access Control address
mHealth	Healthcare services supported by mobile devices

N

NDK	Native Development Kit
NFC	Near-Field Communication
NHS	National Health Services (United Kingdom)
NUI	Natural User Interface

O

OpenPGP	Open Pretty Good Privacy, a cryptographic method of ensuri authenticity and confidentiality of transmitted data.
OS	Operating System

P

Persona	Fictional stereotypical members of the target audience

PSTN	Public Switched Telephone Network
PT	Physical Training
PTNH	Personalized Transportation News Headlines

Q

R

R&D	Research and Development
REST	Representation State Transfer; a HTTP-based web service protocol
RSS	Rich Site Summary; an XML-based content syndication format

S

Scenario	Description of a persona using a product to achieve a goal
SDK	Software Development Kit
Smart TV	Television with extended functionality for using the Internet and interactive content
SMS	Short Message Service; synonym for the message itself
SNS	Social Networking Service
SOAP	XML-based web service protocol
SSL	Secure Sockets Layer

T

TCP	Transmission Control Protocol
TJP	Transnational Journey Planning
TNH	Transport News Headlines
TTS	Text-To-Speech

U

UR	User requirements

URI	Uniform Resource Identifier
Use Case	Description of a persona's interaction with a system for a certain purpose
uPnP	Universal Plug and Play

V

VoIP	Voice over Internet Protocol; the concept of performing voice communications over a standard Internet connection.

W

W3C	World Wide Web Consortium; Web technology standardization organization
WebKit	Widely used rendering engine for web browsers
WSDL	Web Service Description Language

X

XHTML	Extensible HTML; XML-based dialect of HTML

Y

Z

EXECUTIVE SUMMARY

In the first part, this deliverable defines the planned MOBILE.OLD services using Use Cases and Application Scenarios, which utilize personas in order to create a tangible vision of the services and how they benefit the target audience. These Use Cases and Application scenarios are refined based on interviews with older people on the four MOBILE.OLD pilot sites in Austria, The Netherlands, Romania, and Spain, which also serve as the base of the nation-specific user requirements presented in this document.

The latter part discusses technological aspects relevant to the project. The dominant state-of-the-art platforms in the areas of Smart TVs, smart phones, set-top-boxes, cross-platform tools, and service platforms, as well as various input/output technologies are presented and compared. Approaches for synchronizing data between smart TVs and smart phones are presented as well. Finally, technological requirements for the service implementations are listed.

1 INTRODUCTION

> *"The MOBILE.OLD project aims to provide a combined smartphone and TV-based service infrastructure with residential and outdoor services that will be delivered in a highly personalized and intuitive way and will advance the mobility of older persons. The services will be provided in a cost-effective way aiming at independent living and sustained mobility, reinforcing activation, maintaining the health status, providing cognitive benefits, thus preventing isolation, depression, increased morbidity and loneliness."* – MOBILE.OLD Project Proposal (LIFEtool gemeinnützige GmbH, 2011)

Essentially, MOBILE.OLD aims to provide so-called *services* to users, which are mutually complimenting Smart TV and smartphone applications, backed by a web service infrastructure, that enhance the users' mobility.

In order to reach the goal described above, a wide variety of hardware and software technologies is necessary. Although this project is based on previous ones, such as HERA and HOMEdotOLD, the technology choices can only be re-used to a limited degree, since many things have radically changed since those projects, among others the explosive growth of the available devices on the Smart TV market. Therefore, current options are revisited in this document.

In order to create a product that suits the needs of the target audience, the whole creation process must be centered around the users. This is why this document presents a user-centered design process, which proposes interviewing the users to determine their needs and the potential usefulness of MOBILE.OLD services, as well as modeling the interaction with the services using personas and use cases.

1.1 SCOPE

This document captures user requirements and use cases for the MOBILE.OLD services introduced in the projects proposal.

Furthermore, this document investigates the leading available technologies in the areas of Smart TVs, Set Top Boxes, Smartphone platforms, service platforms, and cross platform development tools, as well as (web service) technologies to connect endpoints on various devices.

The presented platforms, devices and technologies represent established industrial standards, as well as promising newcomers in emerging fields such as Smart TVs, where an industry standard is yet to be established. Overall, the presented technologies represent the state-of-the-art in the fields relevant to the MOBILE.OLD project.

This document does *not* necessarily reach definitive conclusions pertaining to which technologies will be actually relevant in the process of creating prototypes guided by the defined use cases and scenarios. The provided summaries and conclusions are merely suggestions, aimed to support executive decisions.

1.2 DELIVERABLE STRUCTURE

The following chapter 2 presents the user requirements capturing process, along with the personas used in it. Based on those, use cases and application scenarios are provided, which create a more concrete definition of the MOBILE.OLD services.

This chapter also lists the results of interviews with older persons on the pilot sites in Austria, the Netherlands, Spain, and Romania, along with the nation-specific user requirements resulting from the use cases and interviews.

Chapter 3 provides an overview of the project architecture, the kinds of devices involved in it, and the technologies necessary to provide the MOBILE.OLD services.

Services similar to MOBILE.OLD, commercial as well as non-commercial, are described in chapter 4.

In chapter 5, state-of-the-art technologies from all fields relevant to the project are introduced and compared in detail. This includes modern representatives of mobile platforms, Smart TV platforms (specialized TV sets as well as middleware and set-top-boxes), cross-platform tools, service platforms, input/output technologies, and technologies relevant to connecting Smart TVs and Smartphones. The chapter is split into those categories. The categories themselves dedicate a section to each technology belonging to the category, and provide a summary for easy comparison.

Technical requirements are discussed in chapter 6. They describe the main constraints which ensure that the solutions created in the course of the project achieve their goal accurately and with satisfactory quality.

The document is concluded by an overall summary of the findings herein, and the conclusions that can be drawn from them. This chapter summarizes the previous chapters' conclusions.

The appendices contain the questionnaire used for the user interviews.

1.3 METHODOLOGY

A user-centered design process is used to define the MOBILE.OLD services in detail, in order to ensure that the services target actual needs of older people. This process introduces personas – stereotypical members of the target audience – which are used to create use cases describing how a might persona uses a MOBILE.OLD service. Application scenarios are based on those use cases, and provide a clearer description of how the service is supposed to work. Use cases and application scenarios are validated and improved using interviews with members of the target audience on the pilot sites in Austria, The Netherlands, Romania, and Spain.

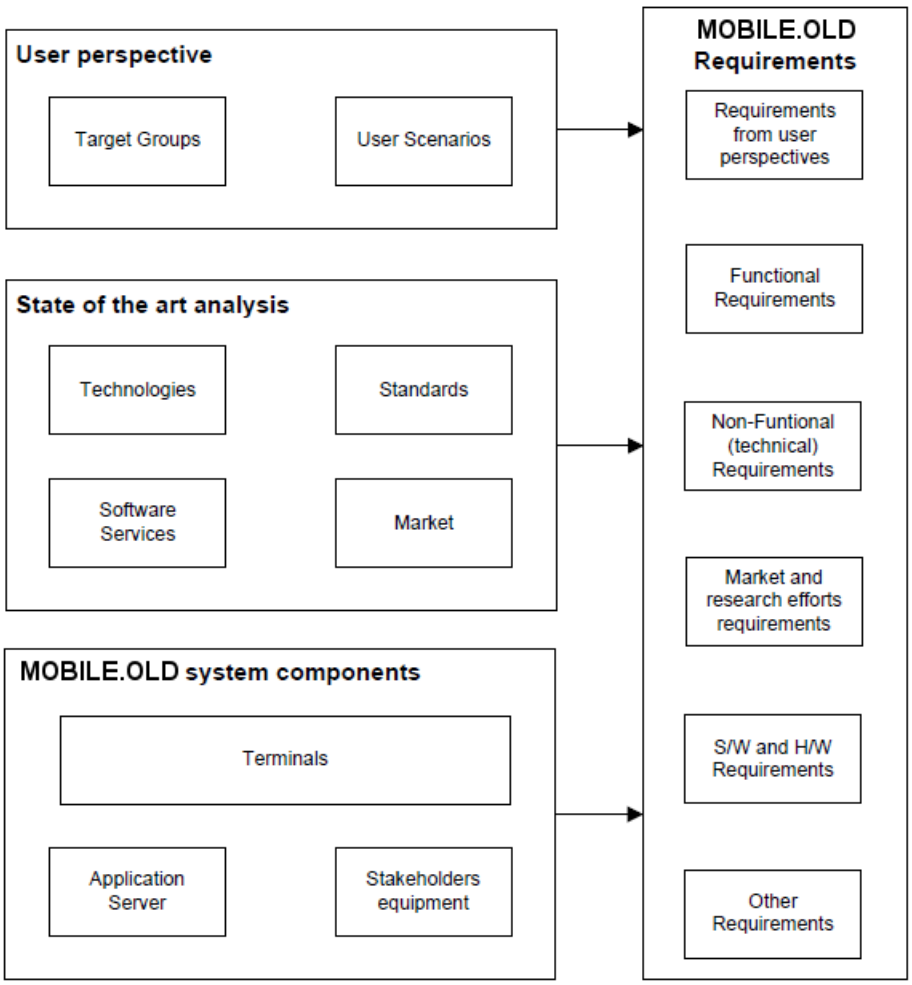


Figure 1: Methodology followed during requirements capturing

User requirements are derived from the sum of all information gathered from the use cases, application scenarios, and interviews.

In general, all kinds of requirements are based on the materials aggregated in this document, which are part of the categories “User perspective”, “State of the art analysis” and “MOBILE.OLD system components” as seen in Figure 1: Methodology followed during requirements capturing

The descriptions of technologies in this document were compiled based on sources with high probability of reliability, such as company web sites, project home pages, standardization documents, or renowned news outlets and other sources. References to sources are supplied where applicable. Additionally, information about technologies was derived from experiments and experiences of the contributors to this document.

1.4 NOTES

Sources in this document are cited using GOST title-ordered syntax. Images that have no source specified, or lack the “unknown source” annotation were created by the contributors of this document.

Throughout the document, dates are written in the following ISO 8601 compliant format:

YYYY-MM-DD

Examples: 2012-12-12 (December 12th, 2012), 2013-01-02 (January 2nd, 2013)

2 USER REQUIREMENTS ANALYSIS

2.1 INTRODUCTION

The user requirements collection is a research exercise which should be undertaken early in the MOBILE.OLD project to establish and qualify the main objectives. The aim of the research is to understand the product from a user's perspective, and to establish users' common needs and expectations. The requirements capture findings are used to balance the business goals with the user needs to increase the chance that the project will be successful. The main advantages of the user requirements collection is the saving of time and money by validating the scope of the project against its users' needs and expectations before any work begins. The user requirements are subject throughout the project progress.

2.2 USER REQUIREMENTS CAPTURE METHODOLOGY

This section establishes the methodology for collecting user requirements (UR) in the MOBILE.OLD project. User requirements collection and analysis aims at providing insights on user needs, as well as on the nature of the MOBILE.OLD services. The UR methodology that is followed in MOBILE.OLD, includes the usage of personas, the definition of a number of draft use cases for the MOBILE.OLD services by the pilot organizations and the technical partners of the Consortium, and the formulation of some application (usage) scenarios, on the basis of the use cases, which will also orient the evaluation activities of the project. Collectively, use cases, scenarios, and personas constitute a powerful technique for user-centered analysis and design. Use cases capture the overall functional behavior of a product; personas specify a (diverse) set of target users for a use case and can therefore express accessibility requirements; and scenarios, linked to specific use cases, describe a real-life sequence of events for a real user. It should be noted that, similarly to the use cases, the usage scenarios are subject to revisions throughout the project progress and could be seen as indicative, although sufficiently robust scenarios. Then, on the basis of these use cases and usage scenarios, free discussions as well as qualitative and quantitative face-to-face interviews are conducted which are based on pre-defined guideline questionnaires. This interaction with the end users helps the Consortium to refine the use cases and derive a number of user requirements as well as functional requirements for the MOBILE.OLD services.

2.3 USER REQUIREMENTS CAPTURING PROCESS

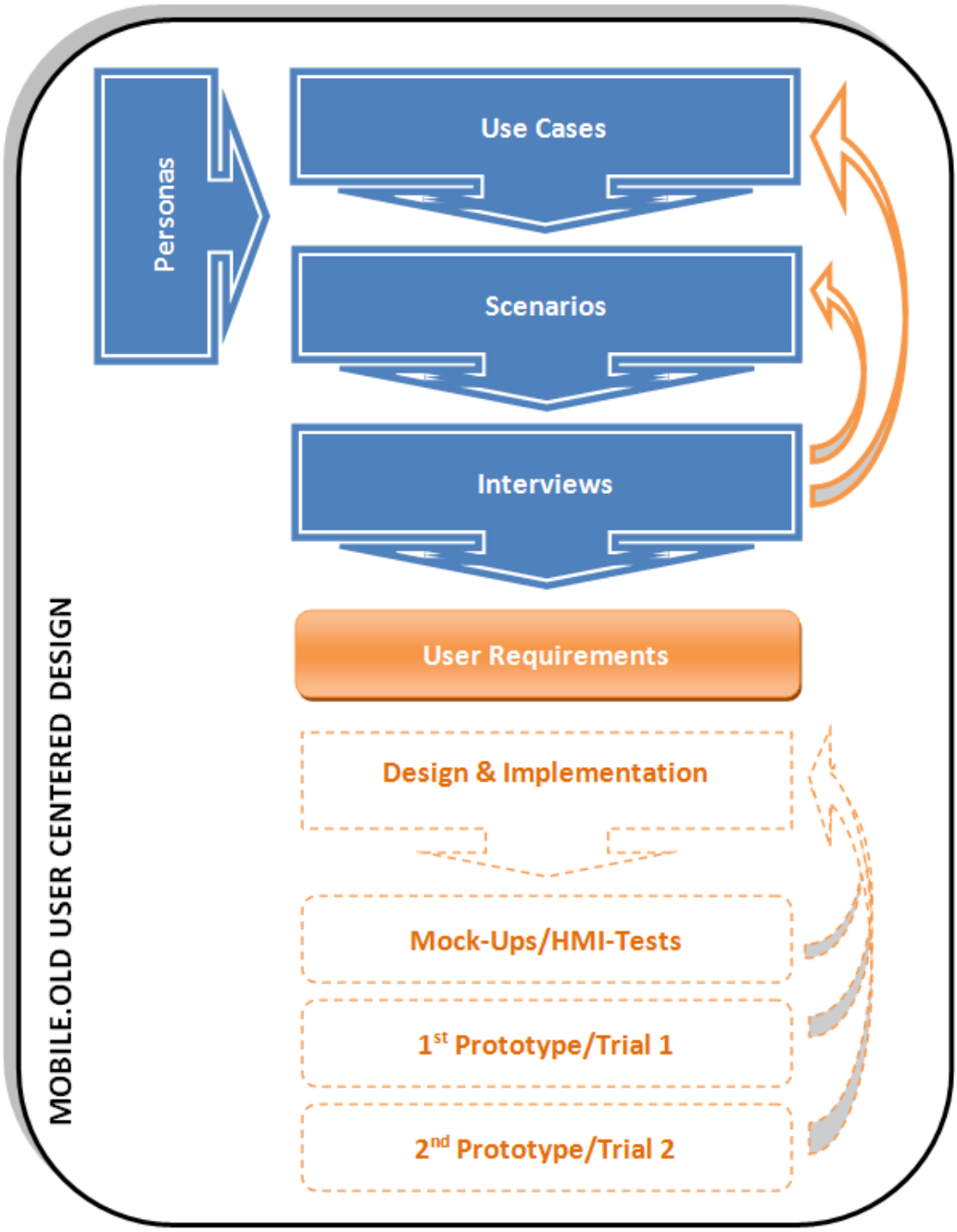


Figure 2: Use requirements capturing process

2.4 PERSONAS

Personas are a design tool based on the ideas of (Cooper, 1999). The aim of the Persona method is to raise the empathy for the end users in development teams through virtual user models and as a means for communicating peer group definitions. Personas allow developers to define which users they are developing products for. They are "specific types of individuals with specific needs". According to (Cooper, 1999) Personas are "a precise descriptive model of the user, what he wishes to accomplish, and why." As an archetypical figure Personas can guide decisions about product features, interactions, and even visual design and assure an effective user-based end product. Personas are considered to be a strong tool for interaction design processes as this method also allows incorporating other techniques.

Personas are based on the behaviors and motivations of real people. They represent them throughout the design process". Personas build consensus and commitment to the design and measure the design's effectiveness. In general they show the nature and scope of the design problem. Personas determine what a product should do and how it should behave. They are a communication tool for stakeholders, developers and other designers. Furthermore, Personas also contribute to other product-related efforts such as marketing and sales plans.

Personas create…

- an understandable form of user data
- a transparent, vivid and realistic representation of complex and abstract data
- sympathy and empathy for the target user group
- a unified representation of the target group in the design team
- a strong focus on the target group and essential aspects
- the possibility for realistic and efficient user scenarios
- a reduced complexity of problems
- time-saving development cycles

Alan Cooper distinguishes between primary and secondary personas. The primary persona represents the main targeted users; it is therefore the main driver for designing the application's user interface. A secondary persona has additional needs; people who fit this description can use the primary persona's interface only if changes are made to address these needs. Of course, these changes must not conflict with the interface needs of the primary persona or those of other secondary personas.

Within the MOBILE.OLD project 5 personas (Mr. Johnson, Siegfried Trauer, Helmuth Schlingel, Doris Schwester, Peter Meister) are chosen from the CURE-Elderly databases which represent the targeted user group best. These personas are acting as primary users throughout the offered services. Another persona assumes the role of a caregiver who is acting as secondary user concerning the Geofencing service. The solution will also satisfy the caregiver's needs as best as it can. Moreover 9 personas (Monica, Maria, Laura, George, Valeriu, Mircea, Lucretia, Ovidiu and Mariana) were created from a Romanian perspective and 5 from a Spanish

perspective, making it possible to obtain a European representation of end-users in the definition of the use cases and application scenarios.

2.4.1 MR. JOHNSON

Mr. JOHNSEN

Odense, Denmark

Well aged

Age: 88

Household | Social contacts | Income

Cognitive:
Memory:
Diseases:
Symptoms:
Limitations:

About & Family:

Mr. Johnsen lives with his wife outside of the city, and their daughters live in the city center. They maintain frequent contact over the phone or meet on weekends. Mr. Johnsen and his wife have no financial problems. They live in a country house with a big garden.

Limitations/Difficulties in

none

Health

He has no diseases except for cataracts. He has no limitations in his daily life and is active in their garden. He can hear well and does not need glasses.

Diseases

cataracts

Symptoms

none

Social

He is satisfied with his life and is generally a happy person. He feels free and able to do what he wants. He and his wife like travelling and going on trips together with friends. Mr. Johnsen maintains good communication with his grandchildren and often takes care of them together with his wife when their parents are busy or out of town.

Psychographics

happy,
positive,
joyful,
communicative

Drugs

none

Hearing

good

Eyesight

cataracts

Educational level

basic

Risks

none

Technology Usage

He does not like mobile phones and is generally skeptical about technological devices. He does, however, have a mobile phone which he uses occasionally when on a holiday or trip. It is otherwise turned off. He likes watching TV.

General Attitude towards Technology

negative

Media - Communication

TV
mobile phone

http://elderlypersonas.cure.at

2.4.2 SIEGFRIED TRAUER

Siegfried TRAUER

Euskirchen, Germany

Mourning

Age: 82

Household | Social contacts | Income

Cognitive:
Memory:
Diseases:
Symptoms:
Limitations:

About & Family:

Siegfried was a salesman and has enough savings for the rest of his life. He does not want to be alone but also does not want to leave his flat and live in a nursing home. He receives nursing care at home and meals on wheels service. Siegfried lost his wife recently. They had been together for almost 60 years. Since they didn't have children he is now alone without any living family.

Limitations/Difficulties in

getting up from chair,
lifting or carrying weights over five kilos,
using a map in a strange place,
preparing a hot meal,
doing work around the house or garden

Health

He does not have any physical diseases but suffers from psychosomatic symptoms such as heart trouble, blackouts, dizziness, etc. He receives psychological treatment. He does not have much energy and feels physically weak. He uses glasses but cannot see well or hear well.

Diseases

none

Symptoms

heart trouble,
dizziness,
blackouts,
depression
sleeping problems,
breathlessness

Social

Siegfried thinks that he has gotten old and it is preventing him from acting freely. He is actually a satisfied and social person but feels depressed and sad. However, he regularly visits the local seniors' club and meets friends there.

Psychographics

depressed,
sad,
introverted,
sentimental,
needs support

Drugs

yes

Hearing

less than good

Eyesight

less than good, glasses

Educational level

medium

Risks

none

Technology Usage

He likes listening to music, on his old LP player. He is interested in technological devices but does not see himself as competent enough to be able to learn to use new devices. He does not like watching TV but it is his main information source.

General Attitude towards Technology

neutral

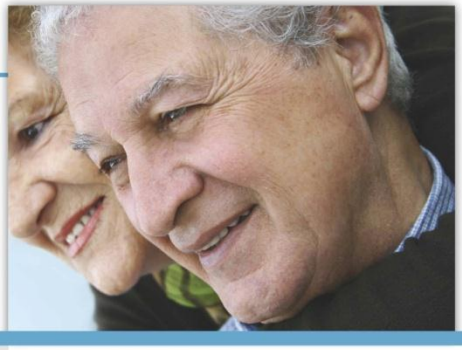
Media - Communication

TV
LP Player

http://elderlypersonas.cure.at

2.4.3 HELMUTH SCHLINGEL

Helmuth SCHLINGEL — Bregenz, Austria



Well aged

Age: 88

Household | Social contacts | Income

Cognitive:
Memory:
Diseases:
Symptoms:
Limitations:

About & Family:

Helmuth lives with his wife outside of the city, and their daughter lives in the city center. They are frequently in contact over the phone or meet on weekends. Helmuth and his wife have no financial problems. They live in a country house with a big garden.

Limitations/Difficulties in

none

Health

He has heart problems but does not need drugs yet. He does not have limitations in his daily life and he is active in their garden, which is good for his heart. However, he is overweight and likes eating fatty meals such as steak. He uses a hearing aid and reading glasses but he is not satisfied with them. He says that he cannot hear or see well enough.

Diseases

heart problems

Symptoms

none

Social

He is satisfied with his life and is generally a happy person. He feels free and able to do what he wants. He and his wife like travelling and going on trips together with friends. Helmuth has good communication with his grandchildren.

Psychographics

happy,
positive,
joyful,
communicative,
eager

Drugs

none

Hearing

aid

Eyesight

glasses

Educational level

basic

Risks

overweight

Technology Usage

He does not like mobile phones and is generally skeptical about technological devices. He does, however, have a mobile phone which he and his wife occasionally use when on a holiday or trip. It is otherwise turned off. He likes watching TV.

General Attitude towards Technology

negative

Media - Communication

TV
mobile phone

http://elderlypersonas.cure.at

2.4.4 DORIS SCHWESTER

Doris SCHWESTER

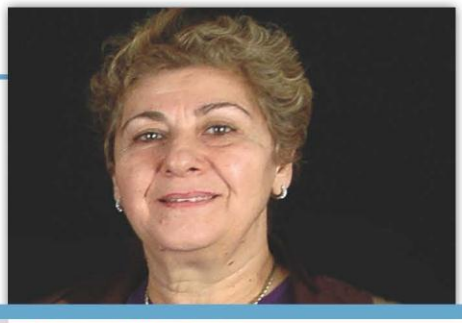
Wels, Austria

Living alone, faithful

Age: 73

Family & Home | Social contacts | Income

Cognitive:
Memory:
Diseases:
Symptoms:
Limitations:



About & Family:

Doris lives alone in her apartment. She has no children or any living family members. Being a religious woman, Doris spends her time praying and in solitude. She was never married and lived until her 50s together with her mother, and took care of her until her death. She has a small pension that barely covers her costs at the end of the month.

Limitations/Difficulties in

climbing several flights of stairs,
shopping for groceries,
doing work around the house or garden

Health

She does not have any diseases or complaints, however she notices that she is getting old when she has difficulties in climbing stairs or doing work around the house. Last year she had an investigative cardiac catheterization but the result was negative.
She can hear well, but needs reading glasses. Due to her concentration problems and her weak memory, she has difficulties in shopping and either forgets to buy things or buys things that she already bought multiple times.

Diseases

none

Symptoms

none

Social

Doris is a lonely person in her daily life. She has some acquaintances but no close friends. She regularly attends the church; however, she does not partake in sports or social activities. Even though she is thankful for being healthy and alive, she sometimes feels sad and very alone.

Psychographics

satisfied,
religious,
modest,
forgetful,
lonely,
obedient

Drugs

none

Hearing

good

Eyesight

glasses

Educational level

medium

Risks

social inactive

Technology Usage

She has a mobile phone that she does not use much. At home she has an old TV, which is her main source of information about daily news. She is used to silence and likes reading books. She does not have a computer.

General attitude towards technology

neutral

Devices in use

TV,
mobile phone

2.4.5 PETER MEISTER

Peter MEISTER

Vienna, Austria

Bon vivant artist

Age: 68

Family & Home | Social contacts | Income

Cognitive:
Memory:
Diseases:
Symptoms:
Limitations:

About & Family:

Peter was a sculptor coming from a rich family and did not need to worry about his retirement days. He is quite healthy and has no diseases or age-related limitations.

He never married but has had long-term relationships. He is now single and has no living family members.

Limitations/Difficulties in

none

Health

Except for his glasses, he does not need any medical aid or support. He does not have any diseases or limitations and he does not feel old yet. He smokes heavily and drinks regularly, sometimes in excess. Although he has many social contacts, he recently started feeling lonely and sad as he lost some of his close friends. Some of his other friends have moved into nursing homes because of their health problems.

Diseases

none

Symptoms

none

Social

As a young man, Peter was very popular amongst his friends and was always invited to events. He is still locally well-known as an artist. He was never interested in being a mentor for younger artists and always did everything alone. He visits a couple of coffee houses and bars regularly and meets friends there. He is keen on having fun, drinking alcohol and smoking.

Psychographics

active,
self-oriented,
feels lonely sometimes,
satisfied with life,
likes having fun

Drugs

none

Hearing

good

Eyesight

glasses

Educational level

medium

Risks

drinks
smokes

Technology Usage

Peter has a mobile phone, which he always takes with him in order to be available to his social contacts, as he spends most of his time out of his flat. He has a computer and internet connection but uses them rarely. He does not have a TV and mostly stays informed about daily issues via friends and newspapers.

General attitude towards technology

positive

Devices in use

computer with internet connection,
mobile phone

2.4.6 MONICA

Locality: Romania

Age: 65

General Characteristics:

- **Household**: With her daughters
- **Social contacts**: Neighbourhoods and family
- **Income**: Medium
- **Cultural level**: Medium
- **Cognitive**: Good
- **Diseases**: Impaired glucose tolerance

About & family:

Monica was technician. She is divorced. Actually she lives in an apartment with two of her daughters. She has four children. One of them lives with his family in a little village at four hundred kilometres and she visits them frequently. The other daughter lives in Chicago.
She has two grandchildren.

Social and activities:

- Shopping
- Housework (clean, preparing meal, paying bills)
- Read
- Travel
- Working with knitting needles

She likes: Meetings with relatives and friends

She doesn't' like: To depend on someone else

Health: She does not have any notable diseases and she feels good.

Technology Usage: She uses the mobile phone.

General Attitude towards Technology: Negative

Devices: TV, telephone, mobile phone, CD player

2.4.7 MARIA

Locality: Romania

Age: 79

General Characteristics:

- **Household**: Alone
- **Social contacts**: Family, friends and neighbourhood
- **Income**: Medium
- **Cultural level**: Medium
- **Cognitive**: Beginning to lose the memory
- **Diseases**: High blood pressure, slightly decreased visual acuity

About & family:

- Maria was nurse. Maria is widow. Actually she lives alone in her apartment. Sometimes she has high blood pressure and slightly decreased visual acuity. She has two children-daughter and son, and two granddaughters that she loves.

Social and activities:

- Shopping
- Housework (clean, preparing meal, paying bills)
- Read
- Going to church

She likes: Meetings with relatives

She doesn't' like: anything

Health: relative good health

Diseases: High blood pressure, slightly decreased visual acuity

Technology Usage: she uses the mobile phone.

General Attitude towards Technology: neutral

Devices: TV, telephone, mobile phone

2.4.8 LAURA

Locality: Romania

Age: 74

General Characteristics:

- **Household**: Alone
- **Social contacts**: Friends and family
- **Income**: Medium
- **Cultural level**: High
- **Cognitive**: Good
- **Diseases**: Osteoporosis, dyslipidaemia, gonarthroses

About & family:

Laura was a chemical engineer and she made many inventions. Actually she lives alone in an apartment. She has three children: two daughters and one son and two grandchildren. One of her daughter lives in Canada. Laura's sister lives in Russia.

Social and activities:

She is an active person, which practice moderate exercise.

- Housework daily
- 2 times per week she goes to the sports center
- Walking daily
- Travels to her relatives out of Romania
- Read, draw

She likes: Go to church, cycling

She doesn't' like: to depend on someone else

Health: Osteoporosis, dyslipidaemia, gonarthroses

Limitations: knees with low mobility

Technology Usage: She loves computers. She can use Internet-chatting with her daughter in Canada, and she use electronic bank frequently.

General Attitude towards Technology: She loves it.

Devices: TV, mobile phone, computers, radio

2.4.9 GEORGE

Locality: Romania

Age: 70

General Characteristics:

- **Household**: With his wife
- **Social contacts**: Son and friend
- **Income**: Medium
- **Cultural level**: High
- **Cognitive**: Good
- **Diseases**: Not notable diseases

About & family:

George was a technician. Actually he lives in an apartment with his wife. They have one son and one grandson that live in the same city. George is an intelligent person who loves to help others and takes care of his bed-ridden wife.

Social and activities:

- Walking
- Read for long times
- Travel
- Meetings with friends
- Internet surfing

He likes: use computer

He doesn't like: The inactivity

Health: Without any notable illness and he feels good.

Technology Usage: He thinks that technology is a good tool for life

General Attitude towards Technology: Positive

Devices: Personal computer, mobile phone, TV

2.4.10 VALERIU

Locality: Romania

Age: 75

General Characteristics:

- **Household**: With his wife
- **Social contacts**: Friends and family
- **Income**: Medium
- **Cultural level**: High
- **Cognitive**: Good
- **Diseases**: not any notable diseases except slightly decreased visual and auditory acuity
- **Limitations**: not notable

About & family

Valeriu was economist. Actually he lives in an apartment with his wife of 70. They have a daughter that lives alone in another apartment. For a couple of days he has to live alone, because his wife is traveling abroad. He wants to handle the domestic chores without much help from his daughter, but he doesn't know how to use the home appliances and the user instructions aren't quiet explicit.

Social and activities:

- Walking on the city
- Read
- Meeting with friends
- Watching TV
- Help his wife with housework

He likes: Watch football matches on TV

He doesn't' like: not know how to use appliances

Health: Good

Diseases: None diagnosed

Limitations: He needs glasses for read

Technology Usage: He thinks that technology is a good tool for life

General Attitude towards Technology: Neutral

Devices: TV, mobile phone

2.4.11 MIRCEA

Locality: Cluj-Napoca, Romania

Age: 77

General Characteristics:

- **Household**: Alone
- **Social contacts**: Daughters and friends
- **Income**: Medium
- **Cultural level**: High
- **Cognitive**: Good
- **Diseases**: *Ischemic Heart* Disease, Mild depression

About & family:

Mircea was a teacher of French language at University. Actually he lives alone in an old house in Cluj after wife's death. He has two daughters. They are established for 27 years in Concord, a town located 29 km away from Boston, USA. He has a granddaughter and two grandsons. Mircea likes to spend time with his friends in the park.

Social and activities:

- Walking alone frequently on the small streets of the old town
- Play cards games with friends in the park
- Use the computer to communicate with his daughters
- In housework shift for oneself (clean, preparing meal, shopping)
- Read books or new articles about the history of Romania
- Write articles in local newspapers about the current problems of the elderly in Romania
- Travel for fishing in the lakes near the city

He likes: To read about history of Romania

He doesn't' like: Malice of the people

Health: He does not have any physical diseases and he feels good. He needs glasses for read

Technology Usage: He likes computers and he uses the mobile phone.

General Attitude towards Technology: Positive

Devices: Personal computer, mobile phone, TV, Radio

2.4.12 LUCRETIA

Locality: Romania

Age: 82

General Characteristics:

- **Household**: Alone
- **Social contacts**: Children, family and caregiver
- **Income**: Medium
- **Cultural level**: Medium
- **Cognitive**: Good
- **Diseases**: Moderate to severe osteoporosis

About & family:

Lucretia was a nurse who worked in a medical health advisory center. She is retired for 20 years. Actually, she lives alone in an apartment and has a caregiver throughout the day. She has 2 children who live in another city located 600 km away from his place of residence. Lucretia is religious and an active member of the Orthodox Christian community of his village.

Social and activities:

She isn`t an active person because three years ago was diagnosed with osteoporosis complicated with spinal injuries that required surgery.

- Housework daily with help
- Cooking, cleaning with help
- 4 times per week she goes to church
- Walking in the park daily with her caregiver
- Travels in groups organized by Christian community for elderly people to visit Romanian monasteries.

He likes: Participate in events with her family

He doesn't' like: The loneliness

Health: Poor health

Limitations: Limited physical mobility-particularly in the lower limbs, She needs glasses for read

Technology Usage: She can use mobile phone, TV

General Attitude towards Technology: She likes it.

Devices: TV, mobile phone, radio

2.4.13 OVIDIU AND MARIANA

Locality: Romania
Age: 78 (Ovidiu)
Age: 79 (Mariana)

General Characteristics:

- **Household** : Together
- **Social contacts**: Children, family, friends and neighbours
- **Income**: Medium
- **Cultural level**: Medium
- **Cognitive**: Beginning to lose the memory for Mariana
- **Diseases**: Mild form of mixed dementia on treatment (Mariana), High blood pressure (Ovidiu)

About & family:

Ovidiu and Mariana live in a house with garden. Ovidiu was engine driver and Mariana worked in a toxic environment as chemical operator. They have a son and two granddaughters. Ovidiu and Mariana love to go to the mountain from the beginning of their marriage.

Social and activities:

Ovidiu is very active and he wants to participate in community activities continuously. Mariana love to stay with her granddaughters or meet her old friends.

They frequently:

- Cooking meals and pastry
- Work in their garden
- Meet the friends, neighbours
- Gardening
- Chat with family
- Go to some activities of the municipal center for the elderly

They likes: , meetings with friends, chat about politics or social problems

They doesn't' like: To stay away from their son and his family

Health: Good Health for Ovidiu and poor health for Mariana

Diseases: They need glasses for read and write. Mariana has problems with her memory.

Technology Usage: Ovidiu likes computers and the mobile phone but Mariana uses just the mobile phone.

General Attitude towards Technology: Positive

Devices: TV, computer, telephone, mobile phone

2.4.14 JAVIER

Locality: Spain

Age: 71

General Characteristics:

- **Household** : With his wife
- **Social contacts**: Sons and family
- **Income** :Medium
- **Cultural level**: Medium
- **Cognitive**: Good
- **Diseases**: High blood pressure

About & family:

Javier was a clerk. Actually he lives in an apartment with his wife of 67. They had two sons. One of them lives in a little v and he visits them frequently and the other one lives in Madrid. They had a granddaughter. Javier is religious and an active member of the Christian community of his village.

Social and activities:

- Walking with his wife frequently
- Play cards games with friends
- Use the computer
- Collaborate in housework (clean, sometimes preparing meal, shopping)
- Read
- Travel with his wife and travel in groups
- Takes photos with his friends
- Dance
- Go to the beach

He likes: To make people happy

He doesn't' like: Bad mood of the people

Health: He does not have any physical diseases and he feels good.

Technology Usage: He likes computers and he uses the mobile phone.

General Attitude towards Technology: Positive

Devices: Personal computer, mobile phone

2.4.15 ISMAEL

Locality: Spain

Age: 67

General Characteristics:

- **Household** : With his wife
- **Social contacts**: Sons and family
- **Income**: Medium
- **Cultural level**: High
- **Cognitive**: Good
- **Diseases**: Not

About & family:

Ismael was a technician. Actually he lives in an apartment with his wife. They had three sons that live in different places. Ismael is an intelligent person that loves to help others and to participate in the social community of his village.

Social and activities:

- Walking in the forest
- Read for long times
- Travel
- Meetings with friends
- Gastronomy

He likes: Give professional help to others

He doesn't like: Anything

Health: Without any notable illness and he feels good.

Technology Usage: He thinks that technology is a good tool for life

General Attitude towards Technology: Positive

Devices: Personal computer, notebook

2.4.16 JULIA

Locality: Spain

Age: 66

General Characteristics:

- **Household** : With his husband and son
- **Social contacts**: Friends and family
- **Income** :Medium
- **Cultural level**: Medium-High
- **Cognitive**: Good
- **Diseases**: Any

About & family:

Julia was a secretary working in a public organization, retired recently. Actually he lives in an apartment with his wife of 67 and her son of 37.

Social and activities:

She is an active person, which practice moderate exercise and collaborate in several events.

- Housework daily
- 2 times per week she goes to the sports center
- Walking daily
- Travels in groups organized by regional government institutes for elderly people. Never out of Spain.

He likes: Participate in events

He doesn't' like: Anything

Health: Good health

Limitations: Left arm without mobility, He needs glasses for read

Technology Usage: She loves computers. She can use Internet, ad she use electronic bank frequently. She can gaming on her computer daily for a half hour.

General Attitude towards Technology: She loves it.

Devices: TV, mobile phone, computers, radio

2.4.17 TINA

Locality: Spain

Age: 75

General Characteristics:

- **Household** : With his husband
- **Social contacts**: Family, friends and neighbors
- **Income** :Low
- **Cultural level**: Low with interest in learning
- **Cognitive**: Beginning to lose the memory
- **Diseases**: No

About & family:

Tina was a housewife all of her live. Actually she lives in a house with garden with her husband of 75. He had good general health but he is lame. They had two sons and two granddaughters that she loves.

Social and activities:

Teresa is very active and she wants to participate in community activities continuously.

She frequently:

- Cooking meals and pastry
- Work in her orchard
- Chat with friends
- Go to the Gym and other activities of the municipal center for the elderly

He likes: Meetings, chat about politics

He doesn't' like: anything

Health: Good Health

Diseases: She needs glasses for read and write

Technology Usage: He likes computers and he uses the mobile phone.

General Attitude towards Technology: Positive 100%

Devices: TV, headphones, telephone, mobile phone

2.4.18 HONORIO

Locality: Spain

Age: 61

General Characteristics:

- **Household** : With his wife
- **Social contacts**: Friends and family
- **Income** :Medium
- **Cultural level**: Medium-High
- **Cognitive**: Good
- **Diseases**: Recovering from an stroke (ictus)
- **Limitations**: Left arm without mobility

About & family

Honorio was a steward. Actually he lives in an apartment with his wife of 61. They had a daughter that lives alone in another apartment. Honorio family help's him in task related with his physical limitations. He was an sportman in the past but now he can´t play any sport.

Social and activities:

- Walking on the city
- Physical exercise for his recovery
- Meeting with friends daily
- Walking on the forest

He likes: Watch football matches on TV

He doesn't' like: Cooking

Health: He is a positive and energetic person that strives to overcome his limitation

Diseases: Ictus

Limitations: Left arm without mobility, He needs glasses for read

Technology Usage: He doesn´t like technology

General Attitude towards Technology: Negative

Devices: TV, mobile phone

2.5 USE CASES

Introduced by Ivar Jacobson in 1992 (Zimmermann, et al., 2005), a use case defines a goal-oriented set of interactions between external personas and the system under consideration.

A use case is initiated by a user with a particular goal in mind, and completes successfully when that goal is satisfied. It describes the sequence of interactions between personas and the system necessary to deliver the service that satisfies the goal. It also includes possible variants of this sequence, e.g., alternative sequences that may also satisfy the goal, as well as sequences that may lead to failure to complete the service because of exceptional behavior, error handling, etc.

Thus, use cases capture who (persona) does what (interaction) with the system, for what purpose (goal), without dealing with system internals. A complete set of use cases specifies all the different ways to use the system, and therefore defines all behavior required of the system, bounding the scope of the system.

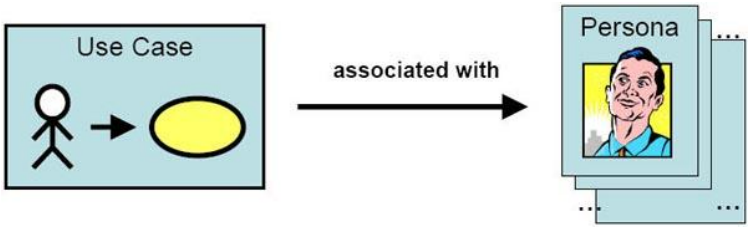


Figure 3: Every use case has associated personas (source: Zimmermann, et al., 2005)

Generally, use case steps are written in an easy-to-understand structured narrative using the vocabulary of the domain. This is engaging for users who can easily follow and validate the use cases, and the accessibility encourages users to be actively involved in defining the requirement.

Defining Use Cases…

1) The first step within the MOBILE.OLD use cases defining process is to determine which dynamic human computer interactions are essential for each service. E.g. concerning the personalized transportation news headlines: logging in at startup, read the news headlines, selection of news categories etc.
2) The second step is the creation of the specific use cases using the MOBILE.OLD use cases documentation template.

2.5.1 PERSONALIZED TRANSPORTATION NEWS HEADLINES

Use Case ID:	1.1
Use Case Name:	Personalizing the transportation news headlines using a Smart TV
Created By:	Gerard van Loon
Date Created:	2012-07-18
Personas:	Peter Meister
Description:	The 68 year old Peter Meister personalizes the services covered by the TNH service such that he will be informed about news for the area and means of transport he is interested in.
Trigger:	Mr. Meister wants to start using the TNH service for the first time and wants to personalize the service to his preferences.
Pre-conditions:	1. The user is at home and his Smart TV is switched on 2. A remote control is used for interaction with the TV 3. The user has chosen the MOBILE.OLD portal using his remote control 4. Remote control has an alpha-numeric keyboard 5. The profile has been set up in the main menu, giving preliminary information for the TNH service.
Post-conditions:	-
Normal Flow:	1. The user selects the TNH service from the portal 2. He selects the personalization item from the TNH menu 3. The personalization selection menu is displayed on the screen, with two options: the news on areas and the news on transport means. 4. The user selects the area selection item from the menu. 5. The list of possible area selections is presented: Regional, National, European with the last selected item highlighted. 6. The user selects one of the possible areas and confirms his selection
Alternative Flows:	1. The user selects the transport selection item from the personalization menu. 2. The list of possible transport selections is presented: bus, train, car, airplane with the last selected item highlighted. 3. The user selects one or several of the possible transport means and confirms his selection.
Frequency of Use:	1x per month

Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	1.2
Use Case Name:	Personalizing the transportation news headlines with social media contacts
Created By:	Gerard van Loon
Date Created:	2012-07-16
Personas:	Peter Meister
Description:	The 68 year old Peter Meister personalizes the services covered by the TNH service such that he will be informed and can publish information about incidents and news from the social network regarding the area and means of transport he is interested in.
Trigger:	Mr. Meister wants to start using the specific service with the social media for the first time and wants to personalize this section of the service.
Pre-conditions:	1. The user is at home and his Smart TV is switched on 2. A remote control is used for interaction with the TV 3. The user has chosen the MOBILE.OLD portal using his remote control 4. Remote control has an alpha-numeric keyboard 5. The profile has been set up in the main menu, giving preliminary information for the TNH service on the social networks he uses.
Post-conditions:	-
Normal Flow:	1. The user selects the TNH service from the portal 2. He selects the personalization item from the TNH menu 3. The personalization selection menu is displayed on the screen 4. The user selects the social network item from the menu. 5. The data supplied in the profile setting is presented. 6. The user can select the activation button on the social network link with the TNH service so that he can receive and give comments on incidents in transport.

Alternative Flows:	-
Frequency of Use:	1x per month
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	1.3
Use Case Name:	Consulting the regional transportation news headlines using a Smart TV
Created By:	Gerard van Loon
Date Created:	2012-07-16
Personas:	Mr. Johnson
Description:	Mr. Johnson consults the TNH to get information about news on the public transport for the trip he wants to make. He has to take the bus and the metro to arrive at his daughter's house. The information will be provided based on his profile information.
Trigger:	Mr. Johnson wants to make a trip with public transport to his daughter in the city center. He wants to know if there are any problems with public transportation.
Pre-conditions:	1. The user is at home and his Smart TV is switched on 2. A remote control is used for interaction with the TV 3. The user has chosen the MOBILE.OLD portal using his remote control 4. Remote control has an alpha-numeric keyboard 5. The user has set up his profile, with all his personal information. 6. The user has set up his personalization choices, being: regional and bus and metro 7. The user does not use a social network.
Post-conditions:	-

Normal Flow:	1. The user selects the TPH service from the portal 2. He selects the transportation news item from the TPH menu 3. The chosen means of transportation are displayed (bus and metro) with the information for bus displayed. 4. The user can browse through the news for bus using the navigation buttons on the remote control.
Alternative Flows:	1. The user selects the TPH service from the portal 2. He selects the transportation news item from the TPH menu 3. The chosen means of transportation are displayed (bus and metro) with the information for bus displayed initially. 4. The user navigates to the metro item in the menu and the news items about metro are displayed 5. The user can browse through the news for metro using the navigation buttons on the remote control.
Frequency of Use:	1 per week
Special Requirements:	Also information should be given about walking distance (physical status), poor illumination conditions during walk (safety!)
Assumptions:	-
Notes and Issues:	-

Use Case ID:	1.4
Use Case Name:	Consulting the national transportation news headlines for public transport using a smartphone
Created By:	Gerard van Loon
Date Created:	2012-07-16
Personas:	Peter Meister
Description:	Peter Meister is in a restaurant with his friends in the north of the country. He has planned on going home this evening. He consults the TNH on his Smartphone to get information about possible problems with the national public transport for the trip he has planned and see if he should expect any delays.

Trigger:	Mr. Peter Meister has planned a trip. He wants to know if there are any problems with public transportation.
Pre-conditions:	1. The user has switched on his Smartphone. 2. The user has chosen the MOBILE.OLD application on his Smartphone. 3. The user has set up his MOBILE.OLD profile. 4. The user has set up his personalization: national, bus and train. 5. The user does not use a social network. 6. The user has planned a trip with the transnational route planner.
Post-conditions:	-
Normal Flow:	1. The user selects the TPH service from the portal 2. The planned routes and chosen means of transportation are displayed. 3. The user chooses a planned route. 4. The news for the planned route is automatically displayed. 5. The user can browse through the current news of the selected route.
Alternative Flows:	1. The user selects the TPH service from the portal. 2. The planned routes and chosen means of transportation are displayed. 3. The user chooses a means of transportation (train). 4. The user selects the train item in the menu and the news items about the train are displayed. 5. The user can browse through the news for the train.
Frequency of Use:	1 per week
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	1.5
Use Case Name:	Consulting news in national transportation news headlines and sharing it in social media using a Smartphone
Created By:	Nina van der Vaart
Date Created:	2012-07-16

Personas:	Peter Meister
Description:	Peter Meister has planned a trip to visit a photo exposition with an ex-colleague. He will go by train to the museum, whereas his friend will come from another direction with the bus. He has his friend included in his social network that he is recently using. He wants to know if they will arrive more or less at the same time, so checks the TNH to see if there is any transport news. He sees that there is traffic on road and shares this news with his friend.
Trigger:	Peter Meister wants to know if there is any transport news that he can share with his friend.
Pre-conditions:	1. The user has switched on his Smartphone. 2. The user has chosen the MOBILE.OLD application on his Smartphone. 3. The user has set up his MOBILE.OLD profile. 4. The user has set up his personalization: national, bus and train. 5. The user uses a social network connected to the TNH services.
Post-conditions:	-
Normal Flow:	1. The user selects the TNH service from the portal. 2. The planned routes and personalized means of transportation are displayed: national, bus and train. 3. The user chooses a means of transportation: bus 4. The user browses the news items and sees an interesting item that he wants to share. 5. The user selects the social network icon next to the news and publishes it directly on this social network so his friend can see it.
Alternative Flows:	-
Frequency of Use:	1x per week
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

2.5.2 TRANS-NATIONAL JOURNEY PLANNING

Use Case ID:	2.1
Use Case Name:	Planning a transnational journey
Created By:	MSALC
Date Created:	19.09.2012
Personas:	Mrs. Tina
Description:	The user wants to make a transnational city trip for a long weekend. Through the interface on the TV she can easily plan her trip, while receiving personalized information and suggestions adapted to her level of mobility and preferences, such as the use of a car or public transport.
Trigger:	Mrs. Tina wants to make a transnational city trip to a neighboring country. She is looking for information on routes, maps, timetables, hotels and restaurants.
Pre-conditions:	1. The user is at home and his Smart TV is switched on 2. A remote control is used for interaction with the TV 3. The user has chosen the MOBILE.OLD portal using her remote control 4. Remote control has an alpha-numeric keyboard 5. The user has set up her profile, with all her personal information.
Post-conditions:	-
Normal Flow:	1. The user selects the TJP service from the portal 2. She selects the destination of the trip. 3. She confirms the origin of the travel (maybe her actual location can be offered to her like a default option) 4. The system asks which transport means she wants to use: car, public transport or airplane. 5. She selects car. 6. The system gives her an overview of a map with information on a recommended route, alternative routes, travel time, estimated costs in gasoline and toll. Based on her level of mobility, the system can suggest places for extra pauses. 7. The system asks if she wants to receive additional information on hotels, restaurants, camping, spa's, shops, etc.. 8. The user selects the additional information she wants > hotels. 9. She receives information on hotels adapted for special requirements (like accessible entrance). 10. She can browse through the information retrieved using the navigation buttons on the remote control. So she can contrast the information received and go back to change her preferences in order to get a complete information about the travel. 11. She can download the results to her Smartphone in order to show it to the family, friends and take it with her on the trip. .

Alternative Flows:	1. The user selects the public transport 2. The system gives a planned route on the public transport she has to use to reach her destination, including a time table, transfers from train. The planned route is adapted to her level of mobility and preferences, with enough time on the transfers. 3. She selects a route and browses through the information retrieved. 4. She downloads the results to the Smartphone to take it with her.
Frequency of Use:	1x per travel (1 time for year estimated)
Special requirements:	-
Assumptions:	-
Notes and Issues:	(In study) She can book the flights or the hotel reservations from MOBILE.OLD

Use Case ID:	2.2
Use Case Name:	Consulting information about a transnational journey
Created By:	MSALC
Date Created:	19.09.2012
Personas:	Mrs. Tina
Description:	The user consults the MOBILE.OLD Transnational Journey Planning service to obtain information on travel offers from a travel agency. She wants to obtain an overview on the different offers and compare them. Additionally she wants to check information on additional data on time tables, travel advice from the Embassy (whether a negative travel advice is brought out, due to an unstable situation in a country), estimated cost of flights and hotels, hospitals, etc. She wants to know if she can find additional difficulties but also compare offers with each other.
Trigger:	The user wants to have an overview of the offers from a travel agency. She wants to receive additional information on the destination from an objective non-commercial partner.
Pre-conditions:	1. The user is at home and her Smart TV is switched on 2. A remote control is used for interaction with the TV 3. The user has chosen the MOBILE.OLD portal using her remote control 4. Remote control has an alpha-numeric keyboard 5. The user has set up her profile, with all her personal information.
Post-conditions:	-
Normal Flow:	1. The user selects the TJP service from the portal 2. In the TJP service she clicks the button, see special travel offers. 3. The user selects an offer. 4. She receives all the details on the offer provided by the travel agency, including destination, amount of days, time tables, calendar, etc. 5. The user can select the button, related information. This will give her more information from a non-commercial nature, such as climate during the time of year, risks on diseases, travel advice from the Embassy, care systems, hospitals, etc.

	6. The user can browse through the information retrieved using the navigation buttons on the remote control. So she can contrast the information received and go back and change her preferences in order to get a complete overview on the travel. 7. She can download the results to her Smartphone in order to show it to her family, friends or return with them to the travel agency.
Alternative Flows:	1. The user selects the TJP service from the portal 2. She selects the destination and the origin from the TJP menu 3. She answers different questions about her interest 4. She receives too much information, or very poor. 5. She returns to the previous menu and fine the parameters for the search.
	1. The user selects the TJP service from the portal 2. She selects the destination and the origin from the TJP menu. 3. If a certain destination is not defined or not recommendable according to her profile (age, limitations etc.), the service will also recommend or type of transport according to her needs in order to propose a highly personalized transportation plan. 4. She evaluates the information and she refuses the travel or not
Frequency of Use:	1x per travel (1 time for year estimated)
Special requirements:	-
Assumptions:	-
Notes and issues:	(In study) The user can book the offer directly from MOBILE.OLD.

2.5.3 GEOFENCING

Use Case ID:	3.1
Use Case Name:	Detection of deviations from a geofencing zone defined for a planned route
Created By:	SIEMENS
Date Created:	2012-07-27
Personas:	Mr. Johnson
Description:	During a local, national or trans-national journey, the position of an older person is monitored and he or she is announced when deviations from the planned route occur.
Trigger:	The older person starts a planned local, national or trans-national journey.
Pre-conditions:	1. The user has a TV, a set-top box and a remote-control to access the journey planning feature of the MOBILE.OLD service. 2. During the journey, the older person has a Smartphone with the MOBILE.OLD application already installed and running. 3. The user has already a profile defined for the MOBILE.OLD services. 4. Using the planning feature of the MOBILE.OLD service the older person has planned a local, national or trans-national journey.
Post-conditions:	1. The older person receives a notification (on the Smartphone) when he or she exits the geofencing zone. 2. A notification is sent to the older person family or caregiver if he or she does not return to the geofencing zone within a certain time interval (specified in the user profile) or when the person gets too far away from the geofenced zone.
Normal Flow:	1. The older person selects the journey that he or she wants to take. 2. The older person starts travelling to the destination point. 3. During the journey the MOBILE.OLD geofencing service updates the position of the older person at a certain time interval defined in the user profile. 4. When the MOBILE.OLD geofencing service detects that the older person is outside the geofencing zone, it generates a warning on the older person's Smartphone (the phone starts to ring or/and vibrate and a notification message is displayed on the screen). 5. The older person acknowledges the warning generated by the mobile phone. 6. If the older person does not acknowledge the warning or he or she does not return to the geofencing area within a certain time interval (specified by the user profile) a notification is sent to his or her family or a caregiver.

Alternative Flows:	-
Frequency of Use:	Every time an older person takes a journey.
Special Requirements:	1. GPS or at least assisted GPS coverage. 2. Internet connection on the Smartphone.
Assumptions:	Minimum knowledge about how to use a mobile phone.
Notes and Issues:	Enhanced attention must be paid to the capital ethical requirements related to user right to Privacy (user and/or caregiver consent especially).

Use Case ID:	3.2
Use Case Name:	Detection of disorientation or abnormal movement patterns
Created By:	SIEMENS
Date Created:	2012-06-27
Personas:	Mr. Johnson
Description:	During a journey (planned or not with the MOBILE.OLD planning feature) the position of the older person is monitored. If abnormal movement patterns are detected (like walking several times around a building or up and down the street), the older person family or caregiver is announced.
Trigger:	The older person starts moving in a planned or unplanned journey.
Pre-conditions:	1. During the journey, the older person has a Smartphone with the MOBILE.OLD application already installed and running. 2. The user has already a profile defined for the MOBILE.OLD services.
Post-conditions:	A notification is sent to the older person family or caregiver if disorientation or abnormal movement patterns are detected.
Normal Flow:	1. The older person starts moving in a planned or unplanned journey. 2. During the journey the MOBILE.OLD geofencing service updates the position of the older person at a certain time interval defined in the user profile. 3. When the MOBILE.OLD geofencing service detects that the older person has an abnormal moving pattern, a message, associated with ring and/or vibrate signals, is displayed on its Smartphone. The message is asking the older person if he or she needs help. 4. If the older person answers with 'yes' or does not answer to the message, the MOBILE.OLD geofencing feature sends a notification message to his or her family or caregiver.

Alternative Flows:	-
Frequency of Use:	Every time an older person takes a journey planned or not with the MOBILE.OLD planning feature.
Special Requirements:	1. GPS or at least assisted GPS coverage. 2. Internet connection on the Smartphone.
Assumptions:	-
Notes and Issues:	User and/or caregiver consent is mandatory.

Use Case ID:	3.3
Use Case Name:	Alarming when heading to a hazardous area
Created By:	SIEMENS
Date Created:	2012-06-27
Personas:	Mr. Johnson
Description:	During a journey (planned or not with the MOBILE.OLD planning feature; inside or outside the geofencing area) the older person is informed about the risks and hazards that are specific to his current position.
Trigger:	The older person starts a journey.
Pre-conditions:	1. During the journey, the older person has a Smartphone with the MOBILE.OLD application already installed and running. 2. The user has already a profile defined for the MOBILE.OLD services.
Post-conditions:	1. The older person receives warnings (on the Smartphone) about the risks and hazards that are specific to his current position. 2. A notification is sent to the older person family or caregiver when he or she is heading to a high risk area.
Normal Flow:	1. The older person starts travelling to his destination point. 2. When the older person wants to get information about the hazards or risks of current location, he or she accesses the section dedicated to risks and hazards from MOBILE.OLD geofencing service. 3. The possible risks and hazards are displayed on the Smartphone screen (for example: There are construction works in the area). 4. Also, during the journey the MOBILE.OLD geofencing service updates the position of the older person at a certain time interval defined in the user profile. 5. If the older person is heading to a high risk area (for example: a building

	is on fire or wild animals are walking on the city streets), then he or she receives a warning on the Smartphone (the phone starts to ring or/and vibrate and a notification message is displayed on the screen). 6. The family or the caregiver receives a notification about the older person position and the specific hazards.
Alternative Flows:	-
Frequency of Use:	Every time an older person takes a journey.
Special Requirements:	1. GPS or at least assisted GPS coverage. 2. Internet connection on the Smartphone.
Assumptions:	Minimum knowledge about how to use a mobile phone.
Notes and Issues:	-

Use Case ID:	3.4
Use Case Name:	Guidance assistance during journeys
Created By:	SIEMENS
Date Created:	2012-06-27
Personas:	Mr. Johnson
Description:	The older person is assisted when he wants to get to a certain location of his or hers journey (planned or not with the MOBILE.OLD planning feature; inside or outside the geofencing area).
Trigger:	The older person is close to his or hers destination point but he or she does not know how to get there (for example: the older person just exited the nearest subway station from the bank office where he or she needs to go).
Pre-conditions:	1. During the journey, the older person has a Smartphone with the MOBILE.OLD application already installed and running. 2. The user has already a profile defined for the MOBILE.OLD services.
Post-conditions:	The older person gets to the destination point.
Normal Flow:	1. The older person selects on the MOBILE.OLD application from the Smartphone its destination (the name of the building or its address). 1. The MOBILE.OLD geofencing feature generates the route to the destination point establishing some intermediate points. 2. The steps 4 to 7 are repeated until the older person gets to the destination point. 3. The MOBILE.OLD geofencing feature displays on the Smartphone screen

	a map where are marked the next intermediate point and the older person current position. 4. Also on the Smartphone screen it is displayed a photo with the next intermediate point. 5. Using the text to speech functionality the older person receives additional information about how to get to the intermediate point (for example: turn left; go to the end of the street; etc.). 6. If the person goes to the opposite direction or any other wrong direction the Smartphone generates a warning (the phone starts to ring or/and vibrate and a notification message is displayed on the screen).
Alternative Flows:	-
Frequency of Use:	Every time an older person takes a journey.
Special Requirements:	1. GPS or at least assisted GPS coverage. 2. Internet connection on the Smartphone.
Assumptions:	Minimum knowledge about how to use a mobile phone.
Notes and Issues:	-

Use Case ID:	3.5
Use Case Name:	Detection of external physical conditions
Created By:	SIEMENS
Date Created:	2012-06-27
Personas:	Mr. Johnson
Description:	Based on the user already defined profile some patterns (sequences of events), which can indicate that the older person has or will have an external physical condition, are monitored.
Trigger:	The older person starts moving in a planned or unplanned journey.
Pre-conditions:	1. During the journey, the older person has a Smartphone with the MOBILE.OLD application already installed and running. 2. The user has already a profile defined for the MOBILE.OLD services.
Post-conditions:	A notification is sent to the older person family or caregiver if an exceptional external physical condition pattern was met.
Normal Flow:	1. The MOBILE.OLD geofencing feature monitors the sensors of the Smartphone (GPS, temperature, acceleration, gyroscope, accelerometer, etc.).

	2. The following steps may vary depending on the user profile. 3. If a sudden deceleration event is generated and it is followed by a no motion event than it is possible that the old person fell off. 4. The MOBILE.OLD geofencing feature generates a message on a Smartphone, associated with ring and/or vibrate signal. The message is asking the older person if he or she needs help. 5. If the older person answers with 'yes' or does not answer to the message, the MOBILE.OLD geofencing feature sends a notification message to his or her family or caregiver. 6. If the MOBILE.OLD geofencing feature receives the events "35 degrees temperature" and "older person waking for 30 minutes" in the context that the older person has cardiac problems, then a notification message is sent to his or her family or caregiver.
Alternative Flows:	-
Frequency of Use:	Every time an older person takes a journey.
Special Requirements:	1. GPS or at least assisted GPS coverage. 2. Internet connection on the Smartphone.
Assumptions:	The older person put the Smartphone in a pocket or a fanny pack very close to his body.
Notes and Issues:	-

2.5.4 PHYSICAL TRAINING

Use Case ID:	4.1
Use Case Name:	Setting the user profile and physical status
Created By:	Gerard van Loon
Date Created:	2012-07-16
Personas:	Helmut Schlingel
Description:	To be able to use the PT service in a proper personalized way the user has to set his profile information
Trigger:	The user wants to use the PT service for the first time.
Pre-conditions:	1. The user is at home and his Smart TV is switched on 2. A remote control is used for interaction with the TV 3. The user has chosen the MOBILE.OLD portal using his remote control
Post-conditions:	-
Normal Flow:	1. The user selects the PT service from the portal 2. He selects the personalization item from the PT menu 3. The personalization selection menu is displayed on the screen: able to stand yes/no, physical status poor/moderate/good/excellent 4. The user selects one of the options and confirms.
Alternative Flows:	-
Frequency of Use:	1x per week. At least after doing the exercises, to update the physical status if required.
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	4.2
Use Case Name:	Start the physical exercise on the TV
Created By:	Gerard van Loon
Date Created:	2012-07-18
Personas:	Helmut Schlingel
Description:	The user selects the proposed exercise and plays the video. The user does the exercise accordingly at home.
Trigger:	The user wants to do exercises to improve its physical status before the trip he/she wants to make (see Transnational Journey Planning service)
Pre-conditions:	1. The user is at home and his Smart TV is switched on 2. A remote control is used for interaction with the TV 3. The user has chosen the MOBILE.OLD portal using his remote control
Post-conditions:	The user returned to the portal
Normal Flow:	1. The user selects the PT service from the portal 2. He selects the exercises item from the PT menu 3. The proposed exercises are displayed. 4. The user navigates to the preferred exercise and selects it. 5. Detailed information about the selected exercise such as type (endurance, strength, balance, flexibility) and duration are displayed together with a start button and a stop button. 6. The user selects the start button and activates the video. The video with spoken text in his preferred language is played. 7. The user executes the exercises presented in the video 8. After the exercise the user will get the option to update his physical status. 9. The user returns to the portal
Alternative Flows:	8. The user has problems with the exercise so he wants to stop the exercise before it is finished. He navigates to the stop button and activates it. 9. The user returns to the portal
Frequency of Use:	1x per week
Special Requirements:	-
Assumptions:	This service also runs in a similar way on a Smartphone/tablet

Notes and Issues:	1. A disclaimer is required that physical training exercises do not guarantee that no problems will occur during a trip. 2. Users should not be obliged to buy special tools to support the exercises. 3. What if a user needs urgent help during an exercise? Send an SMS alert to an informal caregiver?

Use Case ID:	4.3
Use Case Name:	Training/stimulation of user's physical mobility
Created By:	Gerard van Loon
Date Created:	2012-07-18
Personas:	Helmut Schlingel
Description:	In accordance with his physical health status and the recommendation of the physician, a schedule and content for physical exercise is provided.
Trigger:	Gym reminder and tutorial
Pre-conditions:	1. The old person has a Smartphone with a MOBILE.OLD reminder function activated. 2. The old person has already the schedule of his gym needs defined on the MOBILE.OLD services. 3. The smart MOBILE.OLD phone has personalized gym audio-video tutorials already installed on it.
Post-conditions:	At old person's demand ("alarm" button), an alarming notification is sent to his/her relative or caregiver if an exceptional physical condition has appeared (fall, joint damage etc.).
Normal Flow:	1. At the given time the MOBILE.OLD Smartphone emits the reminder for gym session to be done. 2. If the case, the Smartphone emits a reminder on the phone of the specialist in physical recovery that must work with the user during gym sessions. 3. After pressing the "gym" button the MOBILE.OLD application displays the list of gym exercises to be done that day, already configured on it by the caregiver or doctor. The MOBILE.OLD options "gym tutorial 1", "gym tutorial 2", ... accessed by the old person display their audio- video content able to tutor him to accomplish the needed gym items. 4. If the case, the user may action the "alarm" button for alarming a

	relative or the caregiver on an issued physical damage (fall, joint damage etc.).
Alternative Flows:	-
Frequency of Use:	Daily, or at physician's recommendation.
Special Requirements:	1. Audio-video specific tutorials. 2. Internet connection on the Smartphone.
Assumptions:	The old person must be acquainted with audio-video tutorials. The older person put the Smartphone in a pocket or a fanny pack near at hand.
Notes and Issues:	Gym audio-video tutorials are available on Internet, or, maybe, can be created in the project?

2.5.5 ORIENTATION AND MOBILITY TRAINING (INCL. HIKING)

Use Case ID:	5.1
Use Case Name:	Training on buying a long-distance ticket with pensioner discount in the ticket printer application
Created By:	Stefan Schürz
Date Created:	2012-07-03
Personas:	Peter Meister
Description:	The user trains to buy a long-distance ticket with pensioner discount in the ticket printer application.
Trigger:	The user plans to visit a friend the next day which lives on the other side of his hometown. Therefore he wants to train himself in buying a long-distance ticket for the metro with pensioner discount.
Pre-conditions:	1. The user is sitting in a coffee house using the orientation and mobility training app on his Smartphone. 2. The user has opened the ticket printer application.
Post-conditions:	-
Normal Flow:	1. The menu consisting of four items (metro, train, tram, bus) is shown on the ticket printer application home-screen. 2. The user enters the metro submenu by pressing the “metro” button on the screen. 3. The user enters the exercises submenu by pressing the “exercises” button. 4. The user chooses the task which is called “buy a long distance ticket for the metro with pensioner discount”. 5. The user presses “start”. 6. The “virtual ticket printer” pops up. 7. The user buys virtually his ticket on the “virtual ticket printer”. At the “help/status” section of the screen he receives information about his clicks on the machine. 8. After the user has finished his transaction there is a notification shown at the “help/status” section that he has successfully completed the exercise. 9. The user returns to the exercises submenu by pressing “back”.
Alternative Flows:	6.1 The user does not know what he should press in order to buy the ticket. 6.2 The user presses the “back” button.

	6.3 The user presses the “step by step solution (virtual machine)” button. 6.4 The user views the video simulation of the solution. 6.5 The user presses the “back” button and starts the exercise from new.
Frequency of Use:	1-2 times per week.
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	5.2
Use Case Name:	Creating a vacation-checklist from parts of ready vacation-checklists
Created By:	Stefan Schürz
Date Created:	2012-07-05
Personas:	Helmuth Schlingel
Description:	The user creates his own vacation-checklist from parts of ready vacation-checklists.
Trigger:	The user plans a vacation at the beach for 1 week. Therefore he creates a vacation-checklist for avoidance of forgetting things.
Pre-conditions:	1. The user is sitting at home using the orientation and mobility training app on his Smartphone. 2. The user has opened the checklist application.
Post-conditions:	-
Normal Flow:	1. The user presses the “create my own vacation-checklist from parts of ready vacation-checklist” button. 2. The user presses the “clothing” button. 3. The user adds some items of the “clothing” list to his own list by pressing on them. 4. The user clicks on his own list. 5. A virtual keyboard pops up. 6. The user tips in the name(s) of the item(s) he likes to add on his list.

	7. The user presses the “save” button.
Alternative Flows:	-
Frequency of Use:	Once per month.
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	5.3
Use Case Name:	Playing the first-aid quiz in the first-aid application
Created By:	Stefan Schürz
Date Created:	2012-07-05
Personas:	Doris Schwester
Description:	The user plays the first-aid quiz in the first-aid application.
Trigger:	The user is sitting on the train and plays the first-aid application.
Pre-conditions:	1. The user is sitting on the train using the orientation and mobility training app on his Smartphone. 2. The user has opened the first-aid application.
Post-conditions:	-
Normal Flow:	1. The user presses the “first-aid quiz” button. 2. The first question and possible answers are shown on the screen. 3. The user presses the button with the “correct answer”. 4. A notification is shown in the “help/status” section that he has successfully answered the question. 5. The next question and possible answers are shown on the screen.
Alternative Flows:	-
Frequency of Use:	1-2 times per week.
Special Requirements:	-

Assumptions:	-
Notes and Issues:	-

Use Case ID:	5.4
Use Case Name:	Playing the traffic sign memory of the traffic sign memory & quiz
Created By:	Stefan Schürz
Date Created:	2012-07-05
Personas:	Siegfried Trauer
Description:	The user plays the traffic sign memory of the traffic sign memory & quiz application.
Trigger:	The user is sitting in the park and plays the traffic sign memory.
Pre-conditions:	1. The user is sitting in the park using the orientation and mobility training app on his Smartphone. 2. The user has opened the traffic sign memory & quiz application.
Post-conditions:	-
Normal Flow:	1. The user presses the “traffic sign memory” button. 2. The user tries to find the pairs by pressing on the screen. 3. On the “help/status” section information on the chosen signs are shown. 4. The user plays till he has finished.
Alternative Flows:	-
Frequency of Use:	1-2 times per week.
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	5.5
Use Case Name:	Finding the next bathroom on the airport map

Created By:	Stefan Schürz
Date Created:	2012-07-05
Personas:	Helmuth Schlingel
Description:	The user tries to find the next bathroom on the airport using the airport map of the orientation application.
Trigger:	The user is at the airport and must go to the bathroom.
Pre-conditions:	1. The user is at the airport using the orientation and mobility training app on his Smartphone. 2. The user has opened the orientation application. 3. The user has turned on the Wi-Fi and the GPS on his Smartphone.
Post-conditions:	-
Normal Flow:	1. The user presses the “airport” button. 2. The airport map pops up. 3. The coarse (network-based) location of the user is shown on the map. 4. The user presses the “bathroom” button. 5. All existing bathrooms of the airport are shown on the map. 6. The user checks the location of the closest bathroom next to him. 7. The user follows the map and gets to the next bathroom.
Alternative Flows:	-
Frequency of Use:	Once per month
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	5.6
Use Case Name:	Take a picture, geotag it and view it on the TV-set
Created By:	Stefan Schürz
Date Created:	2012-07-05

Personas:	Helmuth Schlingel
Description:	The user takes a picture on his vacation geotags it and views it afterwards on the TV.
Trigger:	The user takes a picture of a sight on his vacation.
Pre-conditions:	1. The user is shooting a photo on his Smartphone. 2. The user opens the orientation and mobility training app on his Smartphone. 3. The user has opened the geotag application. 4. The user has turned on the GPS on his Smartphone.
Post-conditions:	-
Normal Flow:	1. All taken pictures are shown on the screen. 2. The user geotags the picture which he wants by pressing on the picture. 3. A notification is shown on the “help/status” screen that the picture was geotagged. 4. The user presses the “back” button. 5. Back @ home the user opens the orientation and mobility training application on his smart-TV. 6. The user navigates through the remote control to the “geotag” button and presses “OK”. 7. A map with the geotagged pictures is shown on the screen. 8. The user navigates from picture to picture by using the arrow keys on the remote control. 9. The user presses the “back” button in order to return to the orientation and mobility training home screen.
Alternative Flows:	-
Frequency of Use:	Once per week.
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-
Use Case ID:	5.7

Use Case Name:	Identification of points of interest on demand
Created By:	MSALC
Date Created:	24-07-2012
Personas:	Mr. Honorio
Description:	Identification of points of interest on demand
Trigger:	During a trans-national journey, the older finds a place that he finds particularly interesting or a place that he wants to remember. He hasn`t information about it because it is not in the journey planning.
Pre-conditions:	The older person is moving in a planned or unplanned journey.
Post-conditions:	1. The older person finds a special point of the city that want to remember (for example because is similar than another place in his village). 2. He takes a photo but he had any information about that he is seeing.
Normal Flow:	3. The older person use the MOBILE.OLD unknown-places service for Geotagging the place and send the information to a server using 3G. 4. The server finds in the database of another maps service (like Google Maps) and return information about the place. 5. The older save the information for talk about it later with his friends or family.
Alternative Flows:	1. The server cannot locate the place or a problem with the communications occurs. 2. The data about the query are saved, and can be consulted again later or with another software tool.
Frequency of Use:	Every time an older person takes a journey planned or not with the MOBILE.OLD planning feature.
Special Requirements:	1. GPS or at least assisted GPS coverage. 2. Internet connection on the smart phone.
Assumptions:	Minimum knowledge about how to use a mobile phone.
Notes and Issues:	

Use Case ID:	5.8
Use Case Name:	Tracking a hike path on the TV-set
Created By:	Stefan Schürz
Date Created:	2012-07-06
Personas:	Helmuth Schlingel
Description:	The user tracks his hike path on the TV-set.
Trigger:	The user returns home after being out hiking in the hills.
Pre-conditions:	1. The user has tracked his hike on the hiking application of the orientation and mobility training service on his Smartphone. 2. The user has opened the orientation and mobility application on his smart-TV.
Post-conditions:	-
Normal Flow:	1. The user navigates through the remote control to the “hiking” button and presses “OK”. 2. A map with his hiking route is shown on the screen. 3. The user can see the measures of time, distance, pace and elevation of his track. 4. The user presses the “back” button in order to return to the orientation and mobility training home screen.
Alternative Flows:	-
Frequency of Use:	1 per week.
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

2.5.6 ADDITIONAL SERVICE

Use Case ID:	6.1
Use Case Name:	Weather forecast input
Created By:	AAIF
Date Created:	16.07.2012
Personas:	Mr. Johnson
Description:	Old people are particularly sensitive to extreme weather conditions or their sudden change. A daily (weekly) input about weather conditions may be very useful, either for suitably programming various activities or protecting from extreme weather.
Trigger:	Daily/weekly information on weather
Pre-conditions:	1. Internet connection. 2. A list of recommendations for protecting from extreme weather conditions
Post-conditions:	-
Normal Flow:	1. The user presses the “Weather” button. 2. The smartphone displays the actual weather features (temperature, wind, rain, snow falls etc.). 3. If extreme weather conditions are evolving, the user may select the option “Extreme weather recommendations” for consulting the list of recommendations for protecting from those extreme weather conditions.
Alternative Flows:	-
Frequency of Use:	Daily/At demand
Special Requirements:	Previously configured internet connection with a preferred weather forecast site.
Assumptions:	Pervious, careful users training to use the “Weather” function of the smart MOBILE.OLD phone.
Notes and Issues:	The caregiver will introduce the personalized content of the list of recommendations for protecting from extreme weather conditions. The content of this service is linked to the Transportation News Headlines Service.

2.5.7 MAIN MENU

Use Case ID:	7.1
Use Case Name:	User profile setting
Created By:	Gerard van Loon
Date Created:	2012-07-18
Personas:	Peter Meister
Description:	The 68 year old Peter Meister sets his profile to start using MOBILE.OLD services.
Trigger:	Peter Meister wants to start using the services for the first time.
Pre-conditions:	1. The user is at home and his Smart TV is switched on 2. A remote control is used for interaction with the TV 3. The user has chosen the MOBILE.OLD portal using his remote control 4. The user has an alpha-numeric keyboard
Post-conditions:	-
Normal Flow:	1. The first time a user enters, an automatic message appears, to remind the user to set up his user profile. 2. The user selects the profile setting item 3. The profile setting selection menu is displayed on the screen 4. The list of possible profile selections is presented: language, country, birthdates, name, sex, postal code, mobility level, social network information, with the last selected item highlighted. 5. The user selects the language item and makes a selection from the presented languages and confirms the selection.
Alternative Flows:	0.2 The user selects the country item and makes a selection from the presented countries and confirms the selection. 0.3 The user selects the birthdates item, sets his birthdates and confirms the selection 0.4 The user selects the name item, enters his name and confirms the selection. 0.5 The user selects the sex item, enters his sex and confirms the selection. 0.6 The user selects the postal code item and enters his/her postal code using the keyboard and confirms the selection 0.7.1 The user selects the level of mobility item. 0.7.2 A menu is displayed choosing from different options: no limitations, minor walking limitations (e.g. difficulty with stairs and ledges), using a walker, using a

	wheelchair. 0.7.3 The user selects a mobility item and confirms the selection. 0.8.1 The user selects the social network item. 0.8.2 A menu is displayed with different social networks (face book, 50plusnet.nl, LinkedIn). 0.8.3 The user chooses a social network where he has an account and implements the data of that account.
Frequency of Use:	Once per year
Special Requirements:	-
Assumptions:	-
Notes and Issues:	Once the social network information has been supplied in the profile setting, the actions in the different services can request whether the information can be shared in the social network.

2.5.8 USE CASE LIST

The following table creates a connection between the planned service categories, and which use cases they concern. A distinction is made between services introduced in the project proposal and such services that have been conceived as part of the user centered requirements capturing process (see Figure 2).

MOBILE.OLD Services (as per proposal):	**Use Cases:**
Personalized transportation news headlines	1.1, 1.2, 1.3, 1.4, 1.5
Trans-national journey planning	2.1, 2.2
Geofencing	3.1, 3.2, 3.3, 3.4, 3.5
Physical training	4.1, 4.2, 4.3
Orientation and mobility training	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8
Main Menu	7.1
Additional Service:	**Use Case:**
Weather forecast input	6.1

2.6 APPLICATION SCENARIOS

A scenario is a description of a persona using a product to achieve a goal. Scenarios are usually narratives that tell a story describing one or more tasks in a specific environmental situation. Developing scenarios often identifies important aspects of using a product in the real world that were not otherwise identified and considered. Scenarios are useful throughout the design process, particularly in developing task descriptions for usability testing. Scenarios can cover high-level product usage or can focus on detailed product interactions. They are appropriate whenever you need to describe a system interaction from the user's perspective. Whereas use cases capture a generalized view of a user and a task, scenarios describe a specific instance of a use case in terms of a concrete workflow.

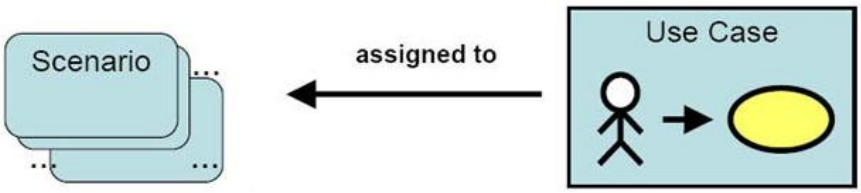


Figure 4: Every scenario has an assigned set of use cases (source: Zimmermann, et al., 2005)

Regarding the MOBILE.OLD project 2-3 scenarios per service are created using the MOBILE.OLD scenario template in order to cover every defined use case. A simple information sheet on how scenarios are written is provided.

These are the application scenarios, related to the Use Cases of the MOBILE.OLD services. It should be noted that, as for the Use Cases provided also the following application scenarios are subject to revisions throughout the project progress and could be seen as indicative, although sufficiently robust scenarios. The vast majority of the Use Cases has been considered for the formulation of the following application scenarios (and indicated for each application scenario).

2.6.1 PERSONALIZED TRANSPORTATION NEWS HEADLINES

Scenario Nr.:	1.1
Relevant Services:	Personalized Transportation News Headlines (PTNH)
Relevant Use-Cases:	1.1, 2.1, 2.2, 2.4, 2.5
Personas:	Mr. Johnson, Peter Meister
Created By:	Gerard van Loon

Date Created:	2012-07-31
Description:	Peter Meister is an active person, he has a many social contacts and is in a good physical shape. He likes to travel and have fun and has decided to use the MOBILE.OLD services to organize his travels and support his mobility further. He has set up his profile and his preferences in the Transportation News Headlines. He has indicated in his preferences that he is using a social network. Peter Meister now wants to visit his old Friend Mr. Johnson, who lives in Denmark, for about one week. Peter will travel by airplane to Denmark. He wants to make use of public transport as much as possible. Because Peter wants to be certain that there are no problems expected with public transport on the day of his trip he opens the MOBILE.OLD portal on his Smart TV and selects the PTNH service. The service received the information about the planned trip from the Transnational Journey Planning service so Peter selects this trip and the service displays directly the news information about the bus, metro train and airplane. It indicates that there are problems expected with the train, but there are no problems reported for the auto route to the airport so Peter decides to take his car. He sends a message to his friend by using the social network icon, demonstrating that there is no news and that he will arrive on time. As Mr. Johnsen also uses the TNH he receives this message directly in the service.

Scenario Nr.:	1.2
Relevant Services:	Personalized Transportation News Headlines (PTNH)
Relevant Use-Cases:	2.3, 2.4, 2.5
Personas:	Mr. Johnsen
Created By:	Gerard van Loon
Date Created:	2012-07-31
Description:	Mr. Johnsen is 88 and lives in Odense, Denmark. He lives outside the city and has two daughters that live in the city. Mr. Johnsen is still very fit, but he prefers to plan his trips within a regional range and doesn't like to take airplanes. He finds it difficult to find information about the bus and tram schedules, as they are nowadays only on the information. Therefore his friend Peter Meister, has

	recommended him the MOBILE.OLD solution. Mr. Johnsen wants to visit his daughter who lives about an hour away by bus. He wants to make use of the public transport as he always does. He wants to be certain that no problems are expected with the public transport on the day of his trip and selects the TNH service on his mobile phone. He did not plan the trip yet, so he selects the general transportation news. He gets an overview of the current news headlines on the transportation of his preferences. He sees that there is a strike expected of bus drivers. Based on this information he decided to postpone his trip. Through the social network icon he can directly inform his daughter on the news headline and tell her that he is not coming in the end.

Scenario Nr.:	1.3
Relevant Services:	Personalized Transportation News Headlines (PTNH)
Relevant Use-Cases:	
Personas:	Peter Meister
Created By:	Gerard van Loon
Date Created:	2012-07-31
Description:	Peter Meister wants to visit his old Friend Mr. Johnson, who lives in Denmark, for about one week. Peter would like to travel by airplane to Denmark. He wants to make use of public transport as much as possible. Because Peter wants to be certain that there are no problems expected with public transport on the day of his trip he opens the MOBILE.OLD portal on his smartphone and selects the PTNH service. He did not plan a trip yet using the Transnational Journey Planning service so he selects the general transportation news. He gets an overview of the current news headlines about the various transportation means relevant for him based on his profile. He sees in the News Headline section a news item that has been posted by his cousin, telling that the traffic is impossible today. Additionally he sees that there is a strike expected on the airport so he decides to postpone his trip. He wants to inform his friend on this new event, so he uses the icon next to the news headline to publish it on his social network. Now Mr. Johnson can see the news headline on his TNH application as a new news item as well.

2.6.2 TRANS-NATIONAL JOURNEY PLANNING

Scenario Nr.:	**2.1**
Relevant Services:	Check travel offers from the agency
Relevant Use-Cases:	2.1
Personas:	Mr. Ismael
Created By:	José Manuel Laperal
Date Created:	09.2012
Description:	Mr. Ismael visited this morning the information center for the elderly and he had seen a brochure of a trip for next month. The trip looks interesting but he has some doubts. Mr. Ismael would like to know if it will be necessary to walk very long in order to visit all the historical sites. Mr. Ismael loves to walk but the doctor has recommended him not walk more than 30 minutes without a break. The trip seems interesting but perhaps not for him. He also wants to review other information such as flight times and more. Mr. Ismael feels also suspicious about the offers from the travel agency and would like to know if the offer is really good or if he can find another similar at any time. Therefore he opens the MOBILE.OLD TJP service and checks the walking route, as well as the prices for the trip. It turns out that the walking routes between the sights during the travel take less than 30 minutes and that the price which the travel agency offers is good. For this reason Mr. Ismael decides to go on the trip which the travel agency offered.

2.6.3 GEOFENCING

Scenario Nr.:	3.1
Relevant Services:	Geofencing
Relevant Use-Cases:	3.1
Personas:	Monica
Created By:	Alice Petrescu, MD
Date Created:	2012-08-13
Description:	Monica accesses the MOBILE.OLD Geofencing application with previously stored data on various routes. The Geofencing application offers her the possibility to choose the desired route, including means of conveyance and information on how to purchase the travel tickets. Monica starts to travel and, if she deviates from the route, the smartphone with the Geofencing application warns (by vibration / sound / visual effect) and communicates her how to return to the chosen route. If this is not remedied within the period already stored in Monica's profile of Geofencing application, Monica's daughter is automatically announced on the location where her mother is.

Scenario Nr.:	3.2
Relevant Services:	Geofencing
Relevant Use-Cases:	3.1
Personas:	Mircea
Created By:	Alexandru Sterea, MD
Date Created:	2012-08-13

Description:	This year on the first Sunday of September, Mircea decides to leave for USA to live with his daughters for 6 months. After 12 hours of flight Mircea gets at Boston. The MOBILE.OLD application warns him that outside is cold and rain. Mircea must find Boston North Station to take the train for getting his final destination – Concord. He configures the MOBILE.OLD application to provide him the route to Boston North Station. Once in the station, Mircea uses the MOBILE.OLD application for finding a ticket machine and understanding how to use it. He gets the ticket and takes the train for Concord.

Scenario Nr.:	3.3
Relevant Services:	Geofencing
Relevant Use-Cases:	3.2
Personas:	Maria
Created By:	Alice Petrescu MD
Date Created:	2012-09-16
Description:	One day, while coming home from the grocery store, the “Geofencing” service detects Maria wandering on the streets near her house. Instantly her daughter is notified. She calls Maria and understands her mother is disoriented and a bit anxious. She calms her down and guides her home, understanding that her mother needs an appointment at the specialist physician.

2.6.4 PHYSICAL TRAINING

Scenario Nr.:	4.1
Relevant Services:	Physical Training
Relevant Use-Cases:	4.1, 4.2

Personas:	Mr. Johnson, Peter Meister
Created By:	Gerard van Loon
Date Created:	2012-07-31
Description:	Peter Meister wants to visit his old Friend Mr. Johnson, who lives in Denmark, for about one week. Peter will travel by airplane to Denmark. Because Peter wants to be physically prepared for this trip he opens the MOBILE.OLD portal on his Smart TV and selects the PT service. The service received the information about the planned trip from the Transnational Journey Planning service so Peter selects this trip and the service displays the proposed exercises based on the profile he entered and the physical status he entered previous time which was ´poor´. Peter selects one of the exercises presented in a video-clip and he does his best to execute them. After having done the exercises Peter answers some questions on his performance during the exercise, based on which his stats will be saved.

Scenario Nr.:	4.2
Relevant Services:	Physical Training
Relevant Use-Cases:	4.1, 4.2
Personas:	Peter Meister
Created By:	Gerard van Loon
Date Created:	2012-07-31
Description:	As Peter Meister loves travelling he wants to improve his physical condition to be able to continue with this as long as possible. He opens the MOBILE.OLD portal on his Smart TV and selects the PT service. He gets a list of exercises based on the profile he entered and the physical status he entered previous time which was ´poor´. Peter selects one of the exercises presented in a video-clip and he does his best to execute them. After having done the exercises Peter updates his physical status through different questions ´ and leaves the application. When his friend Helmuth Schlingel comes by, he wants to demonstrate his progress and enters the PT service with the remote control of the television. In the PT service

	he can see his progress in some charts and figures, showing how he has improved his physical status through regular exercise.

Scenario Nr.:	4.3
Relevant Services:	Physical Training
Relevant Use-Cases:	4.1
Personas:	Laura
Created By:	Alice Petrescu, MD
Date Created:	2012-08-13
Description:	On her Smart TV she opens the MOBILE.OLD application and she selects the gym program. She finds the exercise list based on her profile and physical status (appointed by her physician) she tries to do the exercises as good as she can. At the end of the gym program she answers to a list of questions, this way updating the profile, and/or she leaves the application. Within this service she can see the progress she's done due to different graphics and she can show them to her daughter who is abroad.

2.6.5 ORIENTATION AND MOBILITY TRAINING (INCL. HIKING)

Scenario Nr.:	5.1
Relevant Services:	Orientation and Mobility Training (Smartphone) Orientation and Mobility Training (TV-set)
Relevant Use-Cases:	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7
Personas:	Mr. Johnson, Peter Meister
Created By:	Stefan Schürz
Date Created:	2012-07-12
Description:	Peter Meister visits his old Friend Mr. Johnson who lives in Denmark for about one week. Peter travels by airplane to Denmark so he has to get up early in the morning in order to get to the airport by metro. One day before he starts of his trip, he wants to train himself on buying a long distance ticket with pensioner discount in the MOBILE.OLD ticket printer application. Peter opens the app on his smartphone and runs through the ticket buying process two times on the virtual

	ticket printer. Now he feels confident and prepared for the real case. Afterwards he wants to pack his bag for travel. In order to avoid forgetting something he starts the MOBILE.OLD checklist application. He creates his own vacation-checklist from parts of ready vacation-checklists with the aid of the application. Now he packs his bag step by step and feels secure of not forgetting something. Tomorrow morning Peter gets up at 6 am and catches the metro at 7 am in order to get to the airport. He has to travel for about half an hour with the metro. He feels bored and starts playing the MOBILE.OLD first-aid quiz to pass time. Now Peter is about 5 minutes away from the airport. He feels that he must go to the bathroom soon, so he starts the MOBILE.OLD orientation app and checks where the bathroom next to him is. Afterwards he is ready for check-in. Now Peter is on the airplane. The flight takes about 1.5 hour. He feels bored again and starts playing the MOBILE.OLD traffic sign memory & quiz to pass time. When he arrives in Denmark Mr. Johnson picks him up from the airport. Afterwards they spend a cozy evening together at Mr. Johnson's place. The next morning they go out hiking in the mountain which is called Himmelbjerget. Peter opens the MOBILE.OLD hiking application at the start. During the hiking he takes some pictures of the landscape and geotags them with the MOBILE.OLD geo tag application. Back at home Peter runs the MOBILE.OLD services on his smart TV. He looks at his geotagged photos on the map and recognizes the places he had been together with Mr. Johnson and feels pleased. Peter also follows the hiking track on the screen. He is interested in seeing in real time the measures of time and distance.

Scenario Nr.:	5.2
Relevant Services:	Orientation and Mobility Training (incl. Hiking)
Relevant Use-Cases:	-
Personas:	Helmuth Schlingel and his daughter Kate
Created By:	Stefan Schürz
Date Created:	2012-07-19
Description:	Helmuth and Kate plan to do the MOBILE.OLD scavenger hunt game in Linz. Therefore Helmuth and Kate meet at the Linzer main square. Helmuth starts the orientation application on his smartphone. He presses on the scavenger hunt game button in order to start it. The first station of the game appears on the

	screen. Fortunately they are located right next to the first station which is the Linzer main square. Helmuth and Kate are reading the information text on the screen to gather knowledge on the sight. In order to achieve the next station Helmuth views the map of Linz. Kate and Helmuth have a look at the map to find the way to the next station. They are spending the afternoon together playing the scavenger hunt game until the end having fun.

2.6.6 SERVICE COMPREHENSIVE SCENARIOS

Scenario Nr.:	6.1
Relevant Services:	Geofencing, Weather forecast App, Orientation and Mobility Training (Smartphone)
Relevant Use-Cases:	3.1, 5.1, 5.5, 6.1
Personas:	Mircea
Created By:	Alexandru Sterea, MD
Date Created:	08.2012
Description:	This year on the first Sunday of September, Mircea decides to leave for USA to live with his daughters for 6 months. After 12 hours of flight Mircea gets at Boston. The MOBILE.OLD application warns him that outside is cold and rain. Mircea must find Boston North Station to take the train for getting his final destination – Concord. He configures the MOBILE.OLD application to provide him the route to Boston North Station. Once in the station, Mircea uses the MOBILE.OLD application for finding a ticket machine and understanding how to use it. He gets the ticket and takes the train for Concord.

Scenario Nr.:	6.2
Relevant Services:	Geofencing, Physical Training
Relevant Use-Cases:	3.5, 4.1
Personas:	Lucretia
Created By:	Alexandru Sterea, MD
Date Created:	08.2012
Description:	Recently, when moving to the bathroom, Lucretia fell down and suffered some contusions. The MOBILE.OLD application (which is running on her smartphone) detects a fast acceleration followed by a sudden stop and announced to her caregiver that it might be possible that Lucretia has fallen down. The caregiver calls Lucretia on the smartphone. Lucretia confirms that she has problems. The caregiver *administered first aid to her*. Mrs. Lucretia has been transported to hospital where the medical team decided that a comprehensive program of recovery must be implemented.

	To prevent Lucretia from being bedridden and immobilization, the doctor decides that she must continue a sustained rehabilitation program at home. The doctor provides her a video program with physical exercises which is embedded in the MOBILE.OLD application and visualized on a Smart TV, because the kinetotherapist visits her only on alternate days. The doctor may remotely monitor the accomplishment of each gym session. Moreover the MOBILE.OLD application also reminds Lucretia to take her medicines at the proper time.

Scenario Nr.:	6.3
Relevant Services:	Trans-national journey planning, geofencing, weather forecast app
Relevant Use-Cases:	2.1, 3.1, 6.1
Personas:	Ovidiu and Mariana
Created By:	Alexandru Sterea, MD
Date Created:	08.2012
Description:	For preparing this trip, Ovidiu consults the MOBILE.OLD portal, choosing the camping place at the shortest course. Two days before the departure, Ovidiu opens the "Family Chat Room" application through which he can talk with his son and other family members. Together they agree on the last details regarding the trip and on the date they'll meet there. Through the MOBILE.OLD application Ovidiu can permanently send information to his son about the trip, about their health state and about the emergencies that may appear. The second day in the morning, the two leave for the mountain side, and on the way Ovidiu may follow, the right course to the camping place, and may receive information about the weather evolution through the "Weather Forecast" application embedded on his phone. Mariana, at her turn, may use the MOBILE.OLD application to remember her when to cook dinner, or the proper time to take her medicines.

Scenario Nr.:	6.4
Relevant Services:	Transnational Journey Planner (TJP), Geotagging
Relevant Use-Cases:	2.1, 5.7
Personas:	Mrs. Tina
Created By:	José Manuel Laperal
Date Created:	31.07.2012
Description:	Mr. and Mrs. Tina are planning to make a city trip. They live in Burgos, Spain and together they have decided that they would like to visit Bordeaux in France. Mr. Tina likes very much to be independent and to use his car. Therefore they decide to make the trip in their own car. Together they turn on the SmartTV and start planning their trip in the Transnational Journey planner. The system gives them a

	complete overview of the route and provides them with all the maps and details on the road. They can directly plan where they are going to stop to make a rest and have a bite to eat. Then they browse through the suggested hotel options. They can easily look through the menu and compare the location of the hotel and the prices. They can make a reservation by sending a message. They download all this information on the Smart Phone, which then guides them during their trip, as would a normal navigator do. However, MOBILE.OLD is much easier to use, especially for Mrs. Tina who sometimes gets confused, the system gives a good overview and clear directions. Once they are in Bordeaux they are enjoying very much the sites of the city. They use MOBILE.OLD to see all the different sights. They can make pictures of the sights and link them directly to the location. They decide they would like to visit some wine cellars and do some wine tasting. For this they use the MOBILE.OLD smartphone that automatically suggests different locations and wine cellars. They select one from the TJP that gives them very simple indications and directions to get to the place. When Mrs. and Mr. Tina are at home they can watch the pictures and see directly where they have been. This is a perfect way to relive their trip.

2.7 INTERVIEWS

The last step in the user requirements capture methodology are free discussions as well as qualitative and quantitative face-to-face interviews based on pre-defined guideline questionnaires. The questionnaires include among others personal questions, questions on ICT usage and ratings of the MOBILE.OLD services. This interaction with the end users helps the consortium to refine the use cases and scenarios in order to derive a number of user requirements.

In the context of the MOBILE.OLD user requirements capture methodology interviews with 3-5 end users per pilot site are held. During the interview first user tests are conducted with a simple game app on a Smartphone (e.g. Samsung Galaxy Note). The finding of this observation leads also to more insight regarding the user's perspective.

2.8 THE INTERVIEW STRUCTURE AND METHODOLOGY

The definition of the end user requirements is based on in-depth interviews that were maintained with end-users. The interviews were defined with the help of the scenarios and use cases. It uses qualitative research principles in order to understand the behavior of the MOBILE.OLD target group and the reasons behind this behavior. The numbers that are mentioned in the results are indicative to support the qualitative analysis and do not represent specific statistical value. The results of the interviews are presented here and translated into user requirements for the technical definition.

The interviews consisted of 5 main sections and took approximately 2 hours. The objective of the interview was to obtain first of all a clear impression on the target group and its experience with technological devices, mobile phones and the Internet. Subsequently the interview focused on the daily activities and travels of older persons, to obtain a good view on the level of mobility. This is a key aspect to MOBILE.OLD services that focus on promoting the mobility of older persons. In the last section the two previous sections were combined to obtain specific questions on the MOBILE.OLD services.

Finally users were asked to perform different tasks on a Samsung Galaxy Note to observe the overall level of interaction with a smartphone which will be one of the main interfaces of the MOBILE.OLD services.

2.9 THE PILOT SITES

2.9.1 THE AUSTRIAN PILOT SITE

LIFEtool gemeinnützige GmbH has its seat in Linz (Upper Austria) and is a non-profit-organization founded by Diakonie Austria and the Austrian Research Centers. Therefore LIFEtool has great connections to the care facilities (hospitals, assisted accommodations, day centers for the elderly, homes for the aged, ambulatory supplied households) and the careers of the Diakoniewerk Austria. For the MOBILE.OLD pilot, LIFEtool contacted very active older persons who live independently in individual households and assisted accommodations.

2.9.2 THE DUTCH PILOT SITE

The National Fund for the Elderly focuses its work on seniors that are at danger of exclusion from society. The seniors are mostly 70+ and live independently. The National Fund for the Elderly organizes the Dutch pilot site, due to its close contact to end-users. For the MOBILE.OLD pilot, NFE contacted older persons through one of the activity centers in Amersfoort. These older persons are generally very active and come together at the activity center to do sports, games or follow computer classes. Therefore it is the perfect place to involve end-users that correspond to the target group of MOBILE.OLD, being active and mobile. The interviews were maintained at the activity center and at the homes of the seniors.

2.9.3 THE SPANISH PILOT SITE

The municipalities of the Spanish pilot site have been evaluated whit the specific criteria of facility for development the pilot and subsequent sustainability of the services. Actually the localities that are pre-selected, pending for closing specific details are:

- **Boadilla del Monte:** Located in the center of Spain, in the province of Madrid. With a population of 46.000 inhabitants, taking more than 3.800 people over 60 years.
- **Getafe:** Located in the center of Spain, in the province of Madrid. With a population of 158.000 inhabitants having more than 30.000 people over 60 years.
- **Ermua**: Located in the North of Spain, in the province of Euskadi. With a population of 16.000 inhabitants, with more than 4.000 people over 60 years old.

User groups will be selected and distributed between one or two of these locations, in collaboration with their departments of Social Activities, with a vocation to be extended to others collectives of citizens, in order to achieve gender equality and social levels. Users will be chosen with the criteria of meeting the best conditions for receiving services designed to keep the person living at home, alone or with his family, thereby overcoming the limitations of autonomy that each person can have.

2.9.4 THE ROMANIAN PILOT SITE

The **Ana Aslan International Foundation** (AAIF) is a non-profit, non-governmental organization with research, education and health care activities in the field of aging, with focus on brain aging. AAIF's R&D department, the *Ana Aslan International Academy of Aging*, was established in 2011. AAIF's mission is to integrate scientific progress into the original, holistic concept of predictive, preventive and personalized medicine in order to give patients, medical and scientific community the instruments to make brain aging medicine the longevity medicine. AAIF is involved as medical partner in various clinical trials, fundamental bio-medical research projects, and Ambient Assisted Living projects, where it shares its expertise in elaborating research papers and protocols, identifying the medical methodologies related to the project's content, the target group definition, end-users requirement and preferences definition, applications evaluation and validation, ethics and deontology, dissemination activities. It also runs education programs at academic and non-academic level. In 2003 AAIF

opened its ***Centre for Diagnosis and Treatment of Memory Impairment Diseases and Medical Rehabilitation*, which holds the Romanian Pilot of the Mobile.Old project.** The Centre is structured in such a way as to offer high-performance medical services in the field of aging and brain aging, in an architecturally personalized setting, at European standards, after the model of Centres of Excellence for Memory Impairment in Sweden and France. The resources comprise a data base of 4000 patients and a well-skilled multidisciplinary staff working in the research field as well as in the clinical assistance of the elderly.

2.10 INTERVIEW RESULTS

2.10.1 INTERVIEW RESULTS OF THE AUSTRIAN PILOT SITE

2.10.1.1 THE END USER GROUP

For the definition of the user-requirements, five elderly people who belong to the target group of MOBILE.OLD have been interviewed on the Austrian pilot site. The elderly individuals are in the age of 64-77. The mean age of the participants is 67.6 years. Four of them are female and one is male.

Every participant had signed an informed-consent form. Their data has to remain confidential, and must not be used outside of the MOBILE.OLD project.

Four of the elderly stated that their health situation is across 7 on a 10 point scale which is above-average good. One participant stated that he sometimes has problems with walking up the stairs.

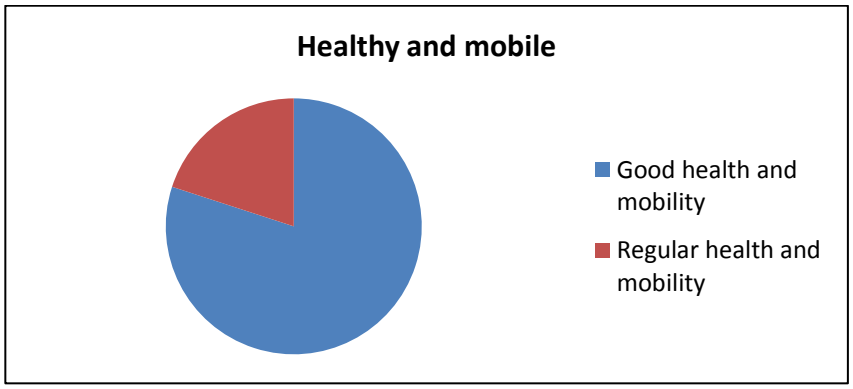


Figure 5: Health and mobility status on the Austrian pilot site.

2.10.1.2 THE END USER GROUP AND TECHNOLOGICAL DEVICES

All of the interviewed seniors indicated that they own a Flat TV, a computer and/or a laptop with internet connection and a mobile phone. In addition they are using these devices on a daily routine: the computer for writing and receiving E-Mails, gathering information via Google and looking at photos. The mobile phone is only used for writing and receiving SMS, calling and photos. Nobody has a Smartphone.

Everyone stated that they like to try out new technologies and devices because they feel curios about them. Additionally they mentioned that new devices should bring a benefit and that it sometimes costs a lot of effort and practice for them to learn the handling.

The majority (four out of five) said that they would like to control the MOBILE.OLD services on the Smart TV via keyboard and mouse.

2.10.1.3 ACTIVITIES AND MOBILITY

All participants stated that they go at least once a year on an international travel. One participant indicated that he only travels to Germany one time per year while the others travel to destinies both inside as well as outside Europe. Four participants normally use the plane when they go on an international trip. They prefer to use a physical map to orient themselves when they are abroad. Three persons go to a travel agency when they organize their trip the other two organize their trips themselves through the internet. Moreover all of the elderly added that they use the internet to look for information on the country and sights. Three of the interviewed users buy their train tickets through the internet because they find the ticket vending machines to complicate.

The participants were asked to range the following activities from 0 to 10. The following are the average results per activity.

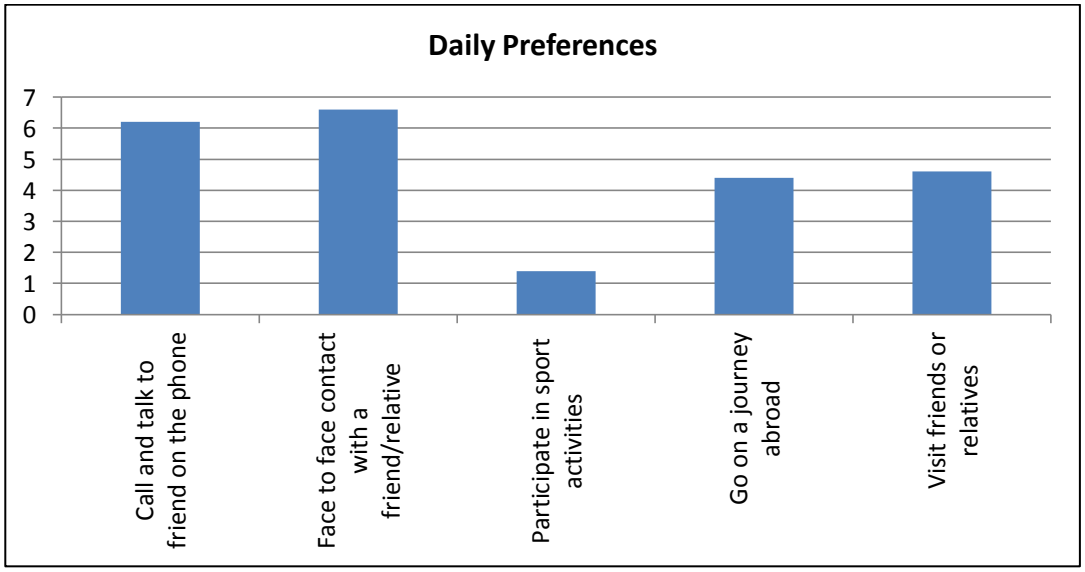


Figure 6: Daily preferences on the Austrian pilot site.

2.10.1.4 RATING OF THE MOBILE.OLD SERVICES

The following diagram demonstrates the rating of the users on the MOBILE.OLD services. In general it can be said that the participants feel very enthusiastic about the MOBILE.OLD services and that the feedback was consistently positive.

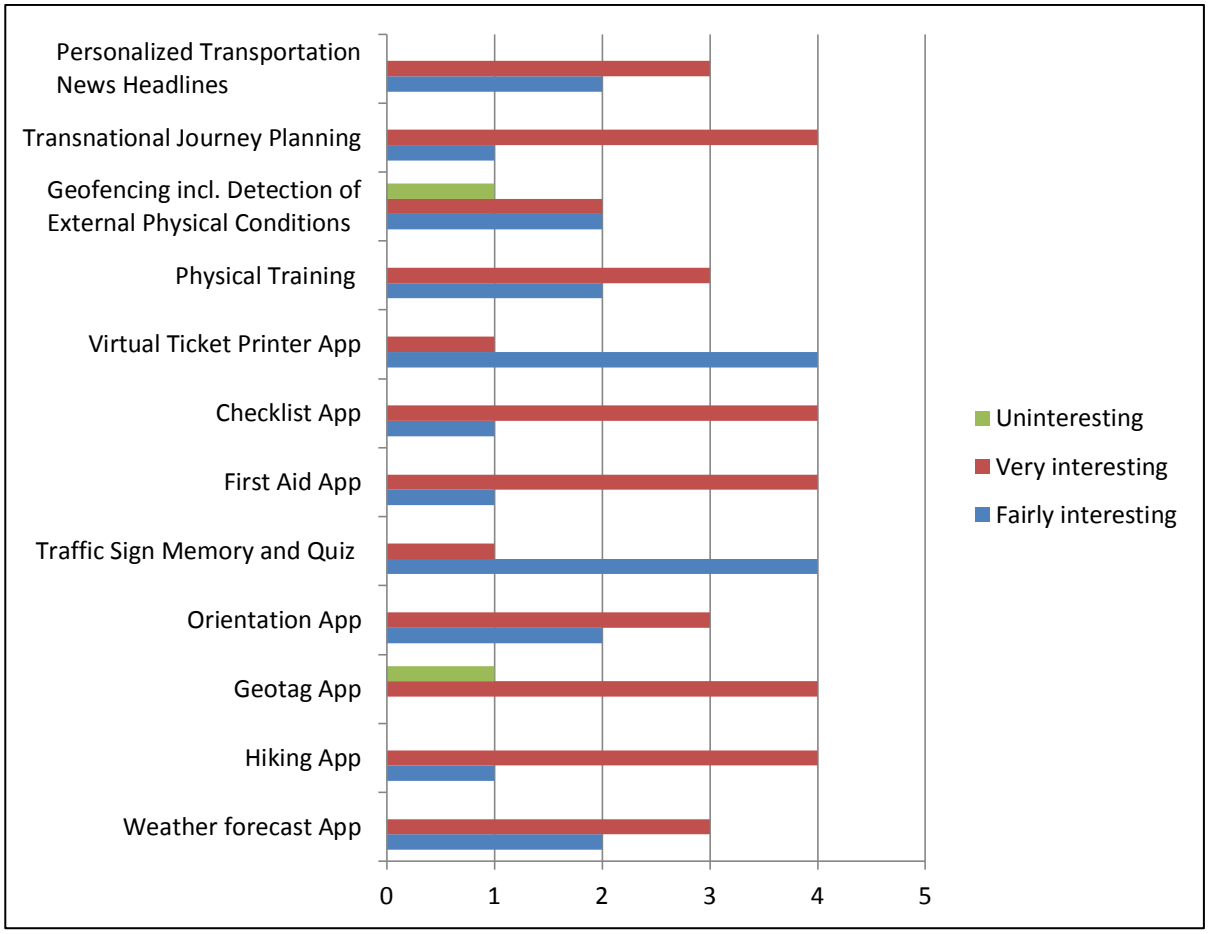


Figure 7: Rating of the MOBILE.OLD services on the Austrian pilot site.

2.10.1.5 COMMENTS OF THE ELDERLY ON THE SERVICES

The following table will give the main comments of the elderly.

Service/App	Comments
Personalized Transportation News Headlines	All participants stated that this would be a useful service. Three of them added that they would like to use it on demand in case of a travel; one elderly said he would use it on a daily routine because shopping or visiting friends is also a sort of travel for him, where this information could be useful.
Transnational Journey Planning	All of the elderly individuals felt really interested about this service. This service would really be used. Nobody of them had planned their journey on the internet before because this seems to be really complicated for them and/or they are afraid that they get tricked.
Geofencing incl. Detection of External Physical Conditions	Four out of five elderly added that they would like to use this application on demand. They think this could also be useful for them even, when they do not suffer from any cognitive impairment (security when they are on a journey). Moreover the detection of external physical conditions was well received among the participants.
Physical Training	Every participant stated that they would love to have this service. They want to improve their physical shape to maintain their mobility. In order to achieve that they could imagine using this service at least one time per week.

Virtual Ticket Printer App	This application was also well received by the elderly. They like the idea of getting prepared for buying tickets. Three of them said that they would use this function at least one time per week at home or on demand when they are in front of a "real" ticket printer in order to have guidance through their Smartphone when they are buying a ticket.
Checklist App	The participants indicated that this would be a useful functionality. They could imagine using it on a weekly routine, when they plan to go shopping or on demand when they go on a journey.
First Aid App	Everybody stated that they would like to have this application in order to get informed about first aid issues. The majority added that they would use it frequently and on demand.
Traffic Sign Memory and Quiz	The elderly said that this utility would be great for learning new traffic signs. A list containing all traffic signs would be an improvement, because the elderly like the idea of having all signs at hand. The participants stated that they would use it at least one time per month.
Orientation App	All of the elderly individuals have shown great interest in this application. They said that they could imagine using it on demand or when they are on the way in order to find the next toilet or the next cash machine quickly.
Geotag App	Four out of five elderly would like to have this application. Especially when it comes to their vacation photos. One of the participants added that he has sometimes trouble in remembering from which specific places he has taken the photos, so this would be a great utility to support him.
Hiking App	Almost every of the elderly individuals indicated that they would like to use this service after a travel, an excursion or after a hiking tour in order to compare distance or speed.
Weather forecast App	Concerning the weather forecast application the majority of the participants stated that they could imagine using the application on demand or on a daily routine when they are on a journey or at home in order to get the newest weather information and recommendations for protecting from extreme weather conditions.

Table 1: Comments on the services on the Austrian pilot site.

- When it comes to necessary pre-conditions for using the services the elderly mentioned:
  - **Confidentiality**
  - **User friendliness**
  - **Good battery performance** (smartphone)
  - **Dependability**
- Everybody said that they would recommend the services to their friends/family.
- The participants added that they would accept to pay in mean about 12 € per month for the services.

2.10.1.6 RESULTS OF THE USER TESTS ON THE SAMSUNG GALAXY NOTE SMARTPHONE (5.3")

Generally it can be said that the participants felt really enthusiastic about the Samsung Galaxy Note device in combination with the “BIG-launcher” app. They liked the size, the handling of the touch screen, the high resolution and the good camera.

In advance it must be said that in the first place several user relevant settings have been made in “BIG-launcher” concerning system permissions, app availability etc… in order to customize it, so the users got the feeling that they cannot mess anything up. The home screen was modified with the help of the “BIG-launcher” app in case of font size, button size etc… in order to fit to the elderly needs.

List of the tasks the elderly needed to execute with the smartphone:

- To make a call
- To make a photo
- To view a photo
- To write a SMS
- To play Hangman
- To play Labyrinth Light
- To play Ultra Senso

The tested users had no major problems in executing these tasks although this was the first time they handled a smartphone. Moreover they also had fun in playing these games.

2.10.2 INTERVIEW RESULTS OF THE DUTCH PILOT SITE

2.10.2.1 THE END USER GROUP

A total of ten end-users participated in the definition of the user requirements through the interviews. The age of the participants ranged from 70 until 83, with an average age of 74.7. Six of the participants were male and four were female. Six participants confirmed that they are very fit, have no health problems and consider themselves very mobile. Three participants said that sometimes their health and fitness is a bit regular, meaning that they have problems to walk up the stairs or lift heavy objects, affecting their level of mobility. Two of these participants were over 80. One participant mentioned that although he is fit and healthy, he doesn’t consider himself mobile, because his wife is in a wheelchair.

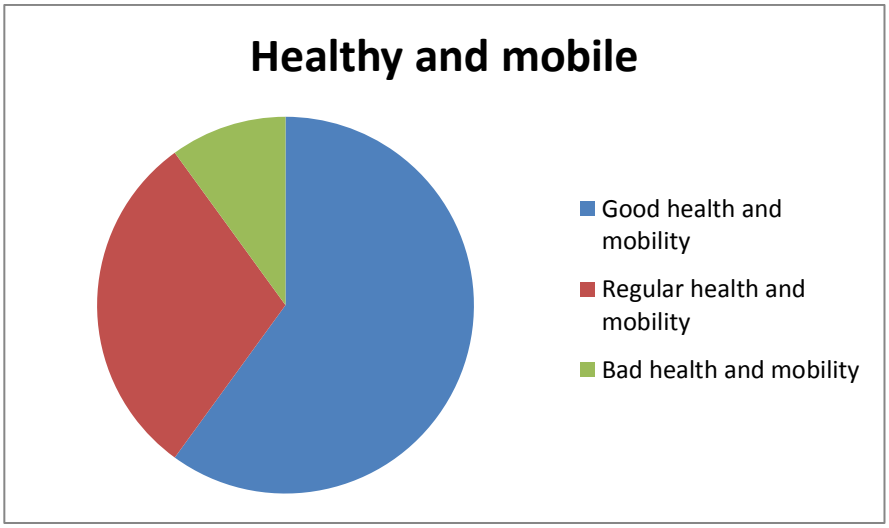


Figure 8: Health and mobility status on the Dutch pilot site.

2.10.2.2 THE END USER GROUP AND TECHNOLOGICAL DEVICES

When talking about technological devices, the involved seniors have all very diverging opinions. The majority of the participants indicated that they like to try out new technologies and devices, although in some cases they mentioned that this costs a lot of effort and practice due to the complicated nature of the devices. Two persons indicated that they have no interest at all, but in order to keep up in society they sometimes try out new devices such as the PC.

All participants have a TV, the majority a flat screen (nine) and they all use it frequently, especially to watch the news. Five participants also use teletext. The main objectives to use the teletext are to check on the news, sports and weather. Four persons indicated that they experience problems in changing from analogue to digital television and they also complained about the amounts of remote controls. All users indicated that they think a remote control is the most practical tool to use the TV.

All ten participants have a PC and an internet connection. However four persons indicated that they don't use the PC very often. These persons said that they have an internet connection because of the providers' package offer with phone and TV. The participants indicated that they use the PC to e-mail, to manage and interchange information and to look up the news, information or plan routes. The participants indicated that when they perform the same activity they normally do not encounter many problems when using the PC. When they do encounter problems they either go to the customer service of the provider, or ask a neighbor or family member to help.

Two of the participants have a tablet. These were the two youngest persons (70) and they both indicated that they use it very frequently and are very content with it because of its ease of use.

All participants have a mobile phone with a pre-paid subscription. Nobody has a Smartphone. Four participants indicated that they hardly ever use the mobile phone and only have it for emergency cases. The other participants use the mobile phone for calling and for sending text messages. Some of the complaints that were mostly mentioned on mobile phones are:

- The mobile phone has very small buttons.
- There is very little contrast which makes it difficult to read from the screen.
- Unwanted pocket calls.
- Too many options make it difficult.
- The use of a mobile phone requires a lot of practice.

These complaints are important feedback for the mobile application of the MOBILE.OLD services.

2.10.2.3 ACTIVITIES AND MOBILITY

All participants indicated that they go at least once a month on trips to national, regional and local destinies. Seven out of ten participants indicated that they additionally go at least once a year on an international travel. Four participants indicated that these international travels are to destinies both inside as well as outside Europe. They go with a travel agency that organizes their trip and their accommodation. Three persons indicated that they normally go on an international trip organized by themselves. These three persons normally go by car to destinies relatively close to the border, such as Belgium, Germany or Switzerland.

Four participants normally use the train when they go on a trip. In order to plan their route they normally use the internet on Dutch websites as www.spoor.nl or www.ns.nl. Participants indicated that they use also the internet to look for information on museums or to view offers from hotels. Only two participants indicated that they use a route planner with a map. They prefer to use a physical map when they are travelling.

None of the interviewed users buy tickets through the internet. Normally the travel agency or family buys flight tickets for them. For train tickets all the participants have a Public Transport chip-card. All participants indicated that they have no problems in using the train ticket vending machines at the stations.

The participants were asked to range the following activities from 0 to 10. The following are the average results per activity. *Going on a trip in the Netherlands* was the favorite activity of all, followed by *Going on a journey abroad*. These are important indicators for functionalities in MOBILE.OLD that must be taken into account.

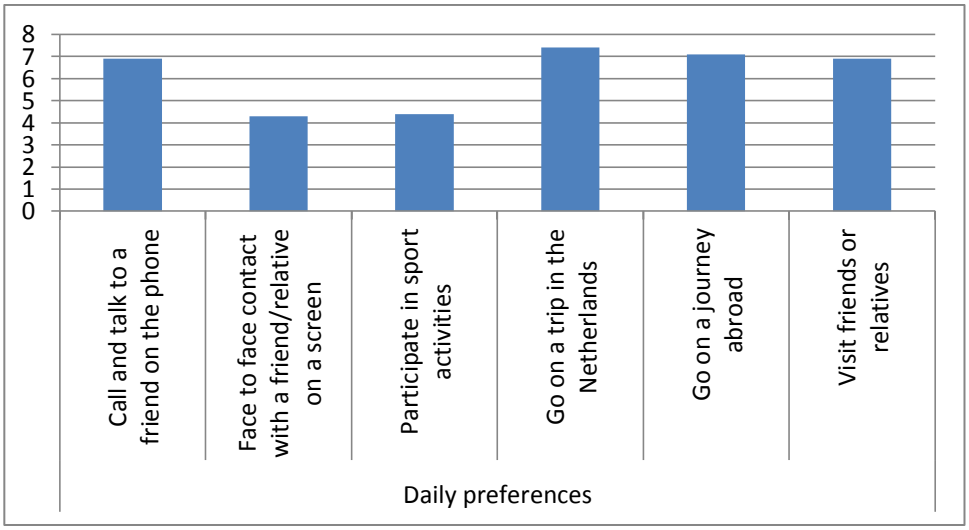


Figure 9: Daily preferences on the Dutch pilot site.

2.10.2.4 RATING OF THE MOBILE.OLD SERVICES

The following diagram demonstrates the rating of the users on the MOBILE.OLD services. Some numbers that stand out are the lack of interest in the Physical Training application. Also there was little interest from end-users in the traffic sign memory and quiz, together with the weather forecast. The highest interest was received by the transportation new headlines, and the hiking app.

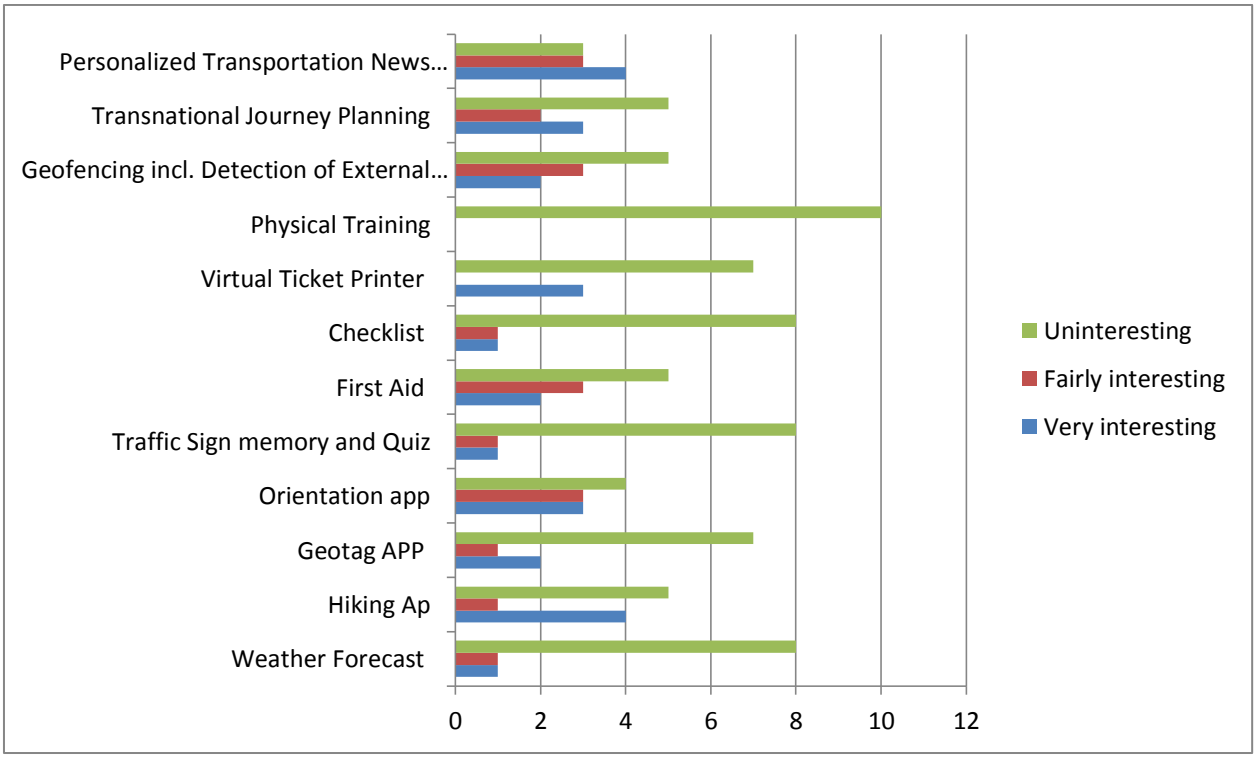


Figure 10: Rating of the MOBILE.OLD services on the Dutch pilot site.

2.10.2.5 COMMENTS OF THE ELDERLY ON THE SERVICES

The following table will give the main comments. Many users said that they might find the application more interesting if they had some specific functionality. These comments are reflected in this section.

Service/App	Comments
Personalized Transportation News Headlines	Three users said they find this application uninteresting, because they can find this information now easily on the internet as well. Three users said they find it interesting if they can use it for national and local trips, to know if there are traffic jams or train delays on advance. Two users indicated that they would use this information only when they go on an international trip. Two persons were not so sure if they found it interesting. One person mentioned that in order to use it before the internet, he would like to see all information under one single button, without having to scroll or search for data.
Transnational Journey Planning	The persons that didn't find the service interesting were using the travel agency and were already happy with this. Other users said they could already find this information on the internet if they wanted to or didn't travel abroad. The persons that found the service interesting would like to include information from a travel agency in the travel planner, in order to look in an easy manner at the different offers available. Another person suggested that the service should be like a portable traffic guide, such as the Lonely Planet, which is easy to use for older persons and contains all information on museums, culture, hotels, etc.
Geofencing incl. Detection of External Physical Conditions	Most people that found the service interesting, didn't see actual use for it at the moment, but thought that maybe they could use it in the future. One person found it fairly interesting if the service would be used by a travel agency, so she could be found if she was lost in a foreign country. Other users were mainly worried about their privacy issues and thought it would hamper their freedom.
Physical Training	Surprisingly this application was found uninteresting by all users. Most people said that they prefer to do sports at the activity center, where they can also meet other people as a social activity. Other people prefer to go walking or cycling than to train with a virtual trainer. Some just don't like to do physical training at all.
Virtual Ticket Printer App	The persons that found this application interesting said that they would only use it if they could actually buy the ticket at the same time. They found it interesting if they can buy also tickets for the theatre, the museum, as well as flight tickets. For flight tickets an explicit remark was that it should be very easy to compare different flight tickets to buy the cheapest and best option.
Checklist App	Many participants remarked that they can easily make a checklist on paper and that they do not need an application for this. One person said she might find it interesting if it also contained a list of all sights to visit in a city, so she wouldn't miss out on anything at a trip.
First Aid App	Many persons indicated that they found this first Aid App interesting if it

	would give on site information in case of emergency issues in a foreign country. In these cases they would be interested in receiving information on where to find medical aid, insurance support, or on road support in case of accidents. They indicated that they would not use it as a preparation application in home, but as an onsite mobile support.
Traffic Sign Memory and Quiz	Only one person that goes by car to foreign countries found it interesting to receive information on traffic signs in foreign countries. The rest of the users didn't find this interesting. One user mentioned that he would find a memory game interesting if it prepared in a playful manner for a country and learn about culture, language, food, etc.
Orientation App	The users that found it interesting said that they would use it on a trip to find an ATM, bus station or toilet. However some were skeptical and said that they could just ask on the street or at a hotel reception. Others said that it might be interesting to visit a city and see all the sights.
Geotag App	Many older persons said that normally they do not make photos and do not need such an app. Other mentioned that they would find it interesting, with the condition that it was very easy to use, without cables and difficult options.
Hiking App	Many persons thought it interesting to use a hiking/cycling application and see afterwards how fast they went, how many kilometers and what route. They also thought it interesting if they could use it as a navigator with indication in points to take a rest and have a refreshment.
Weather forecast App	The persons that didn't find the application very interesting. Many said that they can already find this information on teletext or the internet without a problem.

Table 2: Comments on the services on the Dutch pilot site.

- When it comes to necessary pre-conditions for using the services the elderly mentioned:
  - **Confidentiality**
  - **Privacy of data**
  - **User friendliness (big buttons, a small amount of actions required)**
  - **Good battery performance** (Smartphone)
  - **Dependability**

- Participants indicated that many services were already available for free on the internet and that they would not pay for it. For other services they would be prepared to pay a small fee. They were hesitant towards monthly prescription and would prefer to have a pay-per use contract.

2.10.2.6 RESULTS OF THE USER TESTS ON THE SAMSUNG GALAXY NOTE SMARTPHONE (5.3")

Generally it can be said that the participants felt enthusiastic about the Samsung Galaxy Note and the test. Two persons said it was too big for them and wouldn't fit in their pocket. Most of the users liked the handling of the Samsung and in combination with the Big Launcher they

found the Smartphone easier to handle than their current phones. They liked the color contrasts and the big buttons. Also the menu was very easy to handle and participants could easily find the different functionalities. Eight participants indicated that they would buy such a Smartphone themselves. One mentioned that he would prefer an iPhone instead. Two persons were not interested in buying a Smartphone. Three persons were prepared to have an internet subscription for their mobile phone. The others indicated that they would like to have the phone with internet as a pre-paid subscription, so they would only pay for what they were actually using and have more control on how much they were spending.

The users were asked to perform some activities, such as calling, taking a picture, playing and playing the Labyrinth and Memory game. The following are some main observations from the activities.

- The buttons: Although most users were happy with the big buttons, when writing in the key board many had problems to write well. Users were using the touch screen as a regular button, pressing to hard so the phone didn't react.
- Back button: The back button of the Samsung Galaxy note is only highlighted when it is used. This caused often problems for the users that couldn't find the button anymore.
- Samsung application: Although the Big Launcher app worked very well, as soon as the application was left to write or take a picture, the users had considerable more problem to use the phone. They couldn't find the small picture button for example. Also it was difficult to write on the keyboard for many users.
- Auto-correction: the auto correction should be switched off in order to facilitate the use for seniors.

2.10.3 INTERVIEW RESULTS OF THE ROMANIAN PILOT SITE

The session and interview was about 1 hour and 30 minutes, and took place in the chamber of AAIF's **Centre for Diagnosis and Treatment of Memory Impairment Diseases and Medical Rehabilitation**, on September 17th, 2012**.**

The Agenda included:

1. The informed consent - explained and thereafter signed by each participant.
2. The presentation of MOBILE.OLD project, objectives, estimated impact, scenarios.
3. The virtual presentation of the Samsung Galaxy Note Smartphone (5.3")
4. The virtual presentation of Big Launcher application

The issued discussions were noted, partially recorded, and processed.

Questionnaire – Interview commented and individually filled in by the participants.

For details on the session, the gathered data and their processing see please the attached Archive.

2.10.3.1 THE END USER GROUP DESCRIPTION

For the definition of the user-requirements, 13 elderly people, 3 males and 10 females aged 59-81 years, mean age 69.5 years, were included as voluntary end-users into the target group of the MOBILE.OLD Romanian pilot site.

The predefined key inclusion criterion was their independent living (no need of a formal or informal caregiver for the accomplishment of daily living activities), while the exclusion key criterion was the presence of physical or mental pathology capable to significantly restrict the subjects' indoor and outdoor mobility.

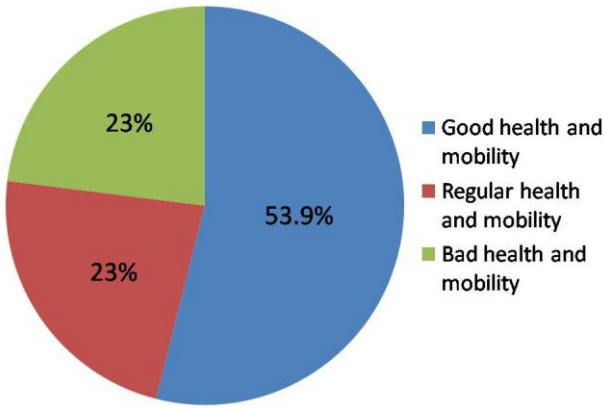


Figure 11: Health and mobility status on the Romanian pilot site.

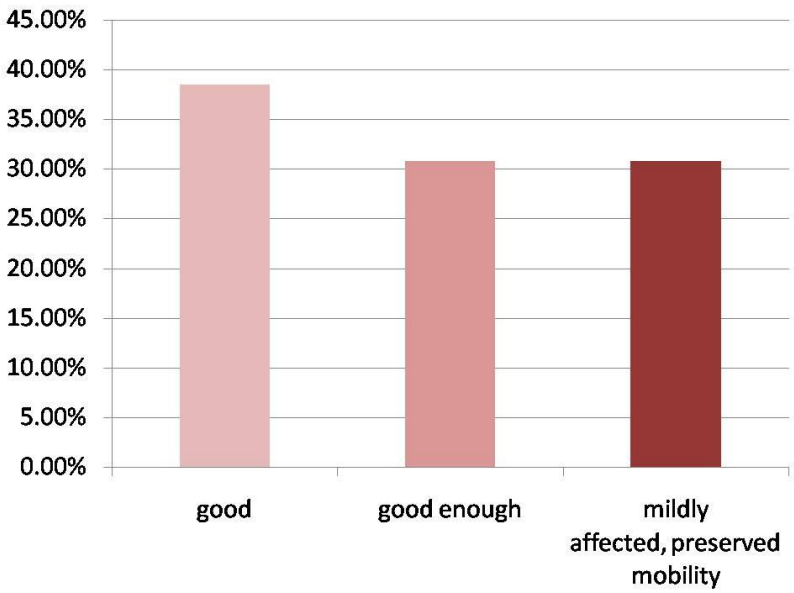


Figure 12: Subjective perception of the health status on the Romanian pilot site.

A percent of 38.5% from the participants felt their health state as being good, 30.8% - good enough and 30.08% mildly affected. From the last, one participant had cardiac pacemaker,

one had occasional memory problems, and one had knee prosthesis, but with preserved capacity of walking and accomplishing their activities of daily living (ADLs).

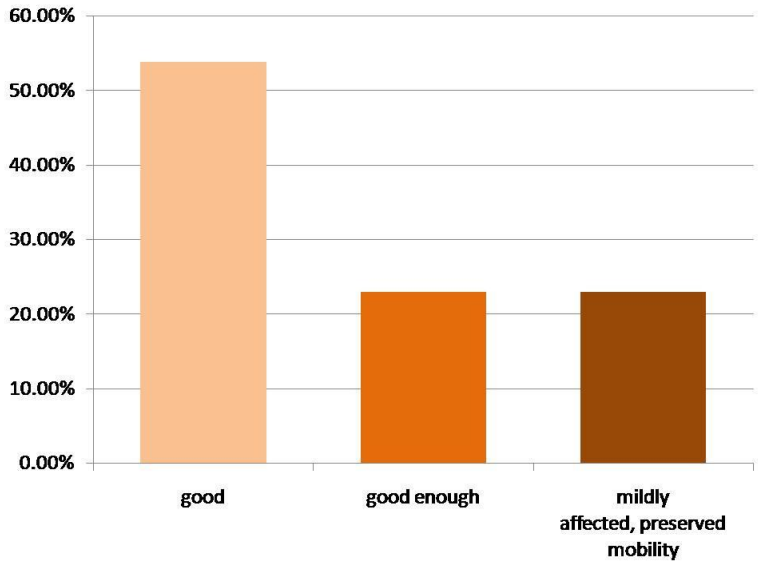


Figure 13: Subjective perception of the mobility on the Romanian pilot site

In 53.9% of the participants mobility is good, it is good enough in 23% and mildly affected in other 23%. Mildly affected mobility causes in the participants are bone pains (osteoporosis), rheumatism, knee prosthesis to one of the participants and gonarthrosis to one another.

38.4% from the participants declare that they are troubled by their physical limitations and are especially interested in gym and other means of improving their mobility. As a matter of fact, except two of them, all the participants are interested in this kind of personal improvement.

2.10.3.2 THE END USER GROUP AND TECHNOLOGICAL DEVICES

All the participants were daily users of conventional mobile phone and TV, 38.5% of them used the computer or laptop with Internet connection, and 1 participant was acquainted with iPhone and iPad.

Mobile phone

92.3% of the participants used the conventional mobile phone with keyboard for talking, 23% used the SMS function and the taking pictures function, one of them used all the functions of her iPhone and one of them used her phone only for receiving calls and not calling herself.

From all, 30.7% declared they face different difficulties in using their mobile phone: too old mobiles; temporary but unforeseen lack of connection; high cost of mobile phone service providers; except SMS, the other functions seem too complex for them. Among advantages, the participants specify that of communicating wherever they are. The user of iPhone appreciate that her mobile has too much functions that she actually does not need.

Computer

From the 38.5% of the participants that use a computer, all of them are using it for getting information and for communicate, 60% of them for entertainment and socialization, and two of them for work and online services (e-commerce, paying invoices etc.). Among the difficulties they face, the participants mentioned the eye and general fatigue they experience after a prolonged period of use, the high cost of anti-virus applications and the aggressive commercial advertisement on various sites.

TV set

Only one from the 13 participants uses the teletext function. A percent of 38.5% of them are reluctant to use a smart TV.

Perception **on** *the new technology*

61.5% of the participants declare they are interested about the new technological applications capable to ease domestic activities, communication and travelling and to facilitate the just in time interventions in case of emergency. A percent of 30.1% are reluctant. The preconditions of successful adaptation and use of new technological applications would be: the easy-to-use design and functions (keyboard, not too sophisticated menus, clear icons and letters); not excessive number of functions or an easy way to enable/disable them depending on person's provisional needs; careful previous training of the user on how to operate them, performed together a human assistant.

2.10.3.3 ACTIVITIES AND MOBILITY

Everyday life preferences

The mean scores of the preferences evaluated on a scale between 0-10 points are the following:

Phone call and talk with a friend/relative	5.6
Face to face contact with a friend/relative	6.9
Participate in sport activities	6
Go on a journey abroad	6.8
Go visit friends/relatives	6.5

Table 3: Communication preferences

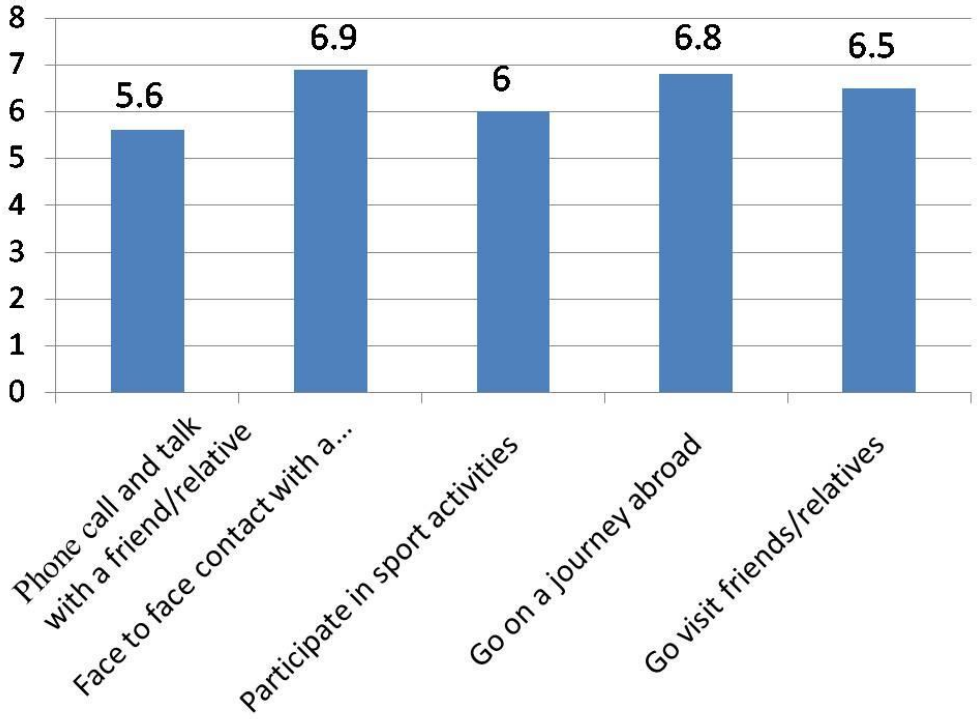


Figure 14: Communication preferences

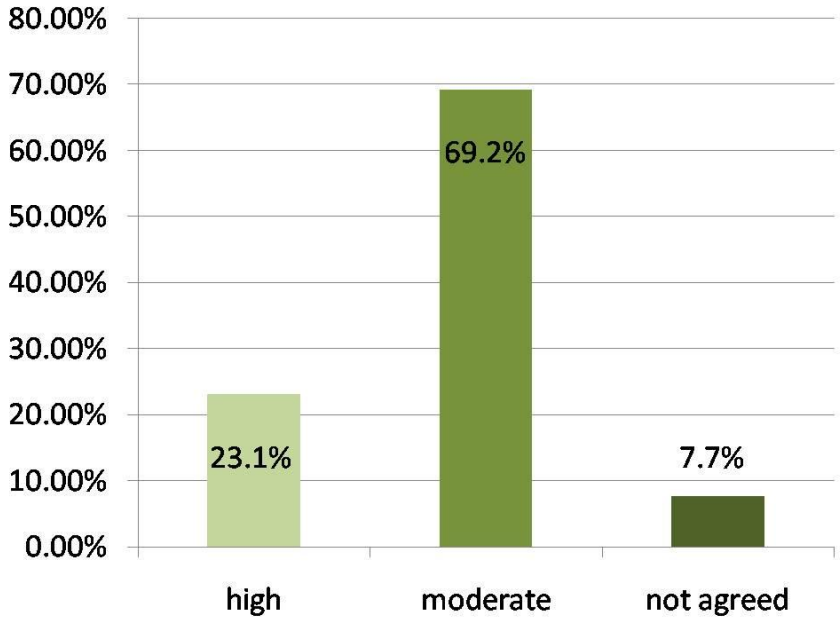


Figure 15: Preference for call and talk with a friend/relative on the phone

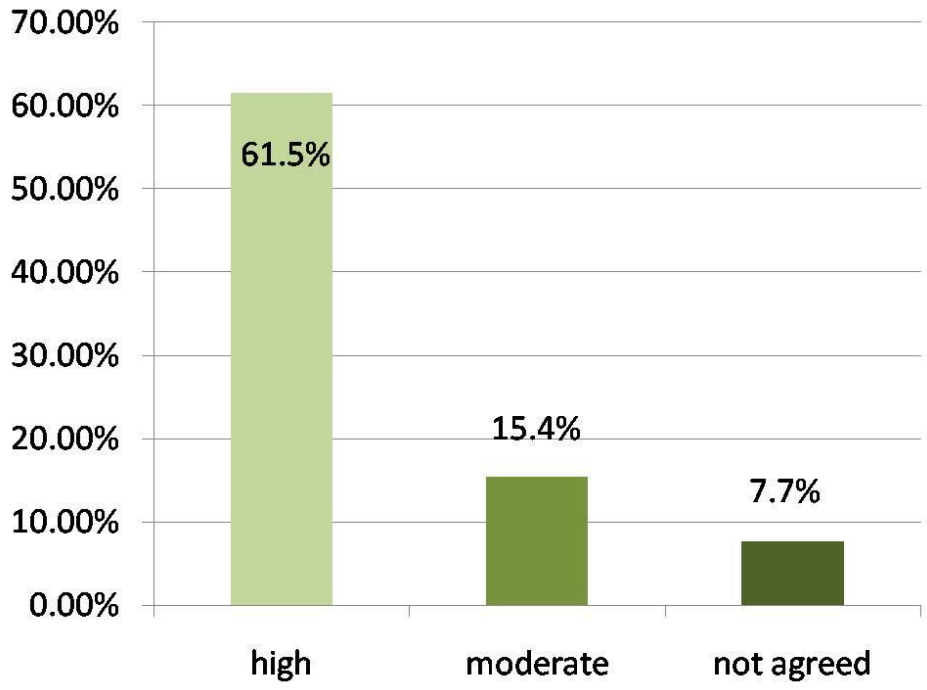


Figure 16: Interest in face to face content with friend/relative

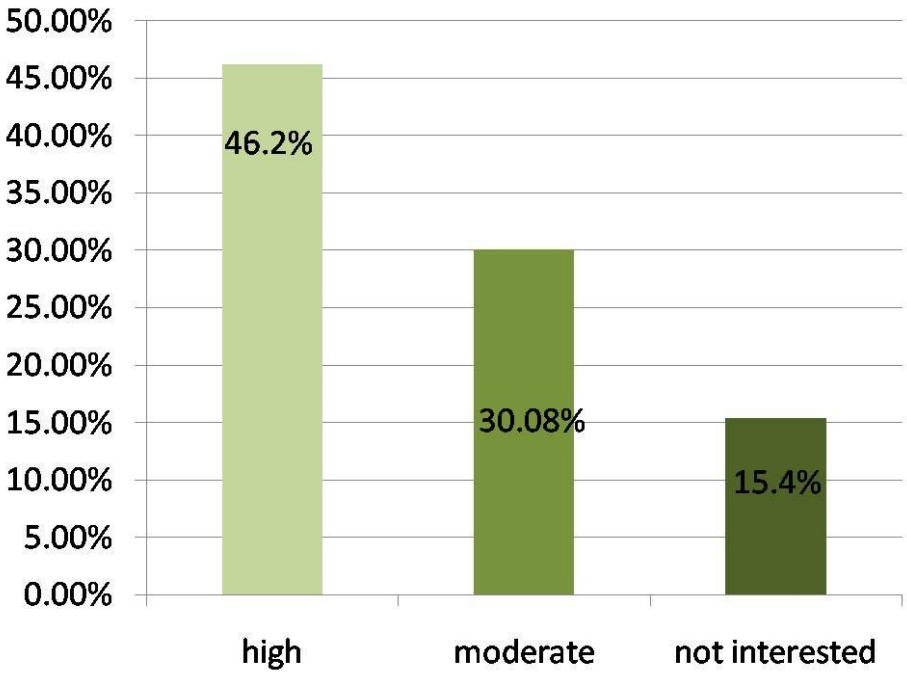


Figure 17: Interest in participation in sport activities

The above percentage reflects the interest of the participants in terms of daily gymnastics activities.

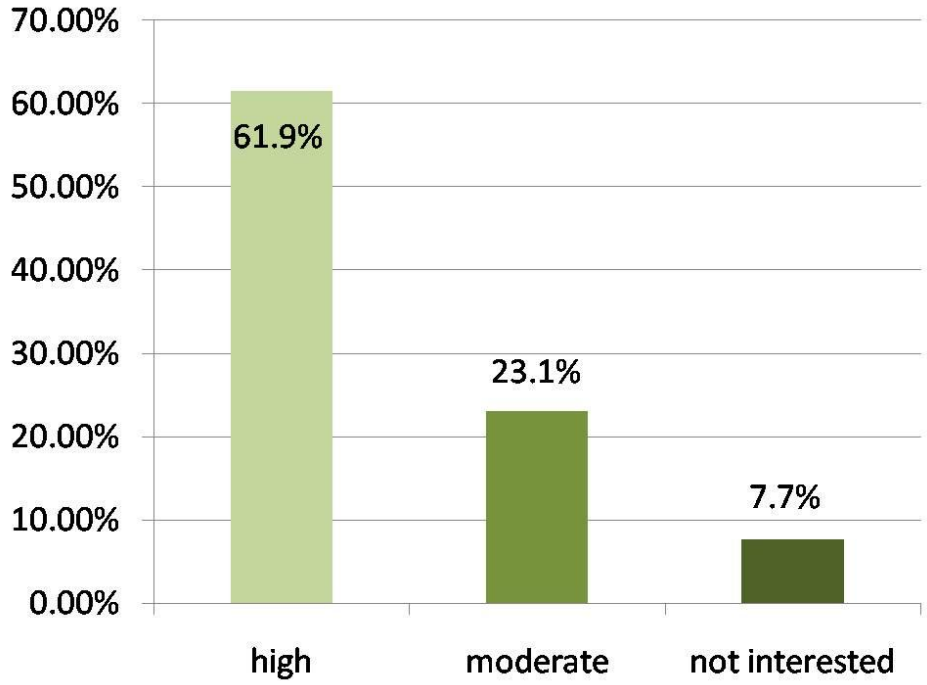


Figure 18: Interest in going on a journey abroad

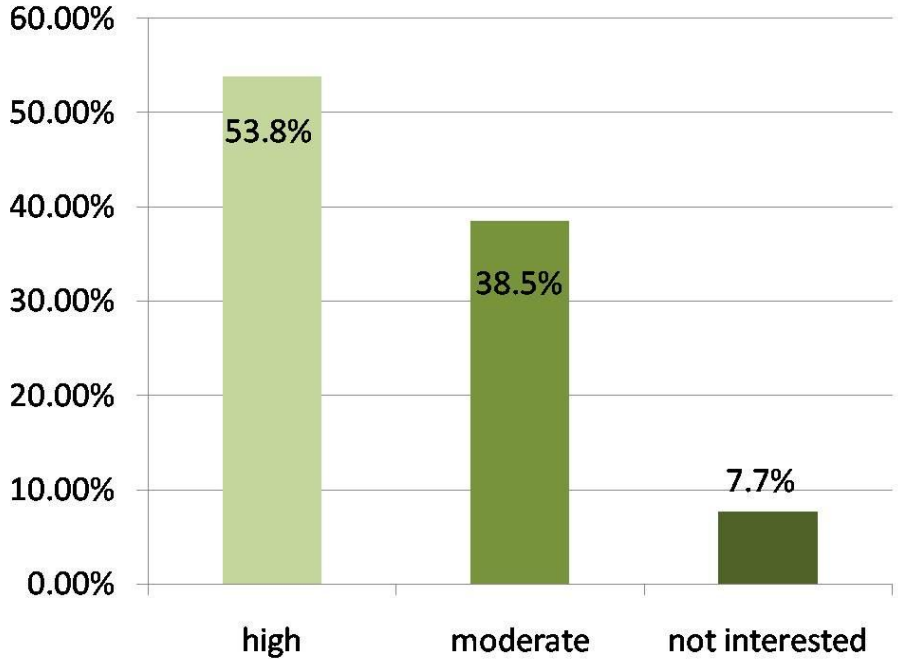


Figure 19: Interest in visiting friends/relatives

The Romanian participants exhibited an almost equal level of interest for all the questioned items. However, a more detailed analysis reveals that the most preferred are *Face to face contact with a friend/relative* (61.5% of them), *Go on a journey* (61,9%) and *Go visit friends/relatives* (53.8%). The *moderate use of mobile phone* is preferred by 69.2% of the participants. The preference for *physical training activities (gym)* is relatively high for 46.2% of

the respondents, 3 of them being highly interested in such programs. The preference for *travelling abroad* is also high in 69.1% of them, and 3 of them are frequently doing it. Regarding the outdoor mobility of the participants, the main activities are: walking (69.3% of them), shopping (69.3)%, various visits (69.3%), workplace (15.4%). The transportation means they are using include the public ones (bus, tram, metro, train) for 84.7% of the participants to the interview, plane (30.87%), own/family car (38.5%).

Trip preparation

Most of the participants prepare their trip together with family or friends (69.3%), 15.4% of them cooperate with a travel agency, 46.2% use maps and guides and 30.8% get information and use online booking services.

Regarding the *orientation during the trip*, 23.1% of the participants use GPS, 53.9% use map and guides, 23.1% ask remote family assistance for solving various situation and 69.3% occasionally ask information from local people.

For *ticket procurement*, 23.1% use online services if available, 23.1% use travel agency services, 23.1% use ticket machines, 30.8% prefer ticket procurement from kiosk or driver.

Regarding *objects forgetting*, 84.7% faced such an event several times, 15.4% faced it only occasionally and only one declare that he never forgot something when travelling. All except one previously make a list of things to be taken in the trip, names and contact details of persons to be eventually met, 23.1% a list with places to be visited.

2.10.3.4 RATING OF THE MOBILE.OLD SERVICES

The rating of MOBILE.OLD services by the participants to the interview are shown in the diagram below. Bar lengths signify the percent of people who appreciated the various services as being very interesting or fairy interesting for them, or declared they are not interested about a given service.

	Non interested	Very interested	Fairly interested
Personalized Transportation News Headlines	15.4%	53.9%	30.8%
Transnational Journey Planning	30.8%	46.2%	23.1%
Geofencing incl. Detection of External Physical Conditions	15.4%	77%	7.7%
Physical Training	7.7%	53.9%	38.5%
Virtual Ticket Printer App	38.5%	38.5%	23.1%
Checklist App	30.8%	38.5%	30.8%
First Aid App	0%	61.6%	38.5%
Traffic Sign Memory and Quiz	30.8%	46.2%	23.1%
Orientation App	30.8%	38.5%	30.8%
Geotag App	38.5%	46.2%	15.4%

Hiking App	46.2%	38.5%	15.4%
Weather forecast App	0%	69.3%	30.8%

Table 4: Potential interest in the proposed MOBILE.OLD services

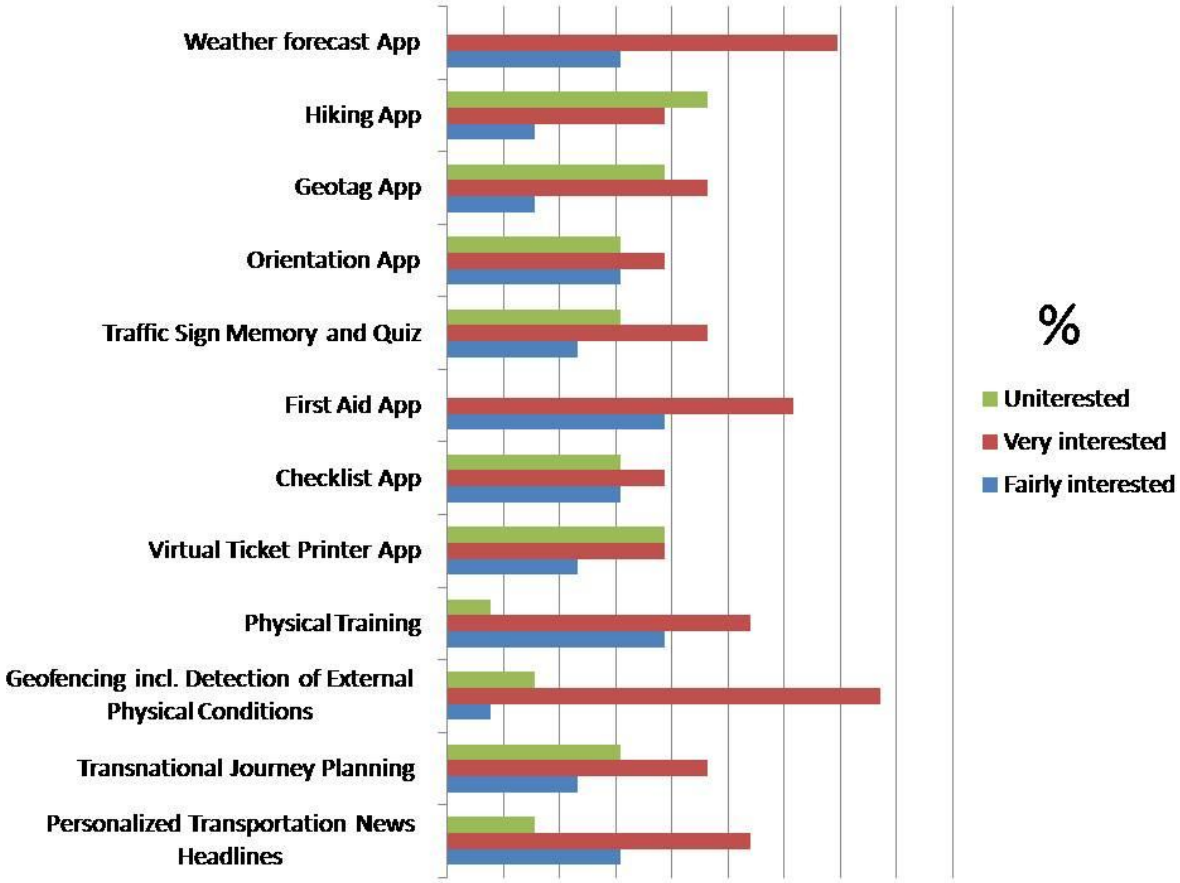


Figure 20: Visualization of the potential interest in the proposed MOBILE.OLD services (see Table 4)

Generally, the participants to the interview are interested in the MOBILE.OLD services. They highly appreciate Geofencing with detection of physical external conditions, as well as the Weather Forecast application, First Aid application, the Physical Training application and the Personalised Transportation News Headlines.

2.10.3.5 COMMENTS OF THE ELDERLY ON THE SERVICES

The following table summarizes the comments of the participants, obtained both, during the discussions realized with them when the introductory presentation of the project and its objectives and activities (Annex I), and by the Interview-Questionnaire form.

Service/App	Comments
Personalized Transportation News Headlines	Useful service both for long and short trips. Half of them are highly interested and the rest of them, except two, would like to use such a service at their demand. Two persons declare uninterested, because of "too many functions on a phone". They are afraid of not be able to learn how to use so

very interested - 53.9% *interested - 30.8%* *not interested - 15.4%*	many functions without getting in a tangle. The suggestion of a careful previous training for learning how to use the phone services was accepted with the condition of being performed under a patient assistance from a specialized person.
Transnational Journey Planning *very interested - 46.2%* *interested - 23.1%* *not interested - 30.8%*	Lesser than half of the participants were interested in this application, because it can simplify their efforts to plan the journey. One third of them are accustomed to plan their travel online. One third declared uninterested because they are currently helped by their family, or the application seems too complicate for them.
Geofencing incl. Detection of External Physical Conditions *very interested - 77%* *interested - 7.7%* *not interested - 15.4%*	Ten out of the thirteen elderly (77%) declared very interested in this application, especially because "old people are particularly scared and even vulnerable when they feel they're lost". One of them asked if the application can also detect her cat in the nearby environment. Two elders assume they are not interested of geofencing because of privacy violation concerns, but agree the detection of external physical conditions.
Physical Training *very interested - 53.9%* *interested - 38.5%* *not interested - 7.7%*	Well received application. Half of the elders are very interested in it, while one of them is reluctant because "I don't know if I'll be regularly in the humor for making gym". Question: "who will update the gym schedule and demo clips?" Saving the gym session results/filled in questionnaire seems a complication among the great number of the demands for operate this complicated phone.
Virtual Ticket Printer App *very interested - 38.5%* *interested - 23.1%* *not interested - 38.5%*	More than one third (38.5%) of the participants highly agree to be instructed/reminded how to use a ticket machine (or an ATM). A similar percent of people, i.e. those who are not frequently interested in long trips out the town, are not interested because in Romania the public transportation for the retired people is free, and for long travels they benefit from family arrangements. Question/suggestion: "Can the phone directly operate a ticket machine, using the user's banking card PIN to pay and involving the user just to pick up the ticket?"
Checklist App *very interested - 38.5%* *interested - 30.8%*	More than one third of the participants guess this application very useful not only for travel, but also for shopping for example. . The participants indicated that this would be a useful functionality. They could imagine using it on a weekly routine, when they plan to go shopping or on demand when they go on a journey.

not interested - 30.8%	
First Aid App *very interested - 61.6%* *interested - 38.5%* *not interested - 0%*	"Application of high interest for everybody, not only for old people". "Can this phone detect user's fall and alarm a relative for example?"
Traffic Sign Memory and Quiz *very interested - 46.2%* *interested - 23.1%* *not interested - 30.8%*	Useful for more than half of participants. Frequency of use: at demand. One third definitely uninterested.
Orientation App *very interested - 38.5%* *interested - 30.8%* *not interested - 30.8%*	Great interest in this application. Frequency of use: at demand. Comments: "My actual position on the map displayed on the screen will be signalled, for example by a flashing point?" One third of the participants are reluctant to map use, "they are usually too complicated". "May I receive a voice message telling me, for example – you are on the Berthelot Street, Victory Avenue is straight forward"?
Geotag App *very interested - 46.2%* *interested - 15.4%* *not interested - 38.5%*	The over 60% of the participants which are interested in this application are also interested in the high performance and easy to use of the phone camera.
Hiking App *very interested - 38.5%* *interested - 15.4%* *not interested - 46.2%*	Almost every of the elderly individuals indicated that they would like to use this service after a travel, an excursion or after a hiking tour in order to compare distance or speed.
Weather forecast App *very interested - 69.3%*	There is a great interest for this application, "very useful not only for the old people". Use frequency: daily or on demand.

interested - 30.8% *not interested - 0%*	

Table 5: Comments of older persons on the proposed MOBILE.OLD services

- When it comes to necessary pre-conditions for using the services the elderly mentioned:
  - **Confidentiality, security of sensitive personal data**
  - **Easy to use, simplest as possible access to different applications**
  - **High screen resolution, friendly interfaces**
  - **Easy to disable/enable a given application (personalization)**
  - **Careful, patient previous training for learning how to use the various functions, better performed together with a human trainer**
  - **Affordability**
- The participants agree to pay a mean amount of 12 € per month for the services.

2.10.3.6 RESULTS OF THE USER TESTS ON THE SAMSUNG GALAXY NOTE SMARTPHONE (5.3")

Samsung Galaxy Note Smartphone features and its performances were presented by the projection of a video clip[1], and discussed with the 13 participants to the interview. Various smart functions and the handling of an iPhone were performed with an iPhone 4S. The Big Launcher application[2] was also projected and its performances were explained. One of the participants was fully acquainted with an iPhone mobile. All of them felt enthusiastic about the Samsung Galaxy Note feature and functions.

The results of participants direct exercise with the iPhone 4S (touch screen, zoom, menu – access to various functions etc.) and the afferent discussions are summarized below.

Generally, the participants liked the big screen and the comparatively reduced weight of the device, thickness and high image resolution. Their habituation to touch screen and touch zoom in/out was not difficult. S-pen function was appreciated as a good solution for the use of the virtual keyboard. There was a roughly important reluctance in handling the Menu and accessing its various items, argued by the participants through "there are a lot of functions, I am not sure I'll come through", "I don't know if I'll have the patience to learn how to use each of these functions". There were also positive comments such as: "I believe that such a phone deserves all the necessary effort and patience to learn to use it", "I don't believe that a complicated and boring User Manual can really help me to learn how to use this device", "the previous, patient training with a person who knows how to use this phone is mandatory", "I believe that learning previously how to use a computer and Internet will be better for me". A particular comment agreed by many participants was related to the security of an old person

[1] http://www.youtube.com/watch?v=qZVol2OCM8k

[2] https://play.google.com/store/apps/details?id=name.kunes.android.launcher.activity&hl=en

using such a natty phone in public spaces. The participants had fun to play “Casual Jewels” and watch Polka Granpa (You Tube) on the iPhone.

List of the tasks exercised with the participants on a smartphone:

- To use the touch screen
- To play with touch zoom in/out
- To make and view a photo
- To write an SMS
- To play “Casual Jewels” game
- To access Google Map

To watch an You Tube video [Polka Granpa (Original) – YouTube]

2.10.4 INTERVIEW RESULTS OF THE SPANISH PILOT SITE

2.10.4.1 THE END USER GROUP

For the definition of the user-requirements, five elderly people who belong to the target group of MOBILE.OLD have been interviewed on the Spanish pilot site. The elderly individuals are in the age of 61-75. The mean age of the participants is 68 years.

Every participant had signed an informed-consent form. Their data has to remain confidential, and must not be used outside of the MOBILE.OLD project.

2.10.4.2 THE END USER GROUP TECHNOLOGICAL DEVICES, ACTIVITIES AND MOBILITY

Each of the elderly stated that his health situation is good, that his level of mobility is across five which is above-average good and that he is travelling abroad at least one time per year. All of them indicated that they own a Flat TV, and a mobile phone. Some of them have a computer and/or a laptop with internet connection. They are using his devices on a daily routine: Some of them uses the computer for writing and receiving E-Mails, or gathering information via Google and looking at photos. The mobile phone is only used for writing and receiving SMS, calling and photos.

Some of them prefers to use the remote control and others said that they would like to control the MOBILE.OLD services on the Smart TV via keyboard and mouse.

2.10.4.3 RATING OF THE MOBILE.OLD SERVICES

The following diagram demonstrates the rating of the users on the MOBILE.OLD services. In general it can be said that the participants feel very interested about the MOBILE.OLD services and that the feedback was consistently positive.

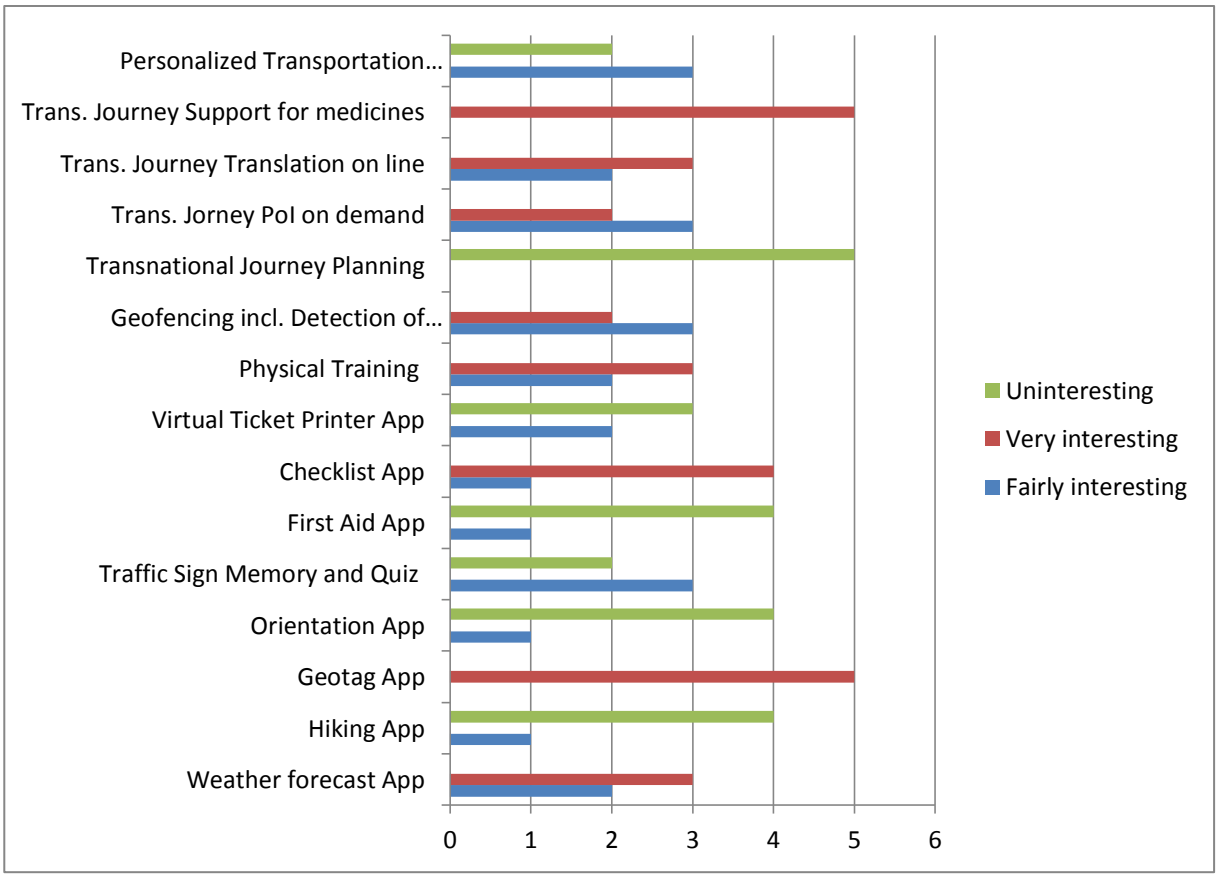


Figure 21: Rating of the MOBILE.OLD services on the Spanish pilot site.

2.10.4.4 COMMENTS OF THE ELDERLY ON THE SERVICES

The following table will give the main comments of the elderly.

Service/App	Comments
Personalized Transportation News Headlines	This application is not very well received for the participants because they may find this information in Internet. Most of them normally not planning his trips with this type of information. It would be very difficult find providers with local information for this service.
Transnational Journey Planning	This service is refused. None of them would use this service for a travel so complicated like a transnational journey. All of them feel more comfortable and safe with the services of a professional agency.
Transnational Journey Point of interest on demand	In a travel organized by a professional organization, this service would be an interesting aid. During the travel is difficult or embarrassing asking to the guide continuously.
Transnational Journey	This is a utility that can help overcome the fear of a foreign travel. It

Translation on line	provides the security of being able to explain (to a doctor, to a taxi driver, etc.) if you have any problems or unexpected situation
Transnational Journey Support for medicines	All participants stated that this would be a useful service. All of them added that it could be useful to help them to overcome fairs to travel outside. All would to pay for the service or would to demand to the travel agents or to the Public Social Services.
Geofencing incl. Detection of External Physical Conditions	This service was considered quite interesting. None of the participants refused. They think this could also be useful for them even, when they do not suffer from any cognitive impairment (security when they are on a journey). Moreover the detection of external physical conditions was fairly well received among the participants.
Physical Training	Participants stated that they would use this service, adapted to their capacities. They want to improve their physical shape to maintain their mobility and even more efficient rehabilitation. They can be used 4 or 5 times per week
Virtual Ticket Printer App	This service was refused. Any of the participants would use this type of service, they had enough time for buy the tickets.
Checklist App	4 of the participants indicated that this would be a useful functionality. They could imagine using it on a weekly routine, when they plan to go shopping or on demand when they go on a journey.
First Aid App	This service had no interest to the participants. They prefer to see a doctor for any problem and they were not sure that this would help for prevention
Traffic Sign Memory and Quiz	This service does not have much appreciation and interest and some participants rejected it completely. Another type of game could be more attractive.
Orientation App	This service was undervalued. They think they can ask to the people in the street/location and they would not pay for it.
Geotag App	All of participants would like to have this application. Especially when it comes to their vacation photos. They think that is especially interesting to remember the places they has taken the photos.
Hiking App	Only one participant makes long trips through the countryside and he values it as a possible interesting service. Rest of participants do not consider it interesting because they doesn`t make this type of activity.
Weather forecast App	Concerning the weather forecast application the majority of the participants stated that they could imagine using the application on demand or on a daily routine when they are on a journey or at home in order to get the newest weather information and recommendations for protecting from extreme weather conditions.

Table 6: Comments of older persons on the proposed MOBILE.OLD services

- When it comes to necessary pre-conditions for using the services the elderly mentioned:
  - **Confidentiality**
  - **User friendliness**
  - **Good battery performance** (Smartphone)
  - **Dependability**
- Everybody said that they would recommend the services to their friends/family but only if the services are really useful.

The participants added that they would accept to pay in mean about 6-8 € per month for the services.

2.10.4.5 CONSOLIDATED RATING OF THE MOBILE.OLD SERVICES

The following diagram demonstrates the consolidated ratings of the 33 interviewed end-users from the four pilot sites.

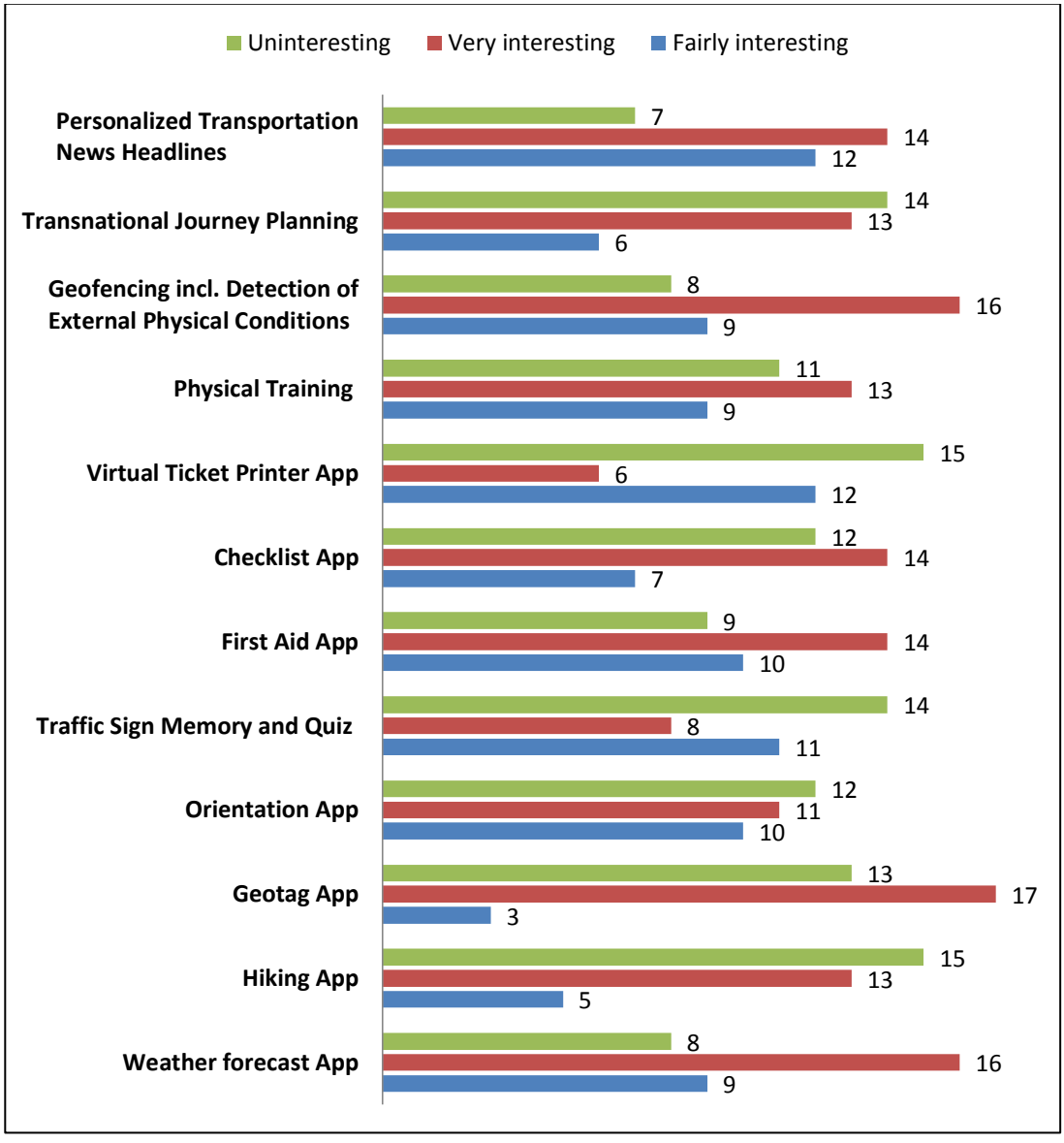


Figure 22: Consolidated rating of the MOBILE.OLD services across all pilot sites

2.11 USER REQUIREMENTS

User requirements are identified by unique identifiers that shall remain constant during the full development process. The pattern is MOBILE.OLD-<User Site>-<Category>-<Number>, where <User Site> is a letter identifying the Country, <Category> is a letter identifying the category of the requirement and <Number> a unique number for the category. The categories include:

- S…….Service Usage requirements
- C…….Security Requirements
- I……..User Interface Requirements

MOBILE.OLD-US-C-N	Title of the UR
	Description of the UR

2.11.1 AUSTRIAN USER REQUIREMENTS

MOBILE.OLD-AUT-I-1	**Menu Tree**
	For elderly users it is very important that they always have good orientation regarding program menus. As a result a menu tree, rich in contrast, which is always visible on the screen, is essential for their better orientation.
MOBILE.OLD-AUT-I-2	**Main Menu Button**
	For elderly users it is very important to have a “main-menu” button provided on each page so they can easily reach exit and return to the “main-menu”. As a consequence a “main-menu”- button, rich in contrast, and always visible on the screen is essential for them.
MOBILE.OLD-AUT-I-3	**Easy/Intuitive User Interface**
	The elderly users wish to have a simple intuitive user interface consisting of self-explanatory buttons, high level contrast, big font size and fewer options.
MOBILE.OLD-AUT-I-4	**> 5.0“ Screen Size for Smartphone**

	It turned out that a screen size above 5.0” has a lot of advantages for the elderly concerning font size, button size, resolution, readability and handling (bigger phone fits better in their hands => less fear that they can drop it).
MOBILE.OLD-AUT-I-5	**Help/Status Field**
	It is very important for the elderly users, that they always have a help/status field visible on the screen. Which always displays the possible control options to them, e.g. on screen cues “Press down to go to next contact”.
MOBILE.OLD-AUT-I-6	**“Big -Launcher” Home Screen on Smartphone**
	It turned out that the elderly love the home screen of the “big- launcher” app. It was designed for readability and easy use. It is controlled by single touches, no swipes, no long presses. It comes with three different color schemes and three font sizes, which allow you to use your phone without glasses. One of the best things about it is that it is highly customizable. You are able to make several user relevant settings concerning e.g. system permissions and app availability so that the users get the feeling that they cannot mess anything up. This is very important because the elderly often have the fear that they can mess something up, when using new technologies. As a result it is highly recommended to equip the Smartphones of the elderly for the tests with the “big-launcher” home screen in order to reach the MOBILE.OLD apps.
MOBILE.OLD-AUT-S-1	**Physical Keyboard and Mouse**
	The elderly prefer to control the MOBILE.OLD application on the Smart TV via a wireless keyboard and mouse. Especially for text input the remote control linked to an on screen keyboard is unusable for them.
MOBILE.OLD-AUT-S-2	**Traffic Sign List within the Traffic Sign Memory & Quiz Application**
	The users wish to have a list where they can check up all traffic signs, because the elderly like the idea of having all signs at hand.

MOBILE.OLD-AUT-S-3	**Only Certified Journey Providers within the Transnational Journey Planning**
	Older people are always afraid to get tricked within the internet, so it is a must that they can rely on the offers they get within the transnational journey planning.
MOBILE.OLD-AUT-S-4	**PC Connectivity to MOBILE.OLD Services**
	Users want to connect their PC to the MOBILE.OLD platform in order to look up their geotagged pictures and hiking paths and send them per e-mail to their friends and family members.
MOBILE.OLD-AUT-S-5	**Direct Motion Feedback within the Physical Training Service**
	The elderly people wish to have a direct motion feedback when they do training exercises in front of their Smart TV e.g. like playing fitness games with the Microsoft Kinect.
MOBILE.OLD-AUT-S-6	**MOBILE.OLD Manual**
	Careful design of the accompanying manual of the MOBILE.OLD services (simple with pictures and in the language of the targeted users).
MOBILE.OLD-AUT-C-1	Advanced Security and Privacy Settings
	Elderly people are often afraid to get “hacked” on the internet, when they provide their private data, so it is important to let them know that their data remains confidential. E.g. when they are making a reservation online (hotel, bus, flight).

2.11.2 DUTCH USER REQUIREMENTS

MOBILE.OLD-NL-S-1	**Manual and helpdesk**
	Seniors prefer to use a physical manual when they are trying out new services. Simultaneously seniors prefer to call to a helpdesk when they encounter problems. This way, they do not have to ask their friends or family.

MOBILE.OLD-NL-S-2	**Subscription**
	When seniors use the mobile phone, they normally do not have a monthly subscription. Instead they prefer to use pre-paid subscriptions. This gives more confidence on what they are spending. For MOIBLE.OLD they prefer to pay for each time they use the application, instead of a monthly fee.
MOBILE.OLD-NL-S-3	**(Trans)national journey planner**
	Seniors go very regularly (approximately once or twice a month) on local, regional and national trips. International trips are approximately once a year organized. Both are activities that score very high. Therefore in order to obtain more impact, it is important to take a national journey planner as a starting point and then focus on an international journey planner.
MOBILE.OLD-NL-S-4	**Travel information**
	As most seniors arrange their travel through a travel agency, a good selection should be made from tour operators that can be presented in the application. This way seniors can use it to browse through the offers and select their preferences. For the mobile application seniors must be able to find all information related to a trip they are making, similar to a travel guide.
MOBILE.OLD-NL-S-5	**Physical training**
	Physical training is only considered interesting if it also contains a social factor. So it should help them to meet other people or to leave the home.
MOBILE.OLD-NL-S-6	**Ticket application**
	The ticket application should also include tickets for theatre, museums and other activities.
MOBILE.OLD-NL-S-7	**First aid application**
	The first aid application should include helpful information for emergency situations in foreign country.
MOBILE.OLD-NL-C-1	**Security**
	Security of data must be good and also communicated (either in the app or in the manual) to the older persons so they feel more confident.

MOBILE.OLD-NL-C-2	**Reliable content**
	The content should be at all times reliable, also when it is supplied by third parties (e.g. travel agencies). Seniors will stop using the application if this is not the case.
MOBILE.OLD-NL-I-1	**Relation between different services**
	Every new application (even if it is very easy to use) takes an effort from older persons to start feeling confident and at ease with the use. Therefore it is important to present the different services in MOBILE.OLD as much as possible as a single service, with the same lay-out, buttons and colors so that there are no barriers to use the different services in the MOBILE.OLD application.
MOBILE.OLD-NL-I-2	**Buttons**
	Buttons have to be large with good contrast compared to the background. Regular text must be different than the buttons, so there is a clear distinction on where to press and where not. The buttons should react the same to a short touch and a long, firm touch.
MOBILE.OLD-NL-I-3	**Small amount of action**
	All information and services should be easily accessible under one button, without having to scroll or enter search names. The application should require as little action from the user as possible.
MOBILE.OLD-NL-4	**Big Launcher home screen**
	It is definitely necessary to have a Big Launcher installed on the Smartphone to use the phone and obtain access to the MOBILE.OLD application. The regular Smartphone options are too complicated and too small to be used.
MOBILE.OLD-NL-5	**Mobile device**
	The application should also be easy to use on a smaller Smartphone, for those persons who find the Samsung Galaxy Note to large.

MOBILE.OLD-NL-I-6	**Key Board Smartphone**
	The keyboard in the Smartphone should be large enough to easily find and touch the letters. The auto-correction should be off and the letters should be clearly visible.

2.11.3 ROMANIAN USER REQUIREMENTS

MOBILE.OLD-RO-I-1	**Easy/Intuitive User Interface**
	Simplest as possible interface with fewer options and self explanatory buttons, high level contrast, big font size. Performances like that of the Big Launcher are highly useful.
MOBILE.OLD-RO-I-2	**Important buttons at hand on screen**
	"Help" button always displayed on screen, for easily getting info about the various icons/buttons significance and functions. "Alarm" button always on screen for instantly signal to a relative that the user faces an emergency situation and must be contacted by that relative.
MOBILE.OLD-RO-I-3	**TV interface**
	More than half of the users agree the TV interface, but suggest the as much as possible use of the smartphone itself as a remote control. The others prefer to run the MOBILE.OLD application on the Smart TV via a wireless keyboard and mouse.
MOBILE.OLD-RO-I-4	**Communication with the smart mobile by voice**
	Where possible, old people prefer to ask and receive services to/from the MOBILE.OLD application by voice.

MOBILE.OLD-RO-S-1	**Easy navigation inside the Menu**
	Easy leaving of a function and easy access to another one.
MOBILE.OLD-RO-S-2	**Previous training on a computer for those functions that include Internet surf**
	This may improve the compliance of people still lacking computer use skills.
MOBILE.OLD-RO-S-3	**(Trans)national journey planner**
	Agreed as important application. A virtual map with the route of a travel figured on it, marked stops, durations, time marks and so on, saved in the phone for being consulted when needed, may be of great help.
MOBILE.OLD-RO-S-4	**Travel agency selection and information trust**
	A list of fiduciary local agencies and their contact details stocked in the phone, to be connected in the easiest manner.
MOBILE.OLD-RO-S-5	**Ticket machine tutoring**
	Instead of a text, video demo or voice tutorial on how to use a ticket machine, would it be possible that the phone itself operates that machine and pays based on the user's banking card ID?
MOBILE.OLD-RO-S-6	**Signalling the closest Info Desk, Ticket Machine, ATM Toilet etc. In a travel environment**
	Would be a useful function for old people and not only, able to minimize the travel stress.

MOBILE.OLD-RO-S-7	**Traffic Sign List within the Traffic Sign Memory & Quiz Application**
	Useful function.
MOBILE.OLD-RO-S-8	**Physical training**
	Schedule and content to be established by the doctor or the kinetotherapist.
MOBILE.OLD-RO-S-9	**Agenda / To do list / Shopping list etc.**
	Easy to be created and updated.
MOBILE.OLD-RO-S-10	**Geofencing incl. Detection of External Physical Conditions**
	Function that may easily violate user's privacy. Easy to be disabled when the user considers that necessary.
MOBILE.OLD-AUT-S-11	**MOBILE.OLD Manual**
	Better if its use is preceded by a careful training of the user by an initiated person.
MOBILE.OLD-AUT-S-12	**First aid app**
	In old persons falls are frequent and harmful. Detection of a possible user fall and instant alarm to a relative would be of great help.
MOBILE.OLD-AUT-S-13	**Affordability**

	Especially important for the large part of old people.
MOBILE.OLD-AUT-C-1	**Advanced Security and Privacy Settings**
	Old people are particularly concerned with their personal data and affairs.
MOBILE.OLD-AUT-C-2	**Long lasting closeness to phone for people having heart pacemakers**
	May such a device influence a heart pacemaker functioning?
MOBILE.OLD-AUT-C-3	**Owner security in public spaces**
	An old person with a natty phone in a public space may be particularly vulnerable to aggression and robbery.

2.11.4 SPANISH USER REQUIREMENTS

MOBILE.OLD-SPA-I-1	**Easy/Intuitive User Interface**
	The elderly users wish to have a simple intuitive user interface with a menu with a few and self-explanatory buttons, high level contrast, big font size and fewer options.
MOBILE.OLD-SPA-I-2	**> 5.0“ Screen Size for Smartphone**
	It turned out that a screen size above 5.0” has a lot of advantages for the elderly concerning font size, button size, resolution, readability and handling (bigger phone fits better in their hands => less fear that they can drop it).
MOBILE.OLD-SPA-I-3	**Help/Status Field**

	It is very important for the elderly users, that they always have a help/status field visible on the screen. Which always displays the possible control options to them, e.g. on screen cues “Press down to go to next contact”.
MOBILE.OLD-SPA-S-1	**Physical Keyboard and Mouse**
	Most of the participants prefer to control the MOBILE.OLD application on the Smart TV via a wireless keyboard and mouse. Especially for text input the remote control linked to an on screen keyboard is unusable for them. Some of them feel comfortable with the remote control.
MOBILE.OLD-SPA-S-2	**Direct Motion Feedback within the Physical Training Service**
	The elderly people wish to have a direct motion feedback when they do training exercises in front of their Smart TV e.g. and they loved the exercise is explained by a voice making funny it
MOBILE.OLD-SPA-S-3	**MOBILE.OLD Manual**
	All users want a manual with clear and simple instructions where they can review all the times they want, when they forget something

2.11.5 CONSOLIDATED USER REQUIREMENTS

MOBILE.OLD-AUT-I-1	**Menu Tree**
	For elderly users it is very important that they always have good orientation regarding program menus. As a result a menu tree, rich in contrast, which is always visible on the screen, is essential for their better orientation.
MOBILE.OLD-AUT-I-2	**Main Menu Button**
	For elderly users it is very important to have a “main-menu” button provided on each page so they can easily reach exit and return to the “main-menu”. As a consequence a “main-menu”- button, rich in contrast, and always visible on the screen is essential for them.
MOBILE.OLD-AUT-RO-SPA-I-3	**Easy/Intuitive User Interface**

	The elderly users wish to have a simple intuitive user interface consisting of self explanatory buttons, high level contrast, big font size and fewer options.
MOBILE.OLD-AUT-SPA-I-4	**> 5.0“ Screen Size for Smartphone**
	It turned out that a screen size above 5.0” has a lot of advantages for the elderly concerning font size, button size, resolution, readability and handling (bigger phone fits better in their hands => less fear that they can drop it).
MOBILE.OLD-AUT-SPA-I-5	**Help/Status Field**
	It is very important for the elderly users, that they always have a help/status field visible on the screen. Which always displays the possible control options to them, e.g. on screen cues “Press down to go to next contact”.
MOBILE.OLD-AUT-NL-RO-I-6	**“BIG -Launcher” Home Screen on Smartphone**
	It turned out that the elderly love the home screen of the “BIG- launcher” app. It was designed for readability and easy use. It is controlled by single touches, no swipes, no long presses. It comes with three different color schemes and three font sizes, which allow you to use your phone without glasses. One of the best things about it is that it is highly customizable. You are able to make several user relevant settings concerning e.g. system permissions and app availability so that the users get the feeling that they cannot mess anything up. This is very important because the elderly often have the fear that they can mess something up, when using new technologies. As a result it is highly recommended to equip the smartphones of the elderly for the tests with the “big-launcher” home screen in order to reach the MOBILE.OLD apps.
MOBILE.OLD-NL-I-7	**Relation between different services**
	Every new application (even if it is very easy to use) takes an effort from older persons to start feeling confident and at ease with the use. Therefore it is important to present the different services in MOBILE.OLD as much as possible as a single service, with the same lay-out, buttons and colors so that there are no barriers to use the different services in the MOBILE.OLD application.

MOBILE.OLD-NL-I-8	**Buttons**
	Buttons have to be large with good contrast compared to the background. Regular text must be different than the buttons, so there is a clear distinction on where to press and where not. The buttons should react the same to a short touch and a long, firm touch.
MOBILE.OLD-NL-I-9	**Small amount of action**
	All information and services should be easily accessible under one button, without having to scroll or enter search names. The application should require as little action from the user as possible.
MOBILE.OLD-AUT-SPA-I-10	**Physical Keyboard and Mouse**
	The elderly prefer to control the MOBILE.OLD application on the Smart TV via a wireless keyboard and mouse. Especially for text input the remote control linked to an on screen keyboard is unusable for them.
MOBILE.OLD-NL-I-11	**Mobile device**
	The application should also be easy to use on a smaller smart phone, for those persons who find the Samsung Galaxy Note to large.
MOBILE.OLD-NL-I-12	**Key Board Smart Phone**
	The keyboard in the smartphone should be large enough to easily find and touch the letters. The auto-correction should be off and the letters should be clearly visible.
MOBILE.OLD-RO-I-13	**Important buttons at hand on screen**

	"Help" button always displayed on screen, for easily getting info about the various icons/buttons significance and functions. "Alarm" button always on screen for instantly signal to a relative that the user faces an emergency situation and must be contacted by that relative.
MOBILE.OLD-RO-I-14	**Smartphone as remote control**
	More than half of the users agree the TV interface, but suggest the as much as possible use of the smart phone itself as a remote control. The others prefer to run the MOBILE.OLD application on the Smart TV via a wireless keyboard and mouse.
MOBILE.OLD-RO-I-15	**Communication with the smart mobile by voice**
	Where possible, old people prefer to ask and receive services to/from the MOBILE.OLD application by voice.
MOBILE.OLD-RO-I-16	**Easy navigation inside the Menu**
	Easy leaving of a function and easy access to another one.
MOBILE.OLD-AUT-RO-S-1	**Traffic Sign List within the Traffic Sign Memory & Quiz Application**
	The users wish to have a list where they can check up all traffic signs, because the elderly like the idea of having all signs at hand.
MOBILE.OLD-AUT-NL-RO-S-2	**Only Certified reliable content**
	Older people are always afraid to get tricked within the internet, so it is a must that they can rely on the offers they get within the transnational journey planning or other services. The content should be at all times reliable, also when it is supplied by third parties (e.g. travel agencies). Seniors will stop using the application if this is

	not the case. A list of fiduciary local agencies and their contact details stocked in the phone, to be connected in the easiest manner.
MOBILE.OLD-AUT-S-3	**PC Connectivity to MOBILE.OLD Services**
	Users want to connect their PC to the MOBILE.OLD platform in order to look up their geotagged pictures and hiking paths and send them per e-mail to their friends and family members.
MOBILE.OLD-AUT-SPA-S-4	**Direct Motion Feedback within the Physical Training Service**
	The elderly people wish to have a direct motion feedback when they do training exercises in front of their Smart TV e.g. like playing fitness games with the Microsoft Kinect.
MOBILE.OLD-NL-S-5	**Physical training**
	Physical training is only considered interesting if it also contains a social factor. So it should help them to meet other people or to leave the home.
MOBILE.OLD-RO-S-6	**Physical training**
	Schedule and content to be established by the doctor or the kinetotherapist.
MOBILE.OLD-AUT-NL-RO-SPA-S-7	**MOBILE.OLD Manual and helpdesk**
	Careful design of the accompanying manual of the MOBILE.OLD services (simple with pictures and in the language of the targeted users). Seniors prefer to use a physical manual when they are trying out new services. Better if its use is preceded by a careful training of the user by an initiated person. Simultaneously seniors prefer to call to a helpdesk when

	they encounter problems. This way, they do not have to ask their friends or family.
MOBILE.OLD-NL-S-8	**Subscription**
	When seniors use the mobile phone, they normally do not have a monthly subscription. Instead they prefer to use pre-paid subscriptions. This gives more confidence on what they are spending. For MOIBLE.OLD they prefer to pay for each time they use the application, instead of a monthly fee.
MOBILE.OLD-NL-S-9	**(Trans)national journey planner**
	Seniors go very regularly (approximately once or twice a month) on local, regional and national trips. International trips are approximately once a year organized. Both are activities that score very high. Therefore in order to obtain more impact, it is important to take a national journey planner as a starting point and then focus on an international journey planner.
MOBILE.OLD-RO-S-10	**(Trans)national journey planner**
	Agreed as important application. A virtual map with the route of a travel figured on it, marked stops, durations, time marks and so on, saved in the phone for being consulted when needed, may be of great help.
MOBILE.OLD-NL-S-11	**Travel information**
	As most seniors arrange their travel through a travel agency, a good selection should be made from tour operators that can be presented in the application. This way seniors can use it to browse through the offers and select their preferences. For the mobile application seniors must be able to find all information related to a trip they are making, similar to a travel guide.
MOBILE.OLD-NL-RO-S-12	**Ticket application**

	The ticket application should also include tickets for theatre, museums and other activities and the possibility to buy these tickets simply via the smart phone based on the user's banking card ID.
MOBILE.OLD-RO-S-13	**Geofencing incl. Detection of External Physical Conditions**
	In old persons falls are frequent and harmful. Detection of a possible user fall and instant alarm to a relative would be of great help. Function that may easily violate user's privacy. Easy to be disabled when the user considers that necessary.
MOBILE.OLD-RO-S-14	**Agenda / To do list / Shopping list etc.**
	Easy to be created and updated.
MOBILE.OLD-RO-S-15	**Signaling the closest Info Desk, Ticket Machine, ATM Toilet etc. In a travel environment**
	Would be a useful function for old people and not only, able to minimize the travel stress.
MOBILE.OLD-NL-S-16	**First aid application**
	The first aid application should include helpful information for emergency situations in foreign country.
MOBILE.OLD-RO-S-17	**Affordability**
	Especially important for the large part of old people.

MOBILE.OLD-AUT-NL-RO-SPA-C-1	**Advanced Security and Privacy Settings**
	Elderly people are often afraid to get “hacked” on the internet, when they provide their private data, so it is important to let them know that their data remains confidential. E.g. when they are making a reservation online (hotel, bus, flight). Security of data must be good and also communicated (either in the app or in the manual) to the older persons so they feel more confident.
MOBILE.OLD-RO-C-2	**Long lasting closeness to phone for people having heart pacemakers**
	May such a device influence a heart pacemaker functioning?
MOBILE.OLD-RO-C-3	**Owner security in public spaces**
	An old person with a natty phone in a public space may be particularly vulnerable to aggression and robbery.
MOBILE.OLD-SP-C-4	**Prevention of control**
	Many users think that these systems can be used to control or monitor people. So it should incorporate a function to lock the use of the system when they wanted.

3 TECHNOLOGY OVERVIEW AND SCOPE

The overall architecture of the MOBILE.OLD concept is depicted in Figure 23. It consists of 5 main sites including:

- **Service provider,** where the services logic and data reside (MOBILE.OLD Application Server).
- **3rd party service and content providers** that provide source of information for the other MOBILE.OLD services.
- **Older persons/users home environment** equipped with a set-top-box or and Internet-enabled TV-set, who want to get significant quality of life benefits by using services advancing their mobility inside the home environment.
- **Older persons outdoor environment** equipped with a Smartphone, who want to get significant quality of life benefits by using services advancing their mobility outside the home environment.
- **Friends and family** that want to stay connected with the older persons, by supervising and assisting them.

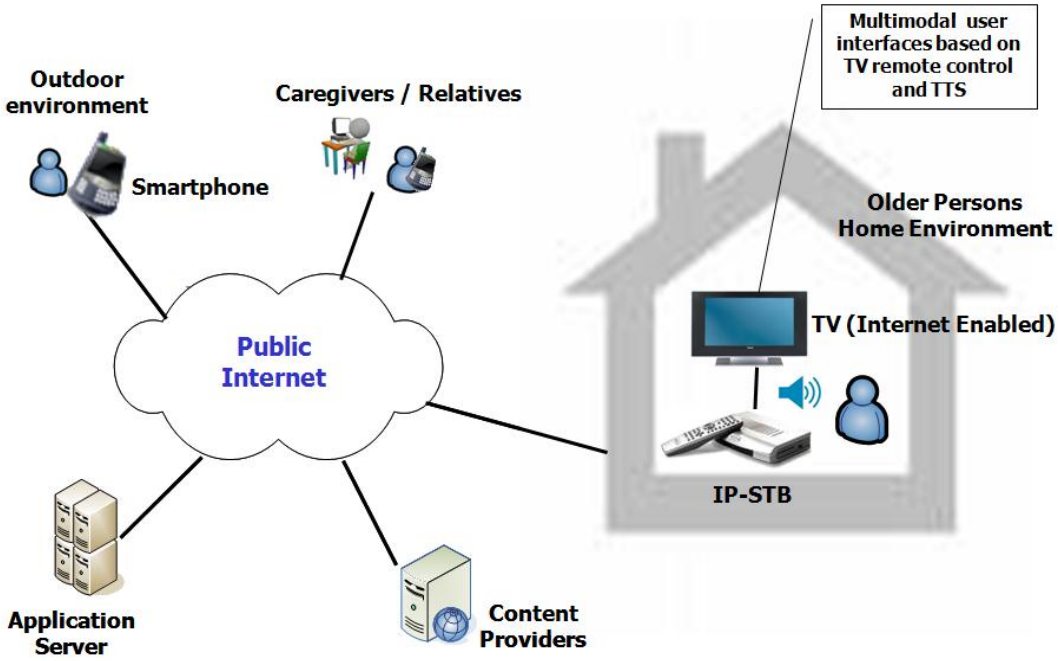


Figure 23: MOBILE.OLD architecture overview

The main equipment constituting this architecture is:

- An **Internet-enabled TV** and/or an off-the-shelf **Set-Top-Box**, which is the main user interface for the older persons, providing multimodal web-based user interfaces using the remote control for service navigation and advanced Text-To-Speech (TTS) solutions for audio announcements.
- A **popular Smartphone** allowing on one hand for accessing the MOBILE.OLD services outside the home environment and on the other hand for offering advanced geofencing services.
- The **Application Server**, which constitutes the core system of the MOBILE.OLD platform. The Application Server hosts all the applications logic, the interfaces to external services,

the user profiles data and the associated policy as well as it handles security and privacy issues.

The application server is the core component of the MOBILE.OLD architecture. Its model relies on the service oriented architecture paradigm (see Figure 24) and includes:

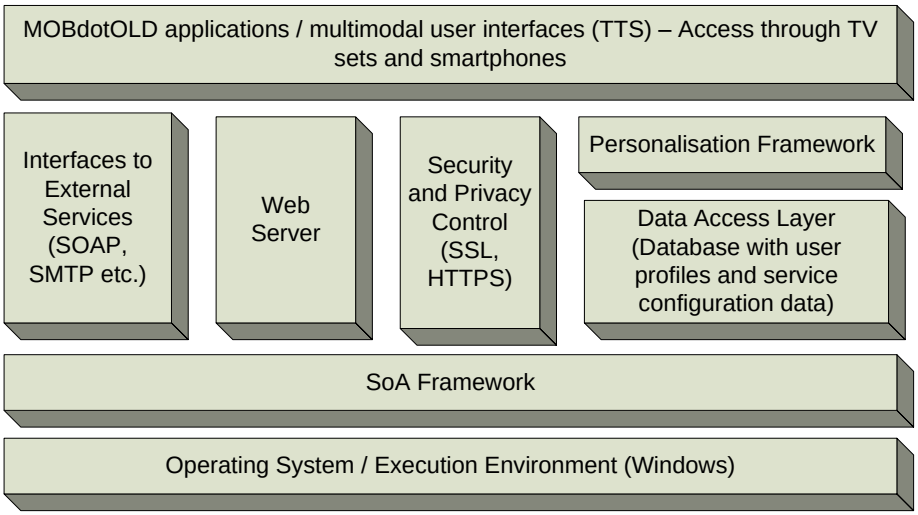


Figure 24: MOBILE.OLD application server subsystems

- A **web server** for deploying the MOBILE.OLD applications and services. It will be based on open technologies such as Java for service development and Apache Tomcat for service execution and deployment.
- **Multimodal user interfaces** for human machine interaction, which will be implemented in the project. The user interfaces will be web-based. They will be based on current standards (Web4CE, CE-HMTL) allowing for services access and navigation over the TV-set and will also include Text-To-Speech (TTS) capabilities, which will be Web-Browser independent. The multimodal interfaces will be designed and developed based on the older persons' requirements that will be collected at the early stages of the project.
- Highly personalized application and services will be provided based on the APIs that will be provided by the **personalization framework**, which will be developed in the project. The personalization framework will be built on the MOBILE.OLD Application Server Database, were the older persons' data and service configuration data will reside on. It will provide the possibility for services configuration according to the older persons' preferences and will allow for dynamic service configuration based on historical data according to services utilization. Additionally, the general colors and "look and feel" of the application will be customizable, either by the user or by a general configuration policy. For example, a user can use a different theme for the application so that the colors are brighter, different layout, buttons etc.
- **Security and privacy control** for allowing access to user profile information and securing communication channels from the home environment or the Smartphones to the application server and from the application server to the 3rd party service and content providers. Well established state-of-the art technologies will be used such as SSL, HTTPS and secure Web Services.

- **Interfaces to external services** provided by content providers and public web resources such as news headlines as well as maps and travel data applications, which will be designed and developed. Well established state-of-the art technologies will be used such as Web Services (SOAP, WSDL), RSS feeds etc.

The Smartphone software architecture is presented in Figure 25 and includes:

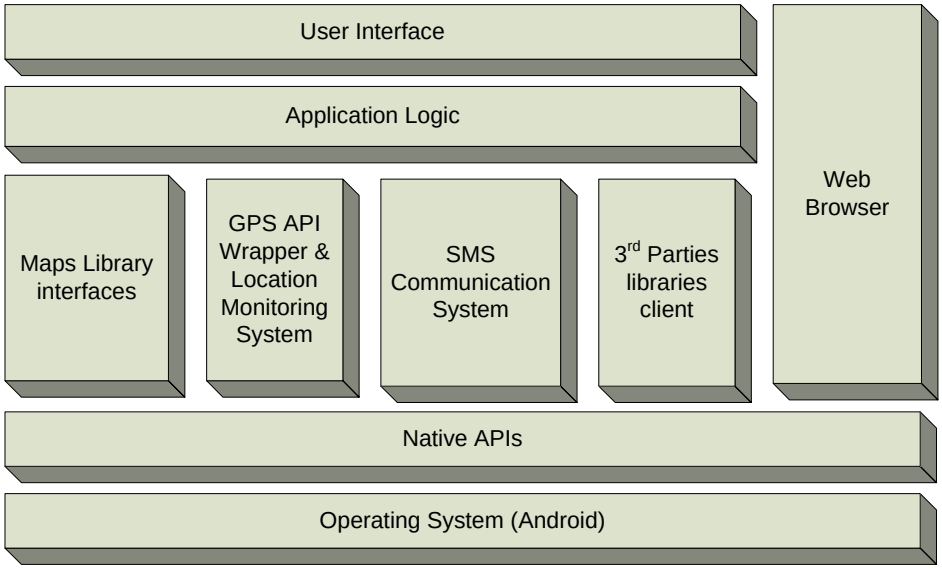


Figure 25: Smartphone SW components

- The **operating system and the native APIs**, which are used by the Smartphone application to provide the MOBILE.OLD services.
- The **Maps Library interfaces**, which retrieve the needed maps, from the native APIs, and provide functions for the addition of overlay items to them.
- The **GPS API Wrapper**, which provides an interface to the device's GPS module for position information retrieval, and the **Location Monitoring System**, which raises events based on the configuration and the user's position.
- The **SMS Communication System,** allowing sending of SMS messages through the device's phone.
- The **3rd Parties Libraries Client,** which connects and retrieves information from third party systems..
- The **Application Logic,** which processes the data from the other components, makes decisions and updates the User Interface. It will be the core part of the applications that will be developed in the project.
- The **User Interface,** which provides the means to visually present to the user the appropriate information. **Simple and easy to handle user interfaces** will be designed and developed, according to the older persons' needs.

4 MARKET SURVEY

This chapter provides a survey of similar products and services as provided by the MOBILE.OLD project. The chapter is divided into commercial and non-commercial services.

4.1 MARKET ANALYSIS

Population ageing is the process by which older persons become a proportionally larger share of the total population. It was first experienced by the more developed countries, but the process has become evident in the developing world as well. In 1950, there were about 200 million persons aged 60 or over throughout the world. Fifty years later, the number of persons aged 60 or over increased about three times to more than 600 million. Meanwhile, the total population increased 2.4 times. The demographic transition associated with population ageing has a substantial impact on economic and social conditions, for instance regarding the viability of intergenerational social support and social security systems. Population ageing results in rising demands for services such as home care, medical provisioning, mobility assistance, emergency calls and assistance, remote monitoring, counseling services, etc..

Million people	EU27+2	Canada	USA	Japan
2010				
All ages	514.0	34.0	310.0	127.0
Aged 65+	88.8	4.7	40.2	29.4
Share, 65+	17.3 %	13.8 %	13.0 %	23.1 %
2020				
All ages	527.0	38.0	341.0	123.0
Aged 65+	106.0	7.0	55.0	35.9
Share, 65+	20.1 %	18.4 %	16.1 %	29.2 %
2030				
All ages	534.0	41.0	373.0	115.0
Aged 65+	126.0	9.6	72.0	36.7
Share, 65+	23.6 %	23.4 %	19.3 %	31.9 %

Figure 26: Population by age group

4.1.1 REIMBURSEMENT MODEL

While gaining approval from regulatory bodies will be the first step in bringing a new device, service or application to the market, the major challenge today lies in gaining acceptance from reimbursement providers. To gain approval for marketing, a company needs to demonstrate function and safety; to gain acceptance from reimbursers, there is an additional need to demonstrate the economic benefits. Comprehensive trials are needed to demonstrate this and a certain amount of lobbying is often necessary, if a new principle is to be established such as the MOBILE.OLD services and applications. The reimbursement issue is further

complicated by the highly fragmented nature of insurance systems as well as the different governmental bodies that are involved with the welfare of the elderly people. For example, most countries with universal healthcare still have multiple payers; this results that in most cases a new device, service or application has to be accepted by each single payer to be reimbursed from that source. While in some cases, groups of payers cooperate in the review process, still it could be the case that a maker may have to sign deals with a large number of reimbursers.

4.1.2 SERVICES AND APPLICATIONS

Services and applications have different levels of complexity and technology requirements, this definitely applies for the MOBILE.OLD case. The services and applications could range from very basic SMS-based information services, to more complex ones requiring high bandwidth, location information, multimedia content, etc. They need a two-prong approach to succeed: one from a business model perspective, focusing on increasing the number of partners and, therefore, increasing the complexity of coordination; the second from a technology perspective, which is often a fairly comprehensive solution requiring the latest in IT hardware and knowhow, as well as high connectivity and service level requirements.

The current market products, services and applications are focused on the health are such as telehealth, home monitoring, mobile health monitoring, medication compliance management and chronic disease management.

Specifically, Sweden, Denmark and Netherlands have already introduced some form of telehealth solutions as part of their healthcare systems. Germany, Italy, France, the UK and Spain are the countries which offer the largest business opportunities for the deployment of home-based solutions due the prevalence of old age and incidence of chronic diseases. Although, they are not leading in terms of infrastructure penetration, the existing infrastructure level is sufficient enough to support a large enough part of the population and thus enable economies of scale when rolling out such type of solutions, applications and services. There is also strong potential in Eastern European countries and this will materialize when the infrastructure is in place.

Telecom operators provide a number of solutions to hospitals, healthcare providers and other medical solution providers, ranging from basic voice and data services to messaging and workforce management solutions. A number of operators have also established dedicated healthcare divisions that develop solutions especially for the healthcare industry such as electronic health records, medical image databases and telehealth applications. The approach that is being followed is illustrated at the following figure.

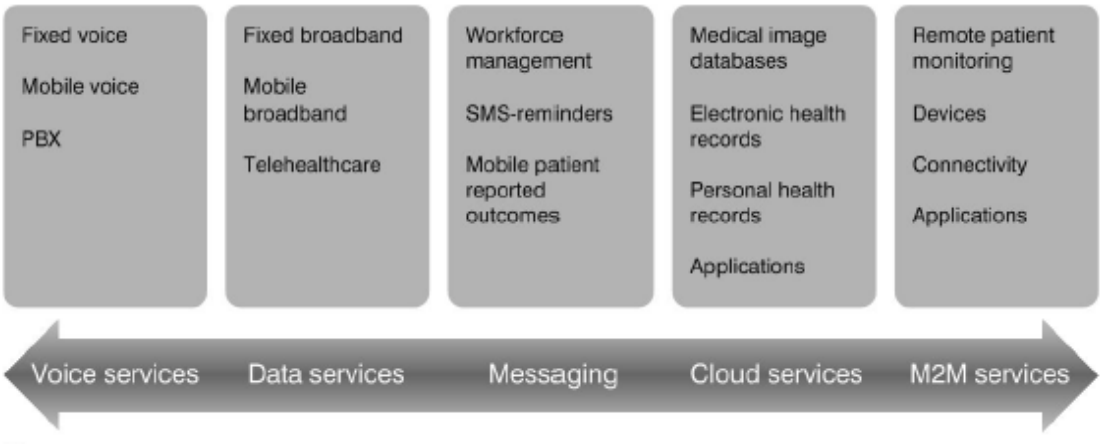


Figure 27: Overview of telecom eHealth and mHealth services

4.1.2.1 INTEGRATED TELEHEALTH SOLUTION PROVIDERS

Several companies have developed integrated solutions for monitoring of chronic diseases and other conditions. These systems enable remote monitoring and disease management for patients at home or in assisted living facilities. Some of these companies also provide their own vital sign monitors, while most use monitors from third parties. Data transfer is provided by the monitoring hub or a connected mobile phone.

Company	Monitoring hub connectivity options
BodyTel	Mobile phone
Bosch Healthcare	PSTN, LAN, optional cellular modem
Cardiocom	PSTN or cellular
Honeywell HomMed	Cellular
iMetrikus	PSTN or cellular
Intel	LAN
MedApps	Cellular
Philips Healthcare	PSTN
SHL Telemedicine	Cellular
Tunstall Group	PSTN or cellular
Vitafone	Mobile phone or cellular

Figure 28: Examples of integrated monitoring solution providers

4.1.2.2 TELECOM VENDORS AND OPERATORS

The current telecom industry such carriers and mobile operators realised that mhealth is an opportunity to provide value-added services on top of connectivity. Newer players are creating separate business units and dedicating significant resources to developing mHealth solutions. Members of the telecom industry realized that pushing mHealth forward will require cooperation; this becomes, evident through the introduction of carrier-agnostic

solutions and concepts such as the hub that provide a stepping stone for medical device manufacturers, service and application providers to enter the space. Continued work in developing mHealth standards and protocols to increase interoperability will help the industry to move forward faster and more efficiently.

For example, there are continuous business initiatives such as AT&T announces ForHealth practice area and service portfolio, mHealth services, cloud-based services and pilot programs; Orange Group aims for leadership in eHealth services, At the hospital, At the doctor's office, At the patient's home; Vodafone establishes Health Solutions business unit; SaskTel and Alcatel-Lucent cooperates on remote patient monitoring; and many more.

4.1.2.3 APPLICATION STORES, A CHANNEL TO THE MARKET

Over the years, thousands of applications have been written for Palm, BlackBerry, Windows Mobile and Symbian smartphones. However, application developers have had difficulties to reach a broad user base in absence of a suitable delivery channel. While early adopters and technology enthusiasts have bothered to search for applications on the web and learn how to install them, mainstream users have not been aware of the possibility or found the process cumbersome. The trend started by Apple that introduced on-device application stores and removed this hurdle. Especially for smaller developers, the application store concept is a significant innovation. Earlier, reaching the mass market has essentially required preinstallation of applications on handsets by reaching distribution agreements with handset vendors or operators. The arrival of on-device application stores partially or completely bypasses operators control over application distribution.

Still, there are issues to be addressed, with drawbacks and benefits, for different actors of the market. For example, the sheer number of application stores being launched requires developers to submit their applications to multiple parties for approval, a process which may be unclear or with subjective rules. Still, the much larger addressable market may however compensate for the extra effort and resources. For users, application stores enable easier access to a broader selection of content that facilitates feature and price comparisons, ultimately increasing competition and customer value.

The importance of a well implemented and easy to use delivery channel has been shown by Apple's App Store for the iPhone, iPod Touch and iPad. In November 2010, a little over two years after launch, over 300,000 applications have been made available through the App Store and the number of downloads has surpassed 7 billion. Other handset and operating system vendors have since followed Apple and announced their own application and content stores. Paid applications became available in the Android Market in March 2009. One month later RIM introduced the BlackBerry App World. Nokia launched its Ovi Store in May 2009. LG's Application Store went live in July 2009. Sony Ericsson opened its PlayNow Arena in August 2009. Samsung followed with Samsung Apps in September 2009 and Windows Marketplace for Mobile became available the following month. Besides handset vendor and OS specific application stores, several mobile operators and third parties are introducing their own

application stores. In contrast, these stores often provide applications and content compatible with multiple handset platforms including feature phones.

4.1.3 OPPORTUNITIES

The following key opportunities can be identified for the MOBILE.OLD services and applications, with the MOBILE.OLD consortium assuming the role of end-to-end product, service or application provider.

Investigating Growth Potential

Aging population is on the rise in both developed and developing countries. MOBILE.OLD concept may be able to offer potential cost savings and efficiency gains through the support of independent living, sustained mobility, reinforcing activation, maintaining the health status, providing cognitive benefits; thus preventing isolation, depression, increased morbidity and loneliness.. Application vendors, device manufacturers and mobile operators could start investigating the potential for future growth now, although current mobile health deployments are mainly in the trial stages.

Collaborating for Better Service and Product Offerings

To create compelling MOBILE.OLD type of applications and services, the previously identified stakeholders such as ehealth and mhealth solution providers, telecom industry as well as device and equipment vendors could consider collaborating and sharing their expertise and knowledge on a multitude of production levels with the other stakeholders, from R&D to launch. Collaboration should yield, due to a greater scope of market and product knowledge, a better understanding of elderly people needs and of which services and devices could create stronger traction in the market. It could also help create a more seamless customer experience and lower the probability of 'glitches' and/or elderly people's non-acceptability during trial and launch.

Approach Care Delivery Organisations (CDOs) and Disease- Specific Advocacy Groups

Service and application providers together with equipment and product providers could jointly seek CDOs and disease-specific advocacy groups that are committed to adopt concepts like MOBILE.OLD as part of sustainable care management programs, and that are willing to make the necessary changes in care processes for the successful adoption of the new applications and services. All parties need to instill confidence in the value of sustained mobility, support of independent living, and maintaining health status among elderly people, clinicians , healthcare and insurance payers as well as governmental parties.

4.1.4 MARKET DRIVERS AND BARRIERS

The adoption of out-of-hospital services and applications in healthcare is driven by a wide range of incentives, related to everything from demographics and technology development to new advancements in medical treatment. There are also challenges such as the financing of

these solutions by a largely underfunded healthcare sector. In order to receive reimbursement, suppliers have to prove their worth in a clinical perspective, but also in an economical perspective. Studies are made continuously and historically new expensive treatments have often been adopted. Generally, there is a certain delay, as evidence of the economic benefits need to be acquired. Clinical usefulness and economic feasibility are not the only factors affecting which services and applications are adopted.

The same market drivers and barriers that apply for the healthcare applications and services apply for the MOBILE.OLD applications and services. There are strong non-scientific and non-economical drivers and barriers among both professionals and elderly people. Ambitious professionals often seek new projects to involve themselves in and are often impressed by new technologies. This has led to numerous adoptions of inferior and expensive solutions. On the other hand, a large group of elderly people and professionals prefer traditional methods, even when there are better alternatives whose usefulness has been proved extensively. Many elderly people also have a disregard for scientific evaluations and may resist new technology by instinct. Yet again, there are groups of elderly people who have a desire for the latest and trendiest tech gadget, without any regard to whether it is useful or not. In addition, there often develops a political pressure to adopt new effective strategies, even if their economic value has not been proven, or the new solutions are not economically justified.

Decreasing fertility and mortality is driving population ageing globally. At the end of 2010, there were almost 134 million people aged 65 and over in the EU and North America. The number is projected to increase to 168 million in 2020 and 208 million in 2030. Globally, there were about 500 million people aged 65 and over at the end of 2010. In 2030, the number is forecasted to reach one billion. Even if there is a tendency of people remaining healthy longer, there is also a significant increase in how long people live with various medical conditions and most importantly a lower quality of life. In order to manage costs, several steps will probably be taken. There will be a debate concerning which treatments, services and applications to pay for. There will probably be an increased focus on preventive measures. In addition, there will probably be a focus on home-based monitoring and disease management to reduce the number of costly visits to general healthcare institutions and medical specialists. It is believed that there will also be an increased focus on MOBILE.OLD type of services and applications as preventive strategy is getting more attention and the support of independent living, sustained mobility, and maintaining health status are becoming more and more important.

In the medical market, there is always the risk that a product or a practice, services or application is made obsolete because an improved alternative treatment appears. However, this is not likely to happen in the near future for the MOBILE.OLD cases. As long as there is no curative treatment, these services and applications are necessary.

Key Findings

- Mobile health is in its very early stages, often still in trials. So while some applications look very promising for a wider uptake, there is little hard evidence to be able to say for certain that the benefits will be big enough to drive adoption for the MOBILE.OLD applications and services.

- Mobile health monitoring and mobile medication compliance management will have a role in the 10-year time frame. This is because they appeal to a broad market, incorporating the consumer and enterprise markets and both developed and emerging markets around the world.

- Devices, services and applications aimed at consumers worried about their health and well-being are likely to generate more revenue for mobile ecosystem participants than services aimed at care delivery organizations (CDOs) and healthcare payers. This is because of their broader appeal, extensive retail channels, less regulation and the potential willingness of customers to pay for their own devices and services. This is something that MOBILE.OLD consortium will look at more detail within WP7, at the commercial feasibility activity.

4.1.5 RECOMMENDATIONS

MOBILE.OLD type of services and applications represent an important and compelling business opportunity. Presently, the market is at an early phase and mobile communication technology is only now being adopted for the elderly people. In order to pave the way for a wider use of wireless solutions, the mobile industry will need to explain that it can fulfill all requirements on safety, data security and reliability while at the same time delivering a tailored, user-friendly system for the elderly people with the same or better performance, at lower cost compared to legacy systems. The industry players must reach out to elderly people, application/service providers and caregivers to present solutions that allow them to integrate the latest communication technologies in commercial solutions. They will also have to offer standardized interfaces for networking devices and data exchange.

The way in which wireless solutions are offered on the consumer market will be critical for the success. It is believed that the best strategy is to offer devices and complement these with software and online services that are convenient to use. The recent boom in smartphone medical applications is an indication that handset manufacturers and operators should invest in the development of appropriate and relevant solutions for the elderly people's category. Mobile operators have also a role to play both to ensure seamless integration with networks and for the commercialization of products on different markets. Mobile operators can provide connectivity and device management services for the device vendors as part of general M2M solutions. mHealth devices and many other critical wireless M2M applications need priority in order not to be disrupted by growing data traffic from consumer broadband and smartphone devices. Instead of basing connectivity pricing on data volume, operators should focus on

number of connections, network availability and service level agreements for mHealth devices. Operators also have an opportunity to sell managed data storage services for device vendors as part of total communication services.

Reaching out to the providers for the elderly people or directly to the elderly people will be a complex and time-consuming task. They will primarily be interested in solutions that reduce costs and have a short payback time on the initial investment. Besides a solid business case, providers for the elderly people also need operational support from external partners for this type of solutions. Mobile operators are well positioned to fill this role as they can provide both network services and data management from a single source.

4.2 NON-COMMERCIAL SERVICES

The current section provides information about European R&D projects that have similarities with MOBILE.OLD project. The projects identified have similarities with MOBILE.OLD either at technological level, or at user group level. They focus on orientation, navigation and health monitoring, allowing the users to have a more active life by mitigating risks common to the elderly populace such as disorientation, falling and getting lost.

In the following table are presented several research projects with results in the field of elderly life enhancement and active aging.

Project	Date	Participants	Theme and main outputs
Activity Coach (AC) Product Concept within the MyHeart Project	2003-2008, co-financed by EC (FP6)	Philips, UPM, University of Pisa, University of Valencia, Vodafone Spain and others	Development of a Training Program Management algorithm and of a Coaching and Motivation Interaction Module.
Activity monitoring module developed in the INHOME Project	2007-2008, co-financed by EC (FP6)	Thales, Teletel, Siemens Germany and others	Activity Monitoring is one of the applications developed in the Project to help older adults to have an independent living at home.
ASK-IT	2004-2008, Co-financed by EC (FP6)	SIEMENS S.A., Spain Centre for Research and Technology Hellas , Greece University of Newcastle upon Tyne UK Universidad Politécnica de Madrid Spain and others	The aim of ASK-IT project is to support and promote the mobility of Mobility Impaired (MI) people, by developing an Ambient Intelligence (AmI) space for the integration of functions and services across various environments. ASK-IT health and emergency management module aim is to enhance the safety feeling of the user both at home and while on the move. The main functionalities of the service

Project	Date	Participants	Theme and main outputs
			are the following: capture and management of user-triggered emergencies, capture and storage of medical data coming from wearable sensors, provision of an interface for the user to request external help (human or information), and integration with local domotic services.
CAALYX, Complete ambient assisting living experiment	2007-2008, co-financed by EC (FP6)	Inesc (Portugal) and others	Development of a wearable device able to measure vital signs of the elder, to detect falls and to communicate with caregivers for request of help. A GPS system gives the location of the person when he is outside home. When used at home, the system could be complemented with video cameras.
CONFIDENCE, Ubiquitous care system to support independent living	2008-2011, Co-financed by EC (FP7)	Fraunhofer Institute. and others	Innovative technologies for the detection of abnormal events such as falls in elderly. The solutions work both indoors and outdoors and are based on the use of wearable tags whose positions are determined using radio technology. Tags coordinates are used to reconstruct the user's posture.
DALI[3]	Co-financed by EC (FP7) 2011 – 2014	Università degli Studi di Trento (IT), Visual Tools SA (E), Foundation for Research and Technology Hellas (GR), University of Northumbria at Newcastle (UK), Università degli Studi di Siena (IT) and others	DALi aims to produce a device that will prolong out-of-home mobility in older adults by providing physical, cognitive and emotional support to older adults in public environments such as shopping centers and airports. The product is called c-Walkier and will support navigation in crowded and unstructured spaces by acquiring sensory information, by anticipating the intent of human agents and by deciding the path that minimizes the risk of accidents.
EMERGE,	2007-2009,	Siemens Germany,	Use of ambient and unobtrusive

[3] http://www.ict-dali.eu/dali

Project	Date	Participants	Theme and main outputs
Emergency monitoring and prevention	co-financed by EC (FP6)	Westpfalz Klinikum Germany, Microsoft , ISOTIS and others	sensors to monitor activity, location and vital data. Daily routine is tracked in order to detect abnormalities and to create early indicators for potentially arising emergencies.
EUROPA[4]	Co-financed by EC (FP7) 2009 – 2012	Albert Ludwigs University of Freiburg (DE), Eidgenössische Technische Hochschule Zurich (CH), KU Leuven (BE), University of Oxford (UK) and others	EUROPA aims to develop the foundations for service robots designed to autonomously navigate in urban environments outdoors as well as in shopping malls and shops to provide various services to users including guidance, delivery and transportation.
HEBE, Mobile monitoring and automatic fall detection device for elderly living alone	2004-2006, co-financed by EC (FP6)	Zenon Robotics and Informatics, Instituto Geron- tologico Matia Sociedad (Spain) and others	Development of an outdoor activity monitoring and automatic alert system based on accelerometers used to detect mobility and elderly's falls. The module is integrated with a GPS system giving the localization of the elderly when the fall event occurs.
MOBISERV[5] An Integrated Intelligent Home Environment for the Provision of Health, Nutrition and Mobility Services to the Elderly	Co-financed by EC (FP7) 2009 – 2013	Ananz wonen-welzijn-zorg (NL) University of the West of England (UK) and others	MOBISERV is an FP7 project which is in the execution phase and aims to deliver a robotic prototype of an open standard-based personal platform capable of sensing the user's personal environment and adapting to his patterns of behavior, issuing warning to mitigate harmful consequences from environmental or emerging medical conditions. This support will be focused on interior daily living situations.
MonAMI Mainstreaming on Ambient Intelligence[6]	Co-financed by EC (FP6) 2006 - 2010	Telefonica Investigacion y Desarrollo Unipersonal (Spain), Siemens Business Services gmbh & co. Ohg (Germany, Europ	Technological augmentation of the living space can help alleviate the problems of daily living, increase quality of life and reduce the need for institutional and other care. The proposed

[4] http://europa.informatik.uni-freiburg.de/

[5] http://www.brl.ac.uk/researchprojects/mobiservproject.aspx

[6] http://www.monami.info/

Project	Date	Participants	Theme and main outputs
		assistance (France) and others	project builds on these results and aims to move such services from the laboratory and small scale demonstrators to the status of mainstream technology. MonAMI focuses on: 1. capitalizing on Ambient Intelligence (AmI) technologies to ensure that the services can be used without behavioral change 2. building on top of mainstream devices and services such as TV based internet, nomadic devices 3. doing initial experimentation in Feasibility and Usability centers and subsequent large-scale validation in Validation centers in five countries 4. addressing economic viability and long term sustainability of such services in large communities in different Member States MonAMI will select bouquets of services in the areas of comfort applications, communication/information, health, safety and security. It will build, test and deploy these services and demonstrate that they can be economically brought through the future mainstream ambient intelligence technologies.
NETCARITY[7]	Co-financed by EC (FP6) 2007 – 2011	Istituto Trentino Di Cultura (I) Siemens Aktiengesellschaft (DE) and others	NETCARITY proposes a new integrated paradigm for supporting independence and engagement in elderly people living alone at their own home place. The project fosters the development of a 'light' technological infrastructure to be integrated in homes of old people at reduced costs, that both allows the assurance of basic support of everyday

[7] http://www.netcarity.org/

Project	Date	Participants	Theme and main outputs
			activities and health critical situations detection, as well as the social and psychological engagement required to maintain in the elder the emotional well-being enhancing dignity and quality of life. The project will seek to advance ambient intelligence technologies in the integration of micro and nano systems in a networked wireless/wired multi-sensing environment with plug and play capabilities and intelligent decision making for an effective detection of critical situations and support of task completion. Efforts will be concentrated in developing low-cost solutions and could rapidly reach the market and facilitate easy adaptation in a wide number of existing homes. The social and psychological factors of the 'ageing-in-place' problem will be addressed in NETCARITY by the development of advanced multimodal interfaces that strengthen the communication channel between the elders and their friends and caregivers, reducing isolation and the feeling of being alone, and stimulating them in the execution of everyday activities to maintain high levels of motivation and a correct perception of their own abilities.
OASIS[8] Open architecture for Accessible Services Integration and Standardisation	Co-financed by EC (FP7) 2008 – 2012	FIMI S.R.L. (Philips) CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS (CERTH) INSTITUTO DE APLICACIONES DE LAS TECNOLOGIAS DE LA	OASIS introduces an innovative, Ontology-driven, Open Reference Architecture and Platform, which will enable and facilitate interoperability, seamless connectivity and sharing of content between different services and ontologies in all application domains

[8] http://www.oasis-project.eu/

Project	Date	Participants	Theme and main outputs
		INFORMACION (ITACA) and others	relevant to applications for the elderly and beyond. The OASIS platform is open, modular, holistic, easy to use and standards abiding. It includes a set of novel tools for content/services connection and management, for user interfaces creation and adaptation and for service personalization and integration. Through this new Architecture, over 12 different types of services are connected with the OASIS Platform for the benefit of the elderly, covering user needs and wants in terms of Independent Living Applications (nutritional advisor, activity coach, brain and skills trainers, social communities platform, health monitoring and environmental control), Autonomous Mobility and Smart Workplaces Applications (elderly-friendly transport information services, elderly-friendly route guidance, personal mobility services and smart workplace applications). Applications are all integrated as a unified, dynamic service batch, managed by the OASIS Service Centre and supporting all types of mobile devices (tablet PC, PDA, smartphone, automotive device, ITV, infokiosk, ...) and all types of environments (living labs, sheltered homes, private homes, two car demonstrators, public transport, DSRT, etc.). As user friendliness and acceptability is a top priority for the project, a user-centered design approach is followed along the service and application development. Tested iteratively and thoroughly by hundreds of end users, their caregivers and other stakeholders, the OASIS platform and applications will be optimized and

Project	Date	Participants	Theme and main outputs
			submitted for standardization by the purpose-established OASIS world-wide Industrial Forum.
PERSONA Perceptive Spaces prOmoting iNdependent Aging	Co-financed by EC (FP6) 2007 – 2010	Fraunhofer Gesellschaft zur Foerderungder Angewandten Forschung e.v. (DE) Consejo Superior de Investigaciones Cientificas (E) Universitat Autonoma de Barcelona (E) and others	PERSONA aims at advancing the paradigm of Ambient Intelligence through the harmonization of Ambient Assisted Living (AAL) technologies and concepts for the development of sustainable and affordable solutions for the social inclusion and independent living of Senior Citizen, integrated in a common semantic framework. It will develop a scalable open standard technological platform to build a broad range of AAL Services, to demonstrate and test the concept in real life implementations, assessing their social impact and establishing the initial business strategy for future deployment of the proposed technologies and services.
Recognition of physical activity patterns	2005	Philips Research, University of Eindhoven, University of Maastricht (The Netherlands)	It is a feasibility study on activity recognition using body acceleration data collected with a single triaxial accelerometer. Target activities for recognition were: walking, running, cycling, driving and sport activities such as football and table tennis. The developed algorithm (CAR: Continuous Activity Recognition) was trained with a set of labeled activity segments sampled from the data of a group of 9 persons. Experimented precision rate in recognition was approx. 80% for known subjects. Precision dropped in the case of unknown subjects.
SMILING[9]	Co-	Istituto Nazionale	SMILING diminishes age related

[9] http://www.smilingproject.eu/

Project	Date	Participants	Theme and main outputs
	financed by EC (FP7) 2008 – 2010	Riposo Cura Anziani (IT), Ab.Acus (IT), Centre Hospitalier Universitarie Vaudois (CH), École Polytechnique Fédérale de Lausanne (CH), Stichting Imec-Nl (NL), Mishan (IL), Step of Mind (IL) and others	impairments by interfering with mobility disability and improving carry-over into real life situation, by providing a wearable, non-invasive computer-controlled system that performs chaotic perturbations to lower extremities during active walking by small alterations of the height and slope of weight-bearing surfaces.
SOPRANO[10] Service-oriented Programmable Smart Environments for Older People	Co-financed by EC (FP6) 2007 – 2010	Universitaet Stuttgart (DE) Netherlands Organisation for Applied Scientific Research (NL) and others	SOPRANO will design and develop highly innovative, context-aware, smart services with natural and comfortable interfaces for older people at affordable cost, meeting requirements of users, family and care providers and significantly extending the time we can live independently in our homes when older. User friendliness and acceptability is top priority for the project - a zero-slope learning curve is to be achieved and interfaces are to "vanish" into domestic settings. Large-scale viability in real homes will be demonstrated with 600 users to raise public awareness and accelerate AAL exploitation.
Spacebook[11]	Co-financed by EC (FP7) 2011 – 2014	Umeå University, Department of Computing Science (SE), University of Edinburgh (UK), Heriot Watt University (UK), KTH, TCS/CSC (SE), The University of Cambridge (UK), Pompeu Fabra University (E)	Spacebook aims to prototype a speech-driven, hands and eyes-free device for pedestrian navigation and exploration. The project will generate concrete technical and scientific advances for eyes-free, hands-free navigation and exploration systems which will support applications in elderly care, tourism and tools for urban workers.
Use of multiple sensors (video	2008	INRIA, France	The approach followed by INRIA is based on the comparison of the

[10] http://www.soprano-ip.org/

[11] http://www.spacebook-project.eu/

Project	Date	Participants	Theme and main outputs
cameras and contact sensors) for monitoring activities of daily living (ADLs) of elderly			activities to be recognized with models of key human postures, models of a set of normal activities related to ADL, models of a set of abnormal activities. Video cameras and contact sensors are used.
WIISEL[12]	Co-financed by EC (FP7) 2011 – 2014	Fundació Privada CETEMMSA (E), Universitat Autònoma de Barcelona (E), stituto Nazionale di Riposo e Cura per Anziani INRCA (IT) and others	WIISEL aims to develop an insole for elderly, placed in the shoe and monitoring the way of walking. The system is expected to detect changes in gait and balance in the daily elderly environment in order to prevent the risk of falls. Moreover, the system will provide security to the elderly directly affecting their quality of life.

[12] http://www.wiisel.eu/

5 STATE-OF-THE-ART TECHNOLOGIES

Smartphones and smart TVs, as well as a range of software tools are necessary in order to provide MOBILE.OLD services to users. This chapter aims to provide a comprehensive overview of technologies relevant to this project. This includes modern technologies with a large feature set, that are state-of-the-art as well as well-proven.

In the following, technologies from the areas mobile platforms, Smart TV platforms, cross-platform tools, service platforms, and input/output are discussed and compared to each other, so that conclusions can be drawn at the end of the chapter. This serves as a guide to determine the most suitable technologies for this project.

5.1 MOBILE PLATFORMS

Next to mobile platforms like Blackberry or Symbian, the big players in this market are Android, iOS and Windows Phone. All of them provide SDKs, APIs, and documentation for developing apps on their system. The following sections will focus on those three platforms, giving details about the necessary functionalities as mentioned in the project proposal:

- the ability to send SMS directly from code,
- showing and interacting with a map, including overlay items,
- retrieving of the own location with GPS.

5.1.1 ANDROID[13]

The Android platform was released in 2008 as open source project. Since then, it was maintained mainly by Google, the Open Handset Alliance and the Android Open Source Project. Google released a new update of Android in June 2012, lifting the version number to 4.1. The platform offers basic APIs for the business logic and hardware abstraction. Android supports location based APIs for GPS and cell based positioning of the Smartphone. In addition, the Google Maps Library can be used to include maps in the application, and add overlay items to them. The Android APIs include basic SMS sending and reading mechanisms.

5.1.1.1 DEVELOPMENT

Android development is done using the IDE Eclipse (eclipse.org, 2012) with the Android Developer Tools (ADT) plugin. Eclipse and hence the SDK is available for:

- Windows PC
- Mac OS X
- Linux

The SDK also offers standalone command line tools, enabling development without Eclipse and ADT plugin, but using a different IDE (Google Inc.).

[13] http://www.android.com/

The development of Android applications is completely free. The main programming language used is Java. Google offers a NDK for developing with C/C++.

Producing apps for Android comes with some restrictions. There is a huge fragmentation of Android versions a developer has to cope with. Android 4.x has reached a distribution of less than 17% by August 2012, while over 75% of Android devices run a version older than Android 3 (Google).

A second drawback is the great amount of different devices that have different hardware configurations. This includes processing power, screen resolution and size, determining the pixel density. Android applications have to take those hardware issues into account and have to react on certain lacks of hardware support. The usage of specific APIs implies the need of hardware features. The Google Play Store only shows apps to devices that support all the required features.

In order to use the Google Maps API, an external library has to be included into the project, providing interfaces for map interactions. To be able to use the map itself, a Google Maps API key is required that can be ordered from Google[14]. Such a key is always connected to a Google account what makes the latter mandatory.

GPS tracking can be done by either using the foreground activity of the application, or by implementing a background task, which informs the UI of location updates. Android doesn't have any restrictions about the tasks performed in the background.

Permissions in Android are a tool to control protected functionality of an application. A basic Android app has no permissions. If certain protected features (e.g.: GPS location, vibration, …) should be used, a corresponding entry in the *AndroidManifest.xml*[15] file is necessary. Permissions for sending SMS and using the device's GPS location are declared as: *android.permission.SEND_SMS* and *android.permission.ACCESS_FINE_LOCATION,* and for cell based location *android.permission.ACCESS_ COARSE_LOCATION*. Without those declarations, the usage of the mentioned features will result in a runtime exception.

5.1.1.2 DEVICES

Nearly all popular end user devices are equipped with standard input/output technologies. These include mobile data connections, WiFi, GPS, and touch screens. Among the most popular devices are the Samsung Galaxy Note and the Samsung Galaxy Nexus.

[14] https://developers.google.com/android/maps-api-signup

[15] The AndroidManifest.xml includes essential information for the building process of an Android application.

	Samsung Galaxy Note (N7000)	Samsung Galaxy Nexus
OS	Android 2.3.6 (update to 4.0.4)	Android 4.0.3 (4.1 announced)
CPU	1.4 GHz dual core (ARM Cortex A9)	1.2 GHz dual core (ARM Cortex-A9)
Memory	1 GB	1 GB
Storage	16 or 32GB Flash	16 or 32 GB
Display	5.29 in with 800x1280 pixels	4.65 in with 720x1280 pixels
Connectivity	WiFi (802.11 a/b/g/n), Bluetooth 3.0, Micro USB 2.0, USB Host, GPS	WiFi (802.11 a/b/g/n), Bluetooth 3.0, Micro USB 2.0, USB Host, NFC, GPS

Table 7: Comparison of the Galaxy Note and the Galaxy Nexus

5.1.2 iOS[16]

The iOS has been developed and distributed by Apple since 2007. Originally, it was developed for the iPhone and iPod, but was extended to support other Apple devices such as the iPad or Apple TV. Apple doesn't license iOS to other hardware manufacturers. It is in fact a violation of the software license agreement to use iOS on non-Apple devices (Apple Inc., 2012). The current version of the OS is 6.0, which, in comparison to earlier versions, most notably switched from using Google Maps to Apple's own solution Apple Maps.

5.1.2.1 DEVELOPMENT

Testing and developing iOS applications without deploying on a device is completely free. In order to be able to deploy to real devices, an annual fee of $99 for a single developer license and $299 for an enterprise developer license has to be paid.

The development is done via the IDE Xcode, only available for the Mac OS X. The languages used are C, C++ and Objective-C. Cross-compilation[17] tools and libraries are available to create apps in other languages.

One big advantage of the development is the knowledge about the hardware the app will run at, since iOS only supports Apple devices.

[16] http://www.apple.com/ios/

[17] Apple prohibits apps which interpret code at run time, making it impossible to use scripting languages or byte-code-compiled languages to create apps. To circumvent this restriction, cross-compilation to C/C++/Objective-C converts source code to a form supported by Apple's tools.

The SDK includes APIs for sending SMS from within apps, but there is no way to do this without user interaction. The procedure to send a SMS is to specify the recipient and the text body and call the native SMS app that shows those values and provides a "Send" button. An alternative to this would be using a separate online SMS service.

Apple Maps can be accessed from the iOS SDK without further ado. It is possible to create a map view and trigger certain interactions like zooming in and out or to a specific location. In addition, overlay items can easily be added on top of the view. However, it has however come to the attention of the public that the quality of Apple Maps is lacking severely in most parts of the world: Roads are missing or inaccurately placed over poorly stitched together satellite imagery, few points of interest (restaurants, ATMs and the like) are available, and names of some places are incorrect. Apple Maps works best in some regions of the U.S.A. and China. For other countries, using Google Maps in a web view is a viable alternative.

Apple restricts the tasks that are allowed to be active in the background. Thus, location based services are affected. Tracking the user's location can be implemented in three different ways:

- **The significant-change location service**
  Location updates are triggered if the location of the device changes significantly, providing more inaccurate results.
- **Foreground-only services**
  This type of service is designed for applications that only need location data while they are in the foreground. The service stops the delivery of data when the app is suspended.
- **Background location service**
  The app gets informed of location updates, regardless of its suspension status.

If the app requires location-based services, an entry in the *Info.plist*[18] file of the project is necessary to require the device capabilities *location-services* and *GPS.*

5.1.2.2 DEVICES

	iPhone 4S	iPad 3
OS	iOS 6.0	iOS 6.0
CPU	800 MHz dual core (ARM Cortex-A9)	1 GHz dual core (Apple A5X)
Memory	512 MB	1 GB
Storage	16, 32 or 64 GB Flash	16, 32 or 64 GB Flash

[18] The Info.plist contains information about the configuration of the project.

Display	3,5” with 960x640 pixels	9.7” with 2048x1536 pixels
Connectivity	WiFi (802.11 b/g/n), Bluetooth 4.0, GPS	WiFi (802.11 a/b/g/n), Bluetooth 4.0, GPS

Table 8: Examples of iOS devices

5.1.3 WINDOWS PHONE[19]

In February 2010, Microsoft announced Windows Phone to replace Windows Mobile as whole new platform. With Windows Phone, Microsoft introduced a new user interface, featuring its design language Metro. Microsoft licenses their OS to hardware manufacturers. The current version of the OS is 7.5 although Microsoft announced Windows Phone 8 to be released later in 2012. The new platform will replace the Windows CE-based architecture with a Windows NT-based one, which allows porting applications to Windows 8. The SDK includes functionality for maps and sending SMS.

5.1.3.1 DEVELOPMENT

Microsoft provides an SDK optimized for Visual Studio, which is available for Windows only. There are two ways to develop applications: Using the Silverlight framework, or the XNA framework for games. Programs are written in C#. The development of applications itself is free of charge.

Windows Phone 7 doesn’t allow direct sending of SMS using native code. It is possible to prepare the content of the message and to call the native SMS application, but only the user can trigger the actual sending. A workaround could be an online SMS service.

Microsoft offers their own maps API based on Bing Maps. A developer using this API has to sign up for a Bing Maps developer account[20], where a Bing Maps key is provided. The Map control allows for adding overlay items, zooming, and other basic functionalities.

Receiving location data is done via the location service. The service encapsulates the hardware and provides interfaces for applications to apply settings and to get location updates. Important for retrieving location data is the level of accuracy. An application using the location service can specify the needed level of accuracy. According to that level, the service takes different hardware functionalities into account, like GPS, cell radio and WiFi.

5.1.3.2 DEVICES

Windows Phone 7 has strict hardware requirements. Therefore developers can benefit from a stable environment. Each Windows Phone has the same resolution and developers can safely

[19] http://www.microsoft.com/windowsphone

[20] http://www.bingmapsportal.com/

assume that the devices configurations fulfill a certain standard. The configurations in Table 3 serve as an example for that.

	HTC TITAN II	Nokia Lumia 900
OS	Windows Phone 7.5	Windows Phone 7.5
CPU	1,5 GHz (Snapdragon S2)	1,4 GHz (Snapdragon S2)
Memory	512 MB	512 MB
Storage	16 GB Flash	16 GB Flash
Display	4.7 in with 800x480 pixels	4.3 in with 800x480 pixels
Connectivity	WiFi (802.11 b/g/n), Bluetooth 2.1, A-GPS	WiFi (802.11 b/g/n), Bluetooth 2.1, A-GPS

Table 9: Examples of Windows Phone 7 devices

5.1.4 SUMMARY AND COMPARISON

There are severe differences in app development between the platforms. Android is known as an open platform, allowing developers to get more into the basic functionality and potentially develop at a low level. Development for iOS and Windows Phone 7 is more restricted. This can be verified by looking at the API for sending SMS: It is not possible to do this without user interaction on iOS- and Windows Phone-powered devices. The other described functionalities are supported by all platforms. Table 10 shows a summary of all mentioned features.

	Android	iOS	Windows Phone
Release	2008	2007	2010
Version	4.1	5.1.1	7.5
Languages	Java, C/C++	C, C++ Objective-C	C#
SMS	Yes	Yes (not w/o additional user interaction)	Yes (not w/o additional user interaction)
Maps API	Yes (key required)	Yes	Yes (key required)
GPS	Yes	Yes	Yes
Cell based location	Yes	Yes	Yes

Development costs	Non	Non	Non
Publishing costs	Once $25	Once $99	Annually $99 for single license, Annually $299 for enterprise license

Table 10: Comparison of mobile development platforms

5.2 SMART TV PLATFORMS

Smart TV is a general term for a television set with enhanced functionality – an attempt to bring rich features of computers to the comfort of the living room. This functionality is either built-in, or a normal TV is retrofitted with a set-top-box running the appropriate software. Such enhanced functionality often utilizes an Internet connection to enable enhanced entertainment, but also interactive utility applications – hence the related term *Internet-enabled TV*. Similar to Smartphones, modern smart TV platforms tend to support running apps developed by third parties.

Since TV manufacturers increasingly feature smart TV software in their new products, the market penetration of smart TVs is rising. In 2011, roughly 10% of globally shipped TVs were smart TVs, which is more than 3 times as many as in 2010. It is projected for 2012 that 20% of globally shipped TVs are smart TVs (Liang, 2011).

There is currently no established standard for the development of smart TV applications. In the recent years, many platforms have emerged. Although some of them utilize existing technologies, such as HTML, a common denominator is hard to establish across different platforms, making multi-platform development no easy feat.

Smart TVs can be a useful computing platform for older people because they are usually familiar with using a remote control to operate a device. Smart TVs offer many of the possibilities of a full-featured computer, without the having to learn to operate possibly unknown input devices such as the keyboard and the mouse. Another advantage is that smart TV user interfaces are often simpler and easier to handle than most desktop software.

Smart TV platforms can be categorized by what hardware they run on:

1. **Vendor-specific platforms** are available only on a certain vendor's devices, and were usually developed by the vendor itself. Such platforms entail a certain danger, since the vendor can stop supporting it at any time and switch to a different platform, rendering old smart TV software useless.
2. **Middleware** is not bound by specific hardware vendors, and is often developed by a consortium or as open source software. Middleware can be installed on any hardware that fulfills the minimum software requirements, usually set-top-boxes.
3. **Set-top-boxes** come with their own smart TV platform, and enable retrofitting a normal TV with smart TV functionality.

Below are descriptions of currently dominant smart TV platforms, split into the categories above.

5.2.1 VENDOR-SPECIFIC PLATFORMS

5.2.1.1 SAMSUNG SMART TV[21]

Samsung's Smart TV solution features various TVs with smart TV capabilities including web browsers with flash support, various types of application types and an application store with over 400 apps. The application store organizes apps into categories which include video, games, sports, education, lifestyle and information categories. The most popular apps of the platform are social applications which allow the user to connect to various social networks, communication applications, like Skype, and video consuming applications, like Netflix and BBC's iPlayer.

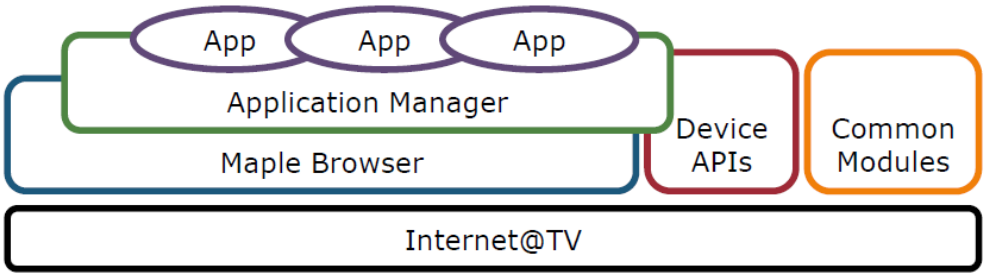


Figure 29: Samsung Smart TV Architecture (source[22])

The Samsung Smart TV platform consists of the following components:

- Maple Browser
- Application Manager
- Device APIs
- Common Modules

Smart TV applications run on top of the Maple browser (Markup Engine Platform for Embedded Systems) which is the web run time engine of the platform and supports various web standards such as HTML5, XHTML, CSS, DOM2, etc.

The Application Manager component controls the installation, registration, removal and update of the applications of the platform, through two native apps. The Smart Hub and Samsung Apps applications.

[21] http://www.samsung.com/us/2012-smart-tv/

[22] http://www.imaso.co.kr/?doc=bbs/gnuboard.php&bo_table=article&keywords=%C0%D0%C0%BB%B0%C5%B8%AE%3B%B5%F0%BA%A7%B7%CE%C6%DB+%C7%C3%B7%AF%BD%BA&page=9&wr_id=38537

Figure 30: Smart Hub and Samsung Apps applications

The Common Modules of the platform include the JavaScript Core Library Set which is provided in the Samsung Web Run-Time. The Common Module provides functions such as Event, Remote Key Value, Image View, etc.

The Device APIs of the platform include the JavaScript APIs for native calls as depicted in the figure below.

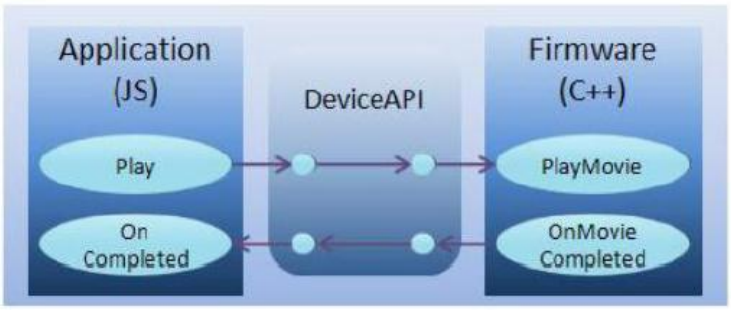


Figure 31: Smart TV Device APIs (source[23])

The functionality that the Device APIs provide is basic TV function calls (file systems, channel, etc.), audio and video player playback control and input method control.

As a platform, the Samsung Smart TV features a full web browser with Adobe Flash support offering a full web experience from the TV. Also, the platform provides the capability to run HTML and JavaScript applications, exposing the appropriate APIs to them for additional functionality such as user authentication and data storage.

In summary, the Samsung Smart TV platform has the following features:

- Integrated web browser
- Ability to run applications written in HTML and JS
- Extensive JS API for functionality such as file storage, single sign-on, etc.

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http://www.imaso.co.kr/?doc=bbs/gnuboard.php&bo_table=article&keywords=%C0%D0%C0%BB%B0%C5%B8%AE%3B%B5%F0%BA%A7%B7%CE%C6%DB+%C7%C3%B7%AF%BD%BA&page=9&wr_id=38537

- Support for flash applications
- Full-screen, widget and ticker applications

Applications for the Smart TV platform are developed using web technologies. The applications are written in HTML, using CSS for styling and JavaScript, where the platform's APIs are exposed through, allowing access to additional functionality. Specifically, the APIs that are available to the developer include:

- Device API which allows access to external devices such as gamepads and medical devices.
- Convergence API which allows client applications running on an external device to communicate with a TV application to synchronize state and exchange data and files.
- Input control API
- Push notification API

Also, later versions of the platform provide support for HTML5 applications.

All Smart TV applications contain an index file which is used as the entry point of the application, JavaScript files which define the behavior of the application, CSS files to control the layout of the user interface, resource files utilized by the application and an application configuration file, holding information for the application.

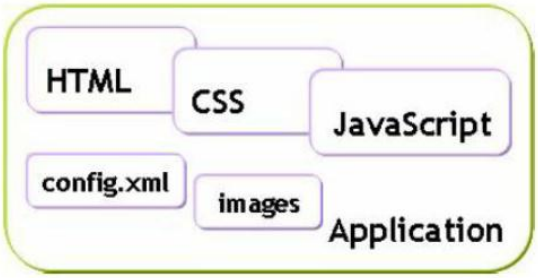

Figure 32: Smart TV Application Structure (source[24])

Samsung provides an SDK with an IDE and emulator for the development of applications.

The Samsung Smart TV SDK is a tool which allows developers to create and edit applications for the platform. It provides an intuitive UI and powerful easy to use features for convenience and functionality. The SDK offers three main benefits: easy code editing, easy visual editing and fast packaging. It allows the inspection and editing of the code of the applications, and it provides a click and drag visual editing environment for designing and arranging the visual aspects of applications.

24

http://www.imaso.co.kr/?doc=bbs/gnuboard.php&bo_table=article&keywords=%C0%D0%C0%BB%B0%C5%B8%AE%3B%B5%F0%BA%A7%B7%CE%C6%DB+%C7%C3%B7%AF%BD%BA&page=9&wr_id=38537

Samsung Smart TV applications consist of a combination of HTML, CSS, JavaScript, image and other files. The SDK arranges files into projects, providing a Project Explorer panel and tabbed document browsing so that the developer can access the project documents easily. Also, the SDK allows the creation of blank applications which contain all of the basic app files. The code editor of the SDK features automatic code completion and syntax highlighting and provides tools to easily access commonly used code. Finally, the SDK provides tools for the validation of an app against the HTML standard and a TV emulator which recreates the TV environment.

Applications written for the platform are distributed only through SmartHub, Samsung's application store. Each application is packed using tools provided by the SDK and is submitted to Samsung for review. If the application passes the review, Samsung will host the application to their servers. It must be noted that even though the application is in a complete package, the TV must be connected to the Internet in order to run it.

5.2.1.2 LG SMART TV[25]

LG's smart TV solution is a TV platform which integrates content access, applications, content sharing and conventional TV access under a single platform.

Figure 33: LG Smart TV

The platform is a solution based on an earlier platform called NetCast and features Smart TV-ready TV sets and a Set Top Box which provides Smart TV capabilities to any TV. The platform runs on a 500MHz MIPS CPU with 512MB RAM and a Linux operating system. Also, it features a Wii like pointing device.

[25] http://www.lg.com/us/smart-tvs

Applications are separated into Premium and LG apps with the Premium applications delivering Pay TV type content such as movies, sports, SNS, etc.

As a platform, the LG smart TV features a full web browser with Adobe Flash support and allows the running of web applications exposing to them APIs for various platform specific functionalities.

In summary, the platform features the following:

- HTTP, HTTPS support
- Full HTML4, partial HTML5 support
- CSS 2.0, a subset of CSS 3 is supported
- Native JSON, XML
- Supports a flash plugin
- Cookies
- Advertisement API
- WebKit based browser

The NetCast platform contains all the underlying technology that is used to run apps in the TV on top of a WebKit based web browser.

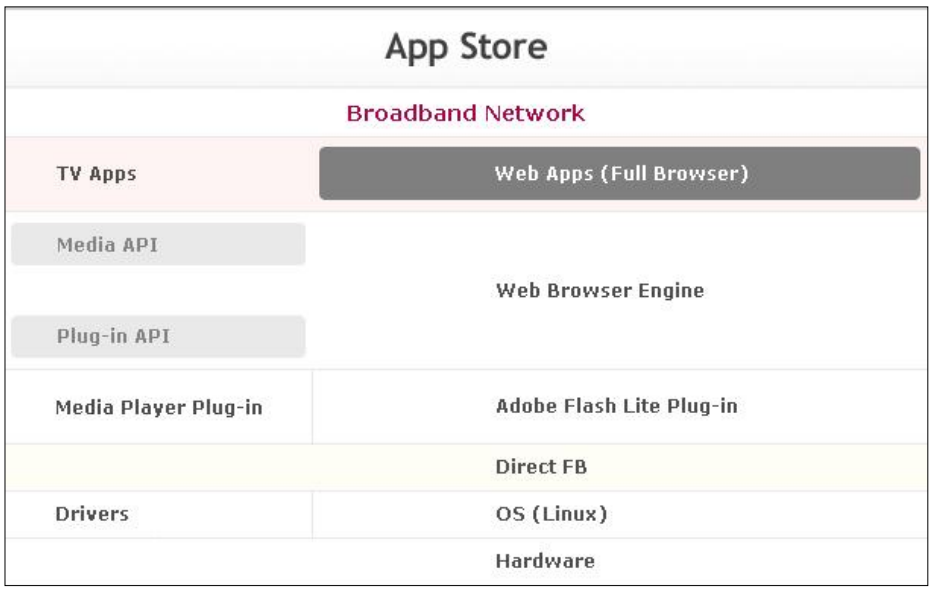

Figure 34: NetCast architecture

Applications are written in HTML and CSS for styling and JavaScript for the logic while there is partial HTML5 support. Also, the platforms APIs are exposed through JavaScript providing the following:

- NetCAST API for the basic control of the application (Exit, back, return, loading, etc.)

- Proprietary events API which is used to handle events coming from the browser (mouse on, mouse off, etc.)
- Media player API which provides methods to control the platform's CEHTML compliant media and audio objects.
- Device info API which provides information about the device such as version, serial number, network type, etc.

LG provides an SDK for the development of applications for its platform. The SDK consists of components for the development of Flash applications, emulation, Eclipse IDE extension, and API documentation among others.

The SDK is available for the Windows OS free of charge.

Applications written for the platform are distributed through LG's TV application store. The applications are packed and submitted to LG for review and after approval they are hosted and distributed from their servers. While the platform's app store supports over 80 countries, paid applications are distributed to only a small subset of them.

During the application review process, LG checks the application for the possibility of harmfulness, language suitability, age rating, copyrights and price reasonability, and tests it in the SDK's emulator and an actual device.

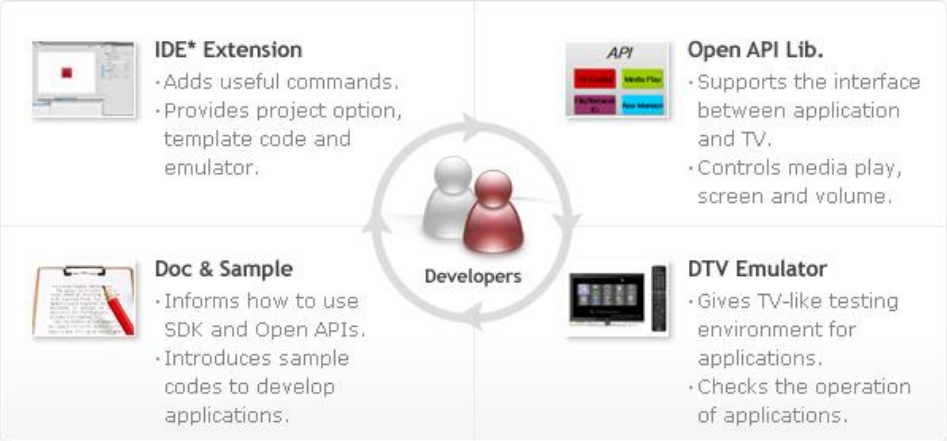

Figure 35: LG Smart TV SDK (source[26])

5.2.1.3 PHILIPS NETTV[27]

The Philips NetTV is a TV platform which allows users to access television and interactive content via the Internet on their television. It is based on elements of the Open IPTV Forum release 1 specifications, with some extensions and subsetting.

[26] http://www.androidside.com/bbs/board.php?bo_table=B47&wr_id=7

[27] http://www.philips.co.uk/c/Smart TV/286454/cat/#nettv

The platform was first introduced in 2009 and offers consumers an integrated experience combining the relaxed TV experience they're used to from their TV with access to Internet delivered services from various content providers. NetTV was first introduced in high-end TV sets but over time it has been added to mid-range TV sets and Blu-ray players. NetTV devices include a web browser supporting the CE-HTML standard as specified by W3C. The integration between the browser and the TV environment is provided by elements from CE-HTML, for internet delivered video, and from the Open IPTV Forum, for integration with the broadcasted program, with downloaded content and with DRM. This selection is close to that required by HbbTV and is evolving to become fully compliant with that specification.

The Philips NetTV allows access to the Internet through its integrated web browser. The web browser is based on Opera Mobile and is CE-HTML compliant. Also, it includes various codecs for audio and video playback which is possible through a proprietary media object due total lack of third party plugin support.

Philips NetTV applications are web applications hosted in third party servers as the platform doesn't provide any method for data storage. The web applications are accessed through the device's integrated web browser and a remote control is used for input. The platform provides methods to capture key press events of the remote and the web applications must use and process these events to allow them to be used with a remote control device.

NetTV applications are written using CE-HTML which is a technology stack for creating user interface pages for consumer electronic devices. CE-HTML consists of various internet technologies such as ECMAScript, XHTML, CSS TV Profile and AJAX through the XMLHttpRequest object.

Development for the platform is the same as developing a web application. Web developers can use the same tools and methods to produce applications for the platform, as long as they conform to the supported standards.

Philips provides the NetTV SDK which is an emulator of the NetTV platform along with a CE-HTML validator. The emulator is a virtual machine which runs a Linux version that is used in the actual hardware, and contains a web browser based on Opera Mobile. The CE-HTML validator checks the web application for conformance with the CE-HTML standard and informs the user about errors and suggestions.

In the Philips NetTV platform there is no centralized application store. Each developer is responsible to host his own application on the Internet, which the users of the platform can access through the device's web browser. Shortcuts to the web application can be placed in the platform's "App Gallery" but information about the procedure is not publicly available.

5.2.2 MIDDLEWARE PROVIDERS

Middleware is defined as any type of software that allows other software to interact (Defining Technology, Inc.). In the case of Smart TVs, middleware provides a uniform way for

applications to interact with the host operating system on a high level. This includes, but is not limited to, providing simple interfaces to graphical operations, GUI creation, network communication, and storage.

This section discusses current Smart TV middleware. Note that, although usually bundled with devices, middleware is not bound to a hardware manufacturer, and can be installed on any device that fulfills the system requirements.

5.2.2.1 GOOGLE TV[28]

Figure 36: Sony NSZ-GS7 (source: Sony Store[29])

Google TV is a platform, based on the Android operating system. In 2010 manufactures started to build set-top boxes supporting Google TV. Among them are companies like Logitech and Sony. The platform tries to combine traditional TV experience with rich online-enabled content and on-demand streaming. Google TV launches the Europe market in fall 2012.

Since Google TV is based on Android, app development can be done with the Android SDK plus Google TV plugin. Google TV enables the user to open the Google Play Store to download existing apps, which have been checked for compatibility. Not all features supported by mobile devices can be accessed on the TV platform since not all sensors are implemented. This includes location-based services, vibration, touch input, and telephone functionality. A developer of an app designed for Google TV has to specifically declare the compatibility in the AndroidManifest.xml file. Setting the requirements for certain features to “false” achieves a correct filtering of apps in the Google Play Store. For example, an app won’t be available for installation on a Google TV device if it needs touch input. An app can also be limited for installation on Google TV devices by declaring the feature *com.google.android.tv.*

The Android platform was mentioned in section 5.1.1. The requirements for Google TV have to be adapted. The Google TV plugin includes an emulator for testing during development.

[28] http://www.google.com/tv/

[29] http://store.sony.com/webapp/wcs/stores/servlet/ProductDisplay?catalogId=10551&storeId=10151&langId=-1&partNumber=NSZGS7

Unfortunately, the emulator runs on Linux only. Additionally, Google TV only supports native and web apps, including flash content.

	Sony NSZ-GS7
OS	Google TV, Android
CPU	1 GHz single core (Apple A5)
Memory	-
Storage	8 GB (internal)
Connectivity	WiFi (802.11 b/g/n), Ethernet 100BASE-TX HDMI, Optical audio, USB

Table 11: Specification of the Google TV device Sony NSZ-GS7

5.2.2.2 APPLE TV[30]

Figure 37: Apple TV (source: Apple Store[31])

The Apple TV is a digital media receiver, manufactured by Apple Inc. The first version was released in 2007 and was designed as an extension for a local iTunes library. In 2008, the company upgraded the Apple TV and made it a standalone device, not depending on iTunes anymore. The latest introduced version is the 3rd generation, which comes with the support of many online streaming platforms and more hardware performance. The latest Apple TV was mainly designed to stream content from either the local network or from the Internet. This includes iTunes libraries, Apple devices supporting AirPlay[32], YouTube, Netflix and other online content providers.

Although the operating system is based on iOS, the development for Apple TV is not yet officially supported. Apple announced a SDK to be released later in 2012. Until then, there is no legal, official method to get any self-developed content onto the Apple TV. Nevertheless,

[30] http://www.apple.com/at/appletv/

[31] http://store.apple.com/us/browse/home/shop_ipod/family/apple_tv

[32] AirPlay is a proprietary protocol that allows the wireless streaming of content from enabled Apple devices to the Apple TV.

developers managed to run iOS Apps on a jailbroken Apple TV. This approach is highly instable and not usable for a productive environment. There is an unofficial open source tool chain for making apps for the Apple TV (tomcool420, 2010).

The advantage of the Apple TV and AirPlay is the ability to mirror the screens of other AirPlay enabled devices made by Apple, like the iPhone and iPad on a TV screen. This allows the user to show any app, developed for the specific mobile devices, on a big screen.

	Apple TV 3rd generation
OS	iOS derivate
CPU	1 GHz single core (Apple A5)
Memory	512 MB
Storage	8 GB Flash (for caching only)
Connectivity	WiFi (802.11 a/b/g/n), Ethernet 10BASE-T, 100BASE-T HDMI, Optical audio

Table 12: Specifications of the Apple TV 3rd generation

5.2.3 IPTV AND SET-TOP-BOXES

5.2.3.1 SAFEVIEW STBS

5.2.3.1.1 IPO-85X ANDROID IP RECEIVER

Figure 38: IPO-85X Android IP Receiver

IPO-85X is a powerful device with a processing capacity higher than 2500 MIPS, supporting MPEG4 H.264 at 1080p resolution and the capacity to record and play any SD or HD program (PVR ready). This STB is prepared for pure IPTV or hybrid QAM-IPTV, video on demand services, interactive Android 4.0 widgets and over the top TV channels.

The main characteristics of this receiver are:

- The capacity to record and play multiformat contents on an external hard disk or flash memory.
- An advanced 3D user interface powered by a 3D accelerator
- Supports local Time Shift TV (TSTV) over hard disk or external flash memory.
- Supports widgets to access Internet services like: YouTube, Weather, Wikipedia, etc.
- An EPG (seven days) with the capability to program the automatic recording of events.
- A miniguide and EPG with the capability to insert interactive advertising banners (WiredTV compliant).
- Picture in Picture of two video signals up to 720p resolution.
- Secure SW download (OTA).
- Safeview DRM. Embedded high level security at chipset level.
- WiFi 802.11n interface.
- RF based RCU.
- Video-conference through a simple Webcam: Supports H.264/MPEG-4 video encoding, a maximum of 720x576@25 fps. One channel audio encoding with echo cancellation.
- Advanced user interface to support PPV, messaging, VoD and interactive widgets.
- WiredTV advanced target advertising compliant.

Includes Webkit Browser and Android 4.0 Operating System. Eases development and integration of new software applications (widgets) and functionalities. Open to the operator for the development and inclusion of new widgets.

5.2.3.1.2 IPO-85C IPTV RECEIVER

Figure 39: IPO-85C IPTV receiver

IPO-85C is a very high performance QAM receiver supporting full HD resolution, MPEG4/MPEG2 video formats and DIVX. It has a USB 2.0 port (optionally two ports) to enable a complete PVR functionality with recording, playing and pausing (time shift TV) capabilities at HD 1080p resolution.

The main characteristics of this STB are:

- It can record and play multiformat contents in an external hard disk or Flash memory (PVR ready) in FAT32 and NTFS formats.
- It supports local Time Shift TV (TSTV) on an external hard disk or flash memory.
- Includes a 7 days EPG with automatic recording programming.
- Secure software download (secure OTA).
- Secure smartcard pairing.

5.2.3.2 OTHER STBS

5.2.3.2.1 ALBIS SCENEGATE 8000[33]

Figure 40: Albis SceneGate 8000

The SceneGate 8000 is an entry level IPTV STB built in a small housing. It is an ideal STB to deliver standard services or can be used as cost efficient «second room» STB. Using an external IR extender the STB can also be used in solutions requiring concealed environments.

It provides the most relevant interfaces while offering high definition (HD) decoding and display quality up to 1080p with 60 Hz via an HDMI 1.3 interface. Therefore high definition content services like Video on Demand (VoD) and linear IPTV services can be brought to the user with unique quality.

The latest system on chip technology provides enhanced processing power and memory, allowing sophisticated applications and attractive user interfaces.

Albis Technologies has made exceptional efforts to optimize the system and graphic performance to its best. The flexible software framework provides open APIs for integration with native or browser based middleware clients and applications. For integration with today's internet media offerings, the software framework can be extended with a flexible media engine allowing de-multiplexing and decoding of the most popular container and codec format including flash video. In addition DLNA based media sharing is available for applications to allow in-home streaming or multi-room concepts.

With its contemporary design the SceneGate 8000 STB is a cost-attractive device for today's living room services. High engineering quality and optimized software guarantee excellent user experience and customer satisfaction for your services.

33 http://www.albistechnologies.com/products/telecommunications/digital_stb/products/scenegate_8000_en.php

5.2.3.2.2 AMINO A140[34]

Figure 41: Amino A140

With an Ethernet input and flexible audio/video output, S/PDIF and RF Modulator outputs, the A140 provides a powerful means of delivering sophisticated interactive digital television including multicast, Video-on-Demand and Internet access. It is supported by a comprehensive ecosystem of middleware, browser and security applications to offer advanced service features. It connects with HD TVs through an HDMI interface and with routers using an Ethernet connection.

5.2.3.2.3 NETGEM NETBOX N8200[35]

Figure 42: Netgem Netbox N8200

The Netbox N8200, delivered with NetgemTV software, offers an exciting next-generation HDTV experience. Featuring a double hybrid DVB-IP tuner and silent hard disk drive for watching and recording TV and VOD programming, it provides advanced permanent time-shifting capabilities that truly redefine the TV experience. Shipping with complete audio/video connectors and home networking features, including WiFi and UPnP, the N8200 Netbox is elegantly designed with a glossy black casing and sleek finish.

5.2.3.2.4 TELERGY T502[36]

[34] http://www.aminocom.com/products/aminet-a140/

[35] http://www.netgem.com/netgem-products-platforms.php

Figure 43: Telergy T502

Telergy's advanced Digital set top boxes enable service providers to deploy numerous services such as IPTV, VOD, VoIP, video surveillance, digital signage, gaming, shopping, e-commerce and a range of interactive services.

Telergy's custom designed browser, together with the implementation of and for DVB-T applications, a complete EPG platform, enables all these services to be provided quickly and efficiently.

The Telergy T502 advanced High Definition digital set top box is a powerful product that enables service providers to easily and rapidly take advantage of the opportunities that HD offers, at a sensible cost.

Telergy T502 includes a new, fully featured and integrated modular software stack. This supports the brand new Telergy browser, which is dedicated to greater functionality and better internet browsing. In addition is supported for the first time allowing enhanced graphics, feature rich content as well as speed of display.

With the additional benefit of the optional terrestrial (DVB-T) tuner, this avoids duplication in network infrastructure, by being able to operate over both IP and terrestrial networks

5.2.4 SUMMARY AND COMPARISON

Different devices are capable for different tasks. Many of the mentioned Smart TV platforms are capable of showing and running custom apps. The kind of these applications varies though. The Samsung Smart TV platform for example offers the ability to run full blown apps including file system access. Samsung supports a variety of programming languages and tools like HTML5, CSS, XHMTL and even Adobe AIR (in newer models). The development process of LG Smart TV is quite similar, although there is a lack of HTML5 support. The Philips NetTV supports the CE-HTML standard, consisting of XHTML, ECMAScript, and CSS TV Profile. Unfortunately, the NetTV platform doesn’t allow file system access and is therefore limiting

[36] http://www.telergy.com/?portfolio=t502

storage capabilities. This leads to the implementation of web applications, displayed on the screen of a Philips NetTV-based device. When it comes to middleware providers, the most common and popular are Google TV and Apple TV. There is no official SDK announced for the Apple TV yet, what makes development unfeasible. The Google TV nevertheless is able to run Android apps and a full SDK is available.

Finally it can be said, that the Samsung Smart TV platform offers the most features for developing purposes. The favorite of the middleware platforms is the Google TV. Safeview's IPO-85X constitutes an interesting set-top-box candidate, as it is based on Android, as opposed to its predecessor IPO-85C, which has a stronger focus on TV functionality. The rest of the mentioned STBs don't differ significantly and use mostly web based standards.

A comparison of all platforms is shown in Table 13 and Table 14Table 14Table 13: Comparison of Set-Top-Boxes. The compatibility of the platforms to each other is also an interesting aspect and can be seen in Table 15. It turns out, that the compatibility is mainly achieved via a shared JavaScript code base.

	Albis SceneGate 8000	**Amino A140**	**NetGem N8200**	**Telergy T-502**	**Safeview IPO-85X**	**SAFEVIEW IPO-85C**
SDK	Yes	Yes	Yes	Yes	Yes	Yes
Languages	JavaScript, HTML, CSS, C/C++	JavaScript, HTML, CSS	JavaScript, HTML, CSS	JavaScript, HTML, CSS, Flash	Java, C/C++	JavaScript
IDE	-	-	-	-	Android Developer Tools (Eclipse)	-
Costs of development	Free	Substantial amount for SDK	Free	N/A	Free[2]	N/A

Table 13: Comparison of Set-Top-Boxes

	Samsung Smart TV	LG Smart TV	Philips NetTV	Google TV	Apple TV
SDK	Yes	Yes	Yes	Yes	No
Languages	JavaScript, HTML5, CSS, XHMTL, Adobe AIR, Flash	JavaScript, HTML 4, (partial HTML5), CSS,	JavaScript, CE-HTML (ECMAScript, XHTML, CSS)	Java, C/C++	-
IDE	Smart Code Editor	LG Eclipse plugin	Philips NetTV Emulator	Android Developer Tools (Eclipse)	-
Cost of development	Free[2]	Free[2]	Free[2]	$ 25[1]	-

Table 14: Comparison of TV platforms

Notes:

1) One-time fee to be able to distribute apps via Google Play, alternative self-hosted distribution possible for no additional cost.
2) Developing for the platform is free of charge. Additional fees apply for publishing.

Compatibility Platforms vs. Platforms (bi-directional)	Samsung Smart TV	LG Smart TV	Philips NetTV	Google TV	SAFEVIEW IPO-85X	Apple TV	Android	iOS	Windows Phone
Samsung Smart TV	F								
LG Smart TV	C[2]	F							
Philips NetTV	S	S	F						
Google TV	C[2]	C[2]	S[2]	F					
SAFEVIEW STB (IPO-85X)	S	S	S	C[1]	F				
Apple TV	N	N	N	N	N	F			
Android	C[2]	C[2]	S[2]	C[1]	C[1]	N	F		
iOS	C[2]	C[2]	S[2]	C[2]	S	N[3]	S	F	
Windows Phone	C[2]	C[2]	S[2]	S	S	N	S	S	F

Legend: fully compatible (F) some restrictions apply (C) code sharing possible (S) not compatible (N)

Table 15: Compatibility of platforms

Notes:

1) Touch- and phone-features not available
2) Only when using HTML/JavaScript
3) Possibly compatible in the future

5.3 CROSS-PLATFORM TOOLS

Cross-platform development is becoming increasingly more important. Not only mobile app development suffers from OS fragmentation: More new technologies, like Smart TVs, are flooding the market.

Cross platform development in general can decrease the development time (Pierres, 2012), since code can be shared and development is done targeting a single API. Additionally, new platforms can be easily reached if the tool starts supporting them, with little or no additional development effort. However, the cross-platform approach comes with some restriction, for example the SDK lock-in: If the tool has been chosen, switching to a different one requires an almost complete rewrite of the application. Furthermore, development can't always be done with already familiar tools. Therefore, the technology to use should be chosen after careful deliberation.

There are three flavors of cross platform tools. The first approach is a pure web application, created using web technologies like HTML, CSS and JavaScript. There are some frameworks that are using HTML5 as main technology, like GWT, xui, jQuery, or WebApp.Net.

Hybrid apps are similar to web apps, but they run as JS/HTML application in a webview with a wrapper for device-specific API access. This allows the connection from JS/HTML code to native functionality. Frameworks using this approach are for example Appcelerator, Sencha, or PhoneGap.

The third category is compiled apps, where the code in the SDK language is either compiled into a native application for each platform or the tool comes with its own runtime. Representatives are Adobe AIR (ActionScript), Unity (C# and others), Xamarin (C#), or Marmalade (C++). The decision for a framework should be made carefully. Factors are the supported platforms, performance issues and the need for native APIs, as well as the prospect of continued development of the framework in the future.

5.3.1 ADOBE AIR[37]

Adobe Integrated Runtime enables the development based on HTML, JavaScript[38], ActionScript, Flex and Flash for multiple devices. AIR is currently in version 3.4 and was initially release in February 2008, and is still under development. The platform supports Windows, Mac OS X, Android, iOS, Blackberry and Linux (up to version 2.6). With Adobe 2.5.1 for TV, apps can be developed for AIR-enabled TV devices like the new Samsung Smart TV line. Adobe offers a set of tools for developing and debugging AIR applications. The recommended IDEs are Adobe Flash Professional CS5 and Adobe Flash Builder 4.5/4.6/4.7. The usage of an own

[37] http://www.adobe.com/de/products/air.html

[38] According to (Goldman, 2011), using HTML and JavaScript on mobile devices depends on the rendering capabilities of the host system. Thus, results may vary depending on the operating system, its version, and manufacturer modifications.

IDE in combination with the freely available Flex- and AIR-SDK is also possible. Flash Builder and Flash Professional are available for Windows and Mac OS X, and are able to perform debugging. Among others, building applications with Flex and ActionScript allows the following functionalities:

- Accelerometer
- Camera
- Connection
- Database
- Geolocation
- Storage

Functionalities in Adobe AIR can be added using AIR Native Extensions (ANE). They are written in native code for Android, iOS, Desktop and TV environments and hooked into the application. One ANE can hold implementations of the same feature for several platforms, providing one single access point for the functionality. For the creation of native extensions, the native SDKs are required in order to debug the code. The native code is then wrapped with ActionScript classes, which provide the interface to the extension via method calls and events. The actual creation of an ANE is done via a command line tool and results in an *.ane file. This file can be included in projects. Native extensions are supported by AIR as of version 3.0.

Using the Flash Builder, library projects can be defined to enable code sharing through projects. This can be helpful when developing one codebase for different target devices with a different GUI or a different hardware profile.

Downsides of ActionScript/AIR include the dependence on a proprietary runtime, and an uncertain future, since Adobe shifts its interests more and more towards HTML/CSS/JavaScript. The latter is indicated by the introduction of new HTML5-oriented products, such as Adobe Edge, the extension of existing products towards HTML5, such as Dreamweaver and Illustrator, as well as the acquisition of the PhoneGap project. There is even a toolkit available for the latest Version (CS6) of Flash Professional that enables exporting Flash animations as HTML/CSS/JavaScript (Adobe, 2012). Most recently, Adobe Edge Animate[39] was released, a full-fledged IDE to create cross-platform HTML5 content and animations.

[39] http://html.adobe.com/edge/animate/

5.3.2 PHONEGAP[40]

PhoneGap is an open source (Apache Public License 2.0) mobile development framework, created by Nitobi and later purchased by Adobe Systems. The project is currently in the process of being incubated as an Apache Software Foundation project under the name Cordova.

The platform is based on HTML5 and allows the development of applications using the web technologies HTML, CSS and JavaScript. PhoneGap supports iOS, Android, Blackberry, WebOS, Windows Phone, Symbian and Bada. The platform doesn't use an included runtime - instead it relies on native wrappers for each target platform. Therefore, it depends on the IDEs, tool chains, or SDKs of the platforms to do the compiling and deploying on the devices, these are for example:

- Eclipse for Android
- Xcode for iOS
- Microsoft Visual Studio 2010 for Windows Mobile

Alternatively, PhoneGap offers a freemium online build service in the cloud[41], run by Adobe. This service takes the source files, as an uploaded archive or directly from a version control system, and compiles native applications for multiple platforms. This feature is available from within the Adobe Dreamweaver CS6 IDE and Adobe Edge Animate, which integrate the codebase and the triggering of the online build process into the IDE. Debugging can be done either on the devices themselves (limited to logs and native debugging), or using any of the available web application debugging frameworks like Socketbug[42] or Firebug[43]. Since the source code is written using web standards, the app should be able to run on any HTML5 enabled browser.

PhoneGap already offers APIs for accessing native functionality like:

- Accelerometer
- Camera
- Compass
- Connection
- Database
- Geolocation

[40] http://phonegap.com/, http://incubator.apache.org/cordova/

[41] https://build.phonegap.com/

[42] http://socketbug.com/

[43] https://addons.mozilla.org/de/firefox/addon/firebug/

- Notification
- Storage

Additionally, the framework allows extending the existing APIs with plugins. This can be achieved by writing native code in the platform dependent SDKs using PhoneGap libraries and providing JavaScript wrappers. In addition, the plugin has to be registered in the plugin.xml file. To test the plugin system, an SMS plugin for Android was developed and included. The process is well documented in the PhoneGap Wiki[44].

5.3.3 APPCELERATOR TITANIUM[45]

Appcelerator is another platform based on HTML, JavaScript and CSS for mobile development. Desktop applications can also be written in PHP, Ruby, and Python. The platform is open source, licensed under the Apache Public License 2.0. Supported operating systems are Android, iOS, Mac OS X, and Windows. The Appcelerator framework can produce native, hybrid iOS/Android, and web apps. The development is usually done via the freely available IDE Titanium Studio. Available SDKs are Titanium Mobile and Titanium Tablet. The development for iOS still requires the Xcode IDE. Titanium Studio is based on Eclipse and therefore available for Windows, Mac OS X and Linux. Apps, written with Appcelerator can be debugged using the native SDKs and emulators. Appcelerator offers interfaces for, among others:

- Accelerometer
- Compass
- Connection
- Database
- Geolocation
- Notification
- Storage

The API description is scattered between Android and iOS devices for some central features, therefore it is necessary to check on which device the app is running to select the appropriate APIs or to develop wrappers for the access. Appcelerator allows for the development and integration of modules. They can be included in existing projects. A module itself can be developed with Titanium Studio. The tool chain for creating a module is rather complicated since it includes: the native language (Objective-C or Java), Python, C/C++ compilers, and Ant to define the build process. Once a module is complete, it can be instantly injected in existing

[44] http://wiki.phonegap.com/

[45] http://www.appcelerator.com/

projects, or uploaded to the Appcelerator community. Appcelerator modules can be compared with AIR Native Extensions and PhoneGap Plugins.

Appcelerator offers a development price plan "App Explore" for free. Included is a cloud service, enabling push notifications and Email. Paid pricing plans offer faster support and more cloud features. A registration is mandatory in any case to use these services.

5.3.4 SENCHA TOUCH[46]

Sencha Touch is the combination of the JavaScript user interface libraries Ext JS, jQTouch and Raphaël. The aim is to enable mobile web applications with a native look-and-feel, resembling native applications as much as possible in terms of visuals and responsiveness.

Being based on the open standards HTML, CSS, and JavaScript, Sencha Touch is not limited to mobile devices. It is optimized for WebKit-based browsers, such as Google Chrome, Safari, RIM Blackberry Browser, Bada Mobile Browser, the native default browsers of Android and iOS, and others. Besides running in the browser, Sencha Touch applications can also be packaged as Android and iOS applications and made available on the respective app market places. When packaged, the application also has access to a set of phone-specific features, such as accessing the camera, the orientation sensor, or checking the availability of an Internet connection.

Sencha Touch applications must follow the Model-View-Controller pattern. Models represent data, controllers handle user interaction, and views are responsible for the graphical user interface. Additionally, Sencha Touch enables easy data store components and so-called "profiles", which provide a way to customize the user interface for various display sizes (e.g. Smartphone vs. tablet). Routing (associating URIs with actions) and history (fully functional navigation via forward/backward browser buttons) are supported as well.

5.3.5 SUMMARY AND COMPARISON

One big advantage of cross platform development tools is the ability to share a common code base for multiple target devices. This can reduce development costs once set up. Developing software for different device types, like Smart TVs and Smartphones, comes with certain restrictions. Although development benefits from a shared code base, the interfaces of the devices have different requirements. As a result, the UIs have to be adapted for different screen sizes and input methods. Some frameworks like Sencha Touch or Adobe AIR offer device profiles for defining the UI, based on the device specification. Based on that, different UI layer for different devices can be developed on top of the core functionalities.

Except of Adobe AIR, there are no cross platform development frameworks announced for Smart TV platforms. Nevertheless, most of the reviewed frameworks and TV platforms support JavaScript or at least a restricted version like the Philips NetTV. This leads to the

[46] http://www.sencha.com/products/touch

approach of implementing platform-dependent hardware and UI layers with a shared core layer in the middle. This approach takes intensive planning and is surely more time consuming than developing native applications. On the plus side is the simplicity of adding features on all devices simultaneously once the core of the application is developed. Cross-platform development also allows for reaching a larger number of target platforms with significantly less effort as compared to developing native solutions for each one. Additional layers, however, increase the complexity of an application, and therefore reduce its performance. A significant downside on relying on cross platform tools is also the vendor lock-in: If the developer of a cross platform tool abandons the product, everyone who uses it is forced to recreate all applications from scratch, so they can be available in the future, or continue the development of the cross platform tool if it is open source.

It can be generally assumed that platform specific solutions provide good results on each target platform at the cost of higher development effort, while cross-platform provides less satisfactory results, but at a lower cost. So the decision of whether or not to use cross-platform development tools comes down to three questions:

1. Are there tools that are compatible with Smart TV platforms and mobile platforms?
2. Is there enough common functionality that can be shared across platforms?
3. Is the quality of the resulting cross platform applications satisfactory?

In order to answer the questions, a detailed look at the compatibility of the reviewed cross platform tools and the previously mentioned system platforms is necessary. Table 16 shows what tools can be used to develop for certain platforms. The frameworks officially working on representatives of both platform types are Adobe AIR (Samsung Smart TV, Android and iOS), PhoneGap (Google TV, Android, iOS and Windows Phone) and Sencha Touch (Google TV, Android and iOS). The platform (conditionally) compatible with most devices is Sencha Touch. The compatibility of other tools is either unknown or the tool has no support for the majority of the platforms. This concludes that there are tools available for both platforms.

Compatibility **Platforms vs. Technologies**	**Samsung Smart TV**	**LG Smart TV**	**Philips NetTV**	**Google TV**	**SAFEVIEW IPO-85X**	**Apple TV**	**Android**	**iOS**	**Windows Phone**
Adobe AIR	F	N	N	N	N	N[1]	F	F	N
PhoneGap	C[3]	C3	C[3]	F	F	N[1]	F	F	F
Sencha Touch	C[2, 4]	C[4]	C[3, 7]	F	F	N[1]	F	F	C[3, 4]
Appcelerator Titanium	N	N	N	N	N	N[1]	F	F	N

Legend: compatible (F) not compatible (N) conditional compatibility (C)

Table 16: Compatibility of cross platform tools

Notes:

1) No 3rd party apps officially permitted yet
2) Only latest devices

3) Some backend JavaScript code can be shared
4) Only without extended hardware access

The functionality shared between the platforms cannot be easily defined. It is basically restricted to the implementation of the business logic of the scenarios since the underlying hardware and the input methods are typically different. The mentioned scenarios and use cases offer enough functionality to consider cross platform development. If the majority of the logic is outsourced to web services, the cross platform approach becomes less attractive.

One measure of the quality of an application is the performance on a device. Comparing native with cross platform development, the performance is in nearly all cases lower with the later approach, possibly reducing the usability of the application. Since the usability plays a major role in the project, this could be a deal breaker.

Writing software for both types of systems can be done using Adobe AIR, native Android (Google TV) or a shared code base. With all the mentioned approaches, the specific platform-dependent features have to be developed separately in either case. When choosing a cross platform approach, it is difficult to say, how much of the functionality is really able to run on both system, which leads to specific adaptions as well. This and all other mentioned drawbacks outperform the value gained from cross platform development and the conclusion is to implement the clients in a native way.

	Adobe AIR	PhoneGap	Appcelerator Titanium	Sencha Touch
Type	Runtime	Hybrid/Web	Hybrid/Web	Hybrid/Web
Languages	ActionScript, Flex	HTML5 CSS3 JavaScript	HTML5 CSS3 JavaScript (PHP, Ruby, Python)	HTML5 CSS3 JavaScript
Platforms	iOS, Android, Blackberry, Mac OS X, Windows, TV (Samsung[47])	iOS, Android, Blackberry, Windows Phone, Symbian, Bada, or any HTML5-enabled browser	iOS, Android, Mac OS X, Windows, any HTML5-enabled browser	iOS, Android, Blackberry, or any HTML5-enabled browser
SDK	Yes	Yes	Yes	Yes
API Documentation	Yes	Yes	Yes	Yes
IDE	Yes Windows,	No	Yes, Windows,	Sencha Architect

[47] http://learn.adobe.com/wiki/display/airquestions/AIR+for+TV

	Mac OS X		Mac OS X, Linux	
Cost	Flash Builder: € 617,61* SDKs: free	free	free	Touch: free others: variable
Native Extensions	Yes	Yes	Yes	Built-ins only
Maturity	Production-ready	Production-ready	Production-ready	Production-ready
Future	Unknown	Continued development	Continued development	Continued development
Open Source	Only Flex (Apache License 2.0)	Yes (Apache License 2.0)	No	Yes (GPL v3)

Table 17: Comparison of cross platform development tools

* Price as of 2012-08-09

5.4 SERVICE PLATFORMS

Web services offer possibilities to aggregate and distribute resources, or outsource common tasks with unprecedented speed. This eliminates the need to re-implement solutions to common problems. Costs can be reduced because content does not have to be created by the company itself, but can be aggregated from specialized providers. The risk and cost introduced by creating and maintaining a large computing infrastructure is reduced as well, since services are hosted off-site at the service provider, and don't usually require additional, possibly mostly unused hardware on the client side. Services often also provide more stability than an in-house solution, as they are battle-proven by a number of other clients, and developed by companies with expertise and specialization in this area.

Sacrificing provider independence allows for significant savings in development, maintenance and infrastructure, and potentially more stable software. The following sections present some services that may be of interest to the MOBILE.OLD project. This enumeration is non-exhaustive.

5.4.1 HOMEDOTOLD SERVICE PLATFORM[48]

The following figure provides an overview of the HOMEdotOLD network architecture.

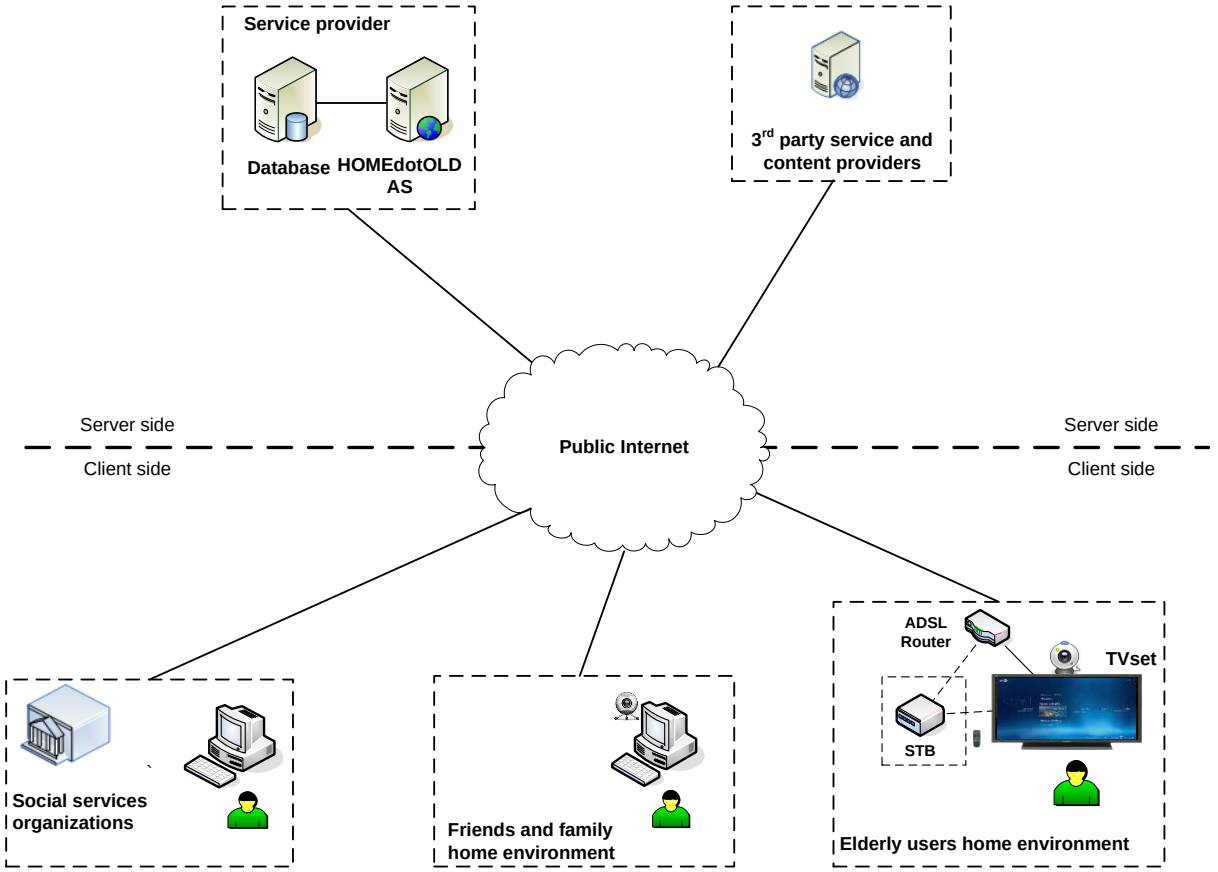

Figure 44: HOMEdotOLD Network Architecture Overview

It consists of 5 main sites including:

- **Service provider,** where the services logic and data reside.
- **3rd party service and content providers** that provide source of information for the news headlines and host the photo and video sharing servers.
- **Social services organizations** that organize and carry out social voluntary work events and notify elderly people about possibilities, by suggesting areas of social voluntary work.
- **Elderly persons/users equipped either with Philips Internet-enabled TVs or the AonTV platform (includes a STB)**, who want to advance their social interaction and improve the quality and joy of their home life. Special focus is on elderly people living far away from their families and close friends.
- **Friends and family** that want to stay connected with the elderly people.

The service provider hosts the HOMEdotOLD AS and the corresponding database with user data. The elderly home environment, the friends and family home environment and the social services organizations environment are communicating with the service provider over the

[48] http://www.homedotold.eu/

Public Internet. In cases that the HOMEdotOLD AS is part of an IPTV infrastructure, the communication between the home environment and the service provider is done over a private IP network. *Communication of the* HOMEdotOLD AS and the 3rd party service and content providers is done over the Public Internet.

The HOMEdotOLD Application Server architecture is depicted in the following diagram:

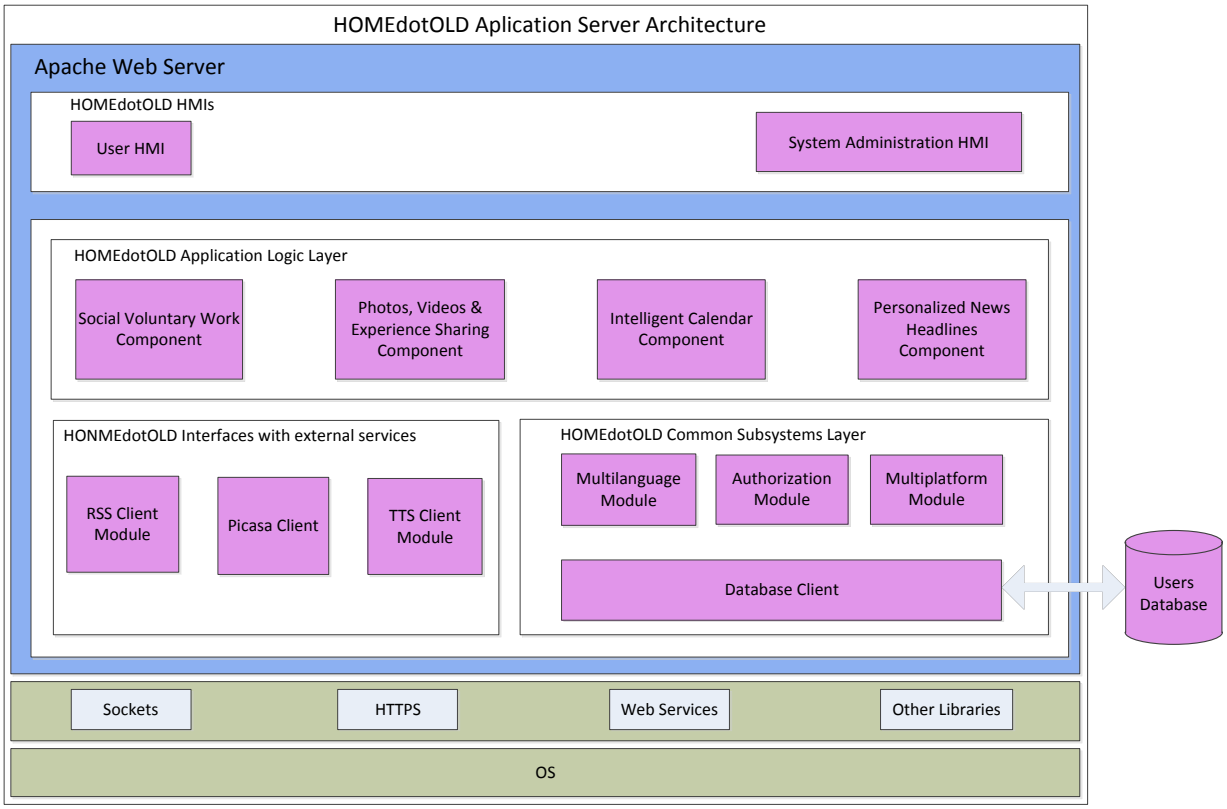

Figure 45: HOMEdotOLD Application Server Architecture

The HOMEdotOLD Application Server is composed by the application logic components, the interfaces with external services components and the common subsystems components. The interfaces with external services components implement the interfaces with the external services used by the platform. These components include the RSS Client Module, which retrieves news content from RSS sites, the Picasa Client module, which retrieves photos from the user's Google Picasa account and the TTS Client Module, which communicates with a third party TTS service to provide text-to-speech capabilities to the platform. The common subsystems components include components which are used by more than one service of the platform.

The Application Server is developed in Java Server Pages (JSP) technology and runs on top of Apache Tomcat v6.0. A MySQL database for data storage is used. The HMIS are web-based and are based on a 10-foot user interface design concept. They are compliant with Web4CE (ECMAScript v3, CSS TV Profile 1.0, XMLHttpRequest object, DOM level 2).

5.4.2 LT FRAMEWORK

The LT Framework is the result of the Assistive Technology Lab (ATLab) project[49], which is a joint project of LFTL, UoAS and Johannes Kepler University, Linz. Its primary goal is to provide a common base for developing cross-platform applications targeted at people with disabilities, who use desktop or tablet computers. The LT Framework is currently under development.

The Framework is based on Adobe AIR (see section 5.3.1), and is therefore limited to Windows, Mac OS X, Android and iOS. The terms of use depend on LFTL, as they reserve the right for commercial exploitation of this software.

The Framework currently supports input device abstraction by sending device-independent events to the application, which express the intent of the user. Input hardware-specific modules translate input into such events. This is a necessary measure to support various accessible input devices, such as push buttons, without having to modify the application itself.

The LT Framework provides an abstract way to create screen-based applications and is geared towards making simple games with sound and flash animations. It is planned to add support for storing and synchronizing user settings and content using the cloud. A completion date for this feature is not known at this time, though.

5.4.3 TWILIO[50]

As mentioned in earlier chapters, services for making phone calls and sending SMS messages might be necessary for some applications, for example to send notifications to a caregiver without having the recipient rely on an available data connection.

Competing providers for such services exist, such as Tropo[51]. None of them, however, has a reach comparable to Twilio, which currently offers voice services in 25 countries, and SMS services almost world-wide.

Twilio's features can be utilized using a RESTful[52] web service, which supports JSON and XML return values. Alternatively, the product *Twilio Client* can be used to bring full VoIP telephony functionality to Android, iOS and web browsers.

Twilio charges per use. Sending an SMS message ranges from 2 to 10 U.S. Dollar Cents (¢) in most European countries. Inbound SMS messages, where available, start at 1¢. Note that for inbound communications, a telephone number must be purchased, which comes at a low monthly fee per number. Making calls has a wider price variation, with landline calls starting

[49] http://www.lifetool.at/show_content.php?sid=658

[50] http://www.twilio.com/

[51] https://www.tropo.com/

[52] See section 5.6.1.

at as little as a few ¢, while calls to mobile networks may well cost up to 50¢ or more per minute. Incoming calls are comparably cheap, where available, starting at 1¢.

5.4.4 SUMMARY AND COMPARISON

The HOMEdotOLD platform is important for this project, as it had quite similar perspectives. The platform consists of a web based service and TV sets respectively personal computers as clients. Additionally, third party services and content provider are attached for getting additional input.

The inability of certain platforms (iOS, Windows Phone 7, Smart TVs,…) to send SMS programmatically, justifies a look into an online SMS service called Twilio. It provides interfaces for sending charged SMS almost worldwide and, important for this project, within Europe.

Due to the current development of additional features of the LT framework, it may become interesting in the future. Since the cross platform aspect was ruled out previously, the gained value of the LT framework, which is based on Adobe AIR is little at this moment.

The following two tables show a summary of the mentioned service platforms and a compatibility chart.

	HOMEdotOLD	LT Framework	Twilio
Maturity	Production-ready	In development	Production-ready
Operating Systems	Any (web-based)	Windows, Mac OS X, Android, iOS	any (uses web service)
Added Value	Personalized news, Google Picasa integration, Smart calendar, Video service	Cross platform development, Simple screen-based applications, (future) cloud-based user synchronization	Sending SMS without user interaction, complete telephony infrastructure (for notifications etc.)
Cost	-	Depends on LFTL	Pay-Per-Use

Table 18: Comparison of service platforms

Compatibility Platforms vs. Technologies	Samsung Smart TV	LG Smart TV	Philips NetTV	Google TV	SAFEVIEW STB	Apple TV	Android	iOS	Windows Phone
HOMEdotOLD	C[2]	C[2]	F	N	N	N[1]	N	N	N
LT Framework	C[2]	N	N	N	N	N[1]	F	F	N
Twilio	F	F	F	F	F	F	F	F	F

Legend: compatible (F) not compatible (N) conditional compatibility (C)

Table 19: Compatibility of service platforms

Notes:

1) No 3rd party apps officially permitted yet
2) Not officially supported

5.5 Input and Output Technologies

Technologies for input and output methods are always important when dealing with user interaction. Next to the obvious techniques, like remote controls of a TV sets or touch gestures on Smartphones, this chapter deals with the classification of basic I/O technologies. As part of this report, a number of relevant technologies were surveyed and the findings summarized below.

5.5.1 Survey and Taxonomy of I/O Technologies

Input and output technologies strongly differ in how they are used, how users perceive them, and, most of all, in their intent. The human input happens mainly through the senses and output directly through the motor control of the effectors and other senses as well. The five main senses are: sight, hearing, touch, taste and smell, where the latter two don't play a significant role in the human computer interaction (see Dix, et al., 2004). Effectors like the limbs, fingers, eyes, head, voice system and body position are important, where the fingers play the primary role for interaction with systems through mouse/remote control, typing or touch input.

5.5.2 Input Technologies

When categorizing input technology, the historic sequence of user interfaces is often used as a guideline:

1. **Command Line Interface (CLI):** Computers are controlled using text-based commands. CLIs are mostly superseded by GUIs, but still used by system administrators and enthusiasts.
   Primary input device: Keyboard
2. **Graphical User Interface (GUI):** This currently most widespread interface type enables graphical display of information in addition to a textual representation. Instead of instructing software using commands, objects on screen can be interacted directly with.

Input devices in general can be classified using following parameters (Buxton, 1983):

- Continuous or discrete
- Agent of control (hand, foot, voice, eye, body, …)
- Property being observed (position, motion or pressure)
- Number of dimensions being sensed (1D, 2D, 3D)

Devices with similar motor skills are grouped. Additionally, devices are distinguished if they are operated by touch (T) or if they require a mechanical intermediary between the hand and the sensing mechanism (M). The controlling devices of GUI interfaces that are continuous and hand controlled can be categorized as shown in Figure 46.

		Number of Dimensions							
		1		2				3	
Property Sensed	Position	Rotary Pot	Sliding Pot	Tablet & Puck	Tablet & Stylus	Light Pen	Floating Joystick	3D Joystick	M
				Touch Tablet		Touch Screen			T
	Motion	Continuous Rotary Pot	Treadmill	Mouse			Trackball	3D Trackball	M
			Ferinstat				X/Y Pad		T
	Pressure	Torque Sensor					Isometric Joystick		T

Figure 46: Taxonomy of input devices (source: Buxton, 1983)

3. **Natural User Interface (NUI):** Previous user interface paradigms all required additional hardware in order to permit the user to interact with the machine. The use of such hardware had to be learned and is in most cases highly counter-intuitive. Natural user interfaces promote the use of movements, touch, gestures, and voice to communicate with software, to make human-computer interaction as intuitive and convenient as possible.

   Primary input "device" is the human body (facilitated by Webcam, Kinect, Wii Remote, and others).

Considering that older people often have trouble adapting to modern technology, it is self-evident that NUI input provide a way for human computer interaction with a low learning curve. Two of those are described below, since they offer ways to use them in a development environment and can be important for this project. The two also fit in Buxton's classification scheme, although the agent of control shifted to the body, the dimension is 3D and the parameter observed is *position* for both techniques.

Television remote controls can be categorized as a GUI input device. Although the buttons can be compared to CLI commands, most modern remote controls feature buttons for 2D navigation, enabling control of graphical user interfaces.

5.5.2.1 MICROSOFT KINECT[53]

Figure 47: Kinect for Windows sensor (source: Microsoft Store[54])

From the various depth sensing technologies commercially available, Microsoft's *Kinect for Xbox360* (initially released in 2010), or more recently the *Kinect for Windows* is clearly the most popular. The depth image quality at the comparatively low price of the device made it popular among gamers as well as computer vision enthusiasts, who were quick to provide drivers to not only use the Kinect on its original target platform, the Xbox360 gaming console, but also on PCs.

In response to the high popularity among desktop developers and the newly discovered applications of depth sensing technology in this area, Microsoft decided to support this movement by providing official drivers and SDKs, as well as a new version of the sensor released in early 2012, specialized for use in front of a desktop PC.

Note that on its own, the Kinect doesn't provide usable input data. Computer vision algorithms and gesture/posture detection are necessary to translate the users movement to standardized input. For example, the location of the hand can be used to set the position of a cursor on screen.

Technical Capabilities and Limitations

The most prominent feature of the Kinect is the depth sensor. It consists of an infrared projector and a 320x240 infrared camera. Using triangulation, the distance of the surfaces in front of the Kinect can be measured. The effective range of the depth sensor lies between 0.8 and 4.0 meters, or 0.4 and 3.0 meters in Near Mode (supported by Kinect for Windows sensor only) (Microsoft).

The Kinect also contains an array of four microphones, which can be used for spatial noise detection and speech recognition. The system works well enough to map the currently

[53] http://www.microsoft.com/en-us/kinectforwindows/

[54] http://www.microsoftstore.com/store/msstore/en_US/pd/Kinect-for-Windows/productID.244210600

loudest noise source to the location of a person, who was previously recognized using the sensor's depth sensing capability.

Additionally, the Kinect features a 640x480 color webcam and an accelerometer.

Development

Depth data acquired from the device can be used for computer vision algorithms to detect people, gestures, faces, or any sort of structure. Popular frameworks enabling some of these tasks are:

- **OpenNI[55]:** A device-independent, highly modular open framework for Natural User Interfaces, supporting tracking of multiple users' body posture by mapping it to a "skeleton". The *NITE*[56] middleware adds elaborate support for gestures and gesture workflows. OpenNI is available for Windows, Mac OS X and Linux, and offers bindings for many programming languages.
- **Kinect for Windows SDK[57]:** Microsoft's official package contains drivers and a complete Kinect access library. Skeleton-Tracking is supported, gesture recognition, however, not. Microsoft also offers the *Kinect for Windows Developer Toolkit*[58], which enables face pose recognition. This solution is Windows-only. C++ and C# can be used for development.

Using these tools, applications can be developed, which are enabled for touch-less, natural interaction. In order to use Kinect on mobile devices or devices where OpenNI and the Kinect for Windows SDK are not supported, a separate computer supporting either of those frameworks must be present. The Kinect is connected to this computer. Specialized Software, such as KinectJS[59], exposes Kinect functionality and data via socket server to the device that needs the data. A similar approach is required in order to access the Kinect from web applications in the browser.

[55] http://openni.org/Documentation/home.html

[56] http://www.primesense.com/technology/nite3

[57] http://www.microsoft.com/en-us/kinectforwindows/develop/new.aspx

[58] http://www.microsoft.com/en-us/kinectforwindows/develop/developer-downloads.aspx

[59] http://kinect.childnodes.com/

5.5.2.2 WII REMOTE[60]

Figure 48: Wii Remote (source: Wikimedia Commons[61])

The Wii Remote, released to the public in 2006 by Nintendo, is a wireless game console input device, featuring several control buttons and an expansion slot, but also a three-dimensional motion sensor (accelerometer) and an infrared optical sensor. It uses Bluetooth for communication and has on-board speakers.

The main feature of the Wii Remote is its spatial sensing capabilities. The device can determine its orientation and position, as well as changes therein fairly accurately using the combined data of the motion sensor and the infrared sensor.

The latter, located on the far end of the Wii Remote as it's visible in Figure 48, has an effective range of up to 5 meters. It can detect infrared sources in its field of vision, such as infrared LEDs, or candle flames. This data, along with the orientation data from the motion sensor, is sent to a computer (or another Bluetooth-capable device) for processing. Using triangulation, the known distance between infrared sources can be used to determine the spatial position of the Wii Remote relative to the infrared sources.

The spatial sensing capabilities of the Wii Remote made it a pioneer in the field of natural user interaction on game consoles, leading to the release of a wide variety of Wii Remote-optimized games, making player movement a core component of gameplay. Also, a variety of hardware extensions are available for the Wii Remote for a more game-specific experience, such as Nunchuks, which provide, beside new buttons and an analog stick, an additional motion sensor for games that require tracking an additional hand.

The Wii Remote was especially well received among technical enthusiasts, leading to the creation of various "hacks", utilizing the capabilities of the device for a not originally intended purpose. The availability of sensor- and button data via Bluetooth made it ideal for things such as a universal remote control for computers, a way to control the mouse position, or a robot remote control. A list of popular examples can be found on (IDGTechNetwork).

[60] http://www.nintendo.com/wii/what-is-wii

[61] http://commons.wikimedia.org/wiki/File:Wii_Remote_Image.jpg

The original Wii Remote is available for approximately € 30.00, while a newer model, the Wii Remote Plus, which features increased precision of the motion sensor, is available for circa € 40.00.

5.5.2.3 SMART TV INPUT ALTERNATIVES

Samsung Smart TV offers a variety of alternative input options, which sets it apart from competing products. The primary input device is a minimalist touch-sensitive remote, which contains a microphone for voice recognition. Similar functionality is available on Android phones if a specialized app is installed. Similar apps exist for LG and Philips Smart TVs. To allow easier input of large amounts of text, a combined keyboard/touchpad device is part of the Samsung Smart TV package.

A camera built into the TV allows identification of users via face recognition. In well-lit conditions, hands can be used to control a cursor. On-screen items can be selected by clenching one's fist. How far the hands must move in order to reach all of the screen is adjusted dynamically. Since the hand position is available to apps as a cursor, it can be used for gesture detection.

LG Smart TVs also offer a cursor, although it's not based on hand motion itself: The remote doubles as a Wii Remote-style controller, enabling cursor control by pointing the remote at the screen.

Both approaches, Samsung's as well as LG's, appear to be rather immature at this point. (Cangeloso, 2012) and (Spector, 2012) report that those input methods offer very limited precision and noticeable lag, making them less ideal for high accuracy tasks.

5.5.3 OUTPUT TECHNOLOGIES

Output technologies can be most easily classified by the sensory stimuli they create. The most commonly stimulated sense is vision – monitors and projectors are used to provide a graphic display of information. People with strongly impaired vision rely on tactile output devices, such as Braille displays. Prototypes of output devices stimulating the olfactory or gustatory senses exist, but have not gained any popularity so far.

Older people's vision tends to be impaired because of degrading elasticity of the eye lens, cataracts, glaucoma, or other reasons. Degrees of impairment vary from person to person.

Generally, the visibility of graphic content must be improved by making text and symbols larger, or by using stronger contrast. In case of stronger vision impairment or just as a convenient feature so that people don't have to strain their eyes all the time, text-to-speech systems come into play. They allow reading text out loud in various languages.

Most text-to-speech systems are available as standalone software package as well as a web service, which makes them available on any platform, provided that the device is connected to the Internet, or a text sample was previously cached as a sound file.

5.5.3.1 FREETTS[62]

FreeTTS is a free speech synthesis system written in Java and therefore platform independent. It partially supports JSAPI 1.0 (only a subset of the javax.speech.synthesis specification). Included in the FreeTTS package is the US English voice. FreeTTS is based on Mbrola[63] and is able to import (English only) Mbrola voice files.

FreeTTS can be used as a JSAPI 1.0 Synthesizer, Remote TTS Server, Desktop engine or downloadable Web Application and any kind of self-developed Java Application including web services.

5.5.3.2 IVONA TTS[64]

IVONA is, according to (Voice Information Associates, Inc., 2011), the most accurate commercial text-to-speech solution in the market. Voices are available for, among others, Dutch, British and American English, German, Romanian, and Spanish.

SDKs are available for a great number of desktop and mobile operating systems, such as Windows, Mac OS X, Linux, Android iOS, and Windows Phone.

Alternatively, IVONA can be used as a web service via REST and SOAP interfaces. In this scenario, the text to be spoken is sent to the IVONA service as plain text, HTML, or SSML (W3C, 2010). The service responds with a sound file encoded in one of the supported audio codecs (such as MP3 or Ogg Vorbis). This file can be played back on the client device. Note that this approach requires an Internet connection. For users who don't have an unlimited data plan, excessive use of TTS might incur additional costs.

Prices for the IVONA SDK or the web services are not listed on the company homepage, as customers receive individual offers. It is known that the web service pricing is on a per-character basis.

5.5.4 SUMMARY AND COMPARISON

The detailed look at the selected I/O technologies showed some important facts to consider. A comparison of the technologies is presented in Table 20. Table 21 shows the compatibility of I/O technologies and the system platforms mentioned earlier.

When it comes to input technology, the Microsoft Kinect is one representative of a natural interface, allowing users to control systems via their body position. For usage with mobile devices or systems where the Kinect is not supported, an additional computer system - functioning as mediator - is required. The Nintendo Wii is useable on devices, allowing access

[62] http://freetts.sourceforge.net

[63] http://tcts.fpms.ac.be/synthesis/

[64] http://www.ivona.com/en/

to the Bluetooth communication. Therefore it is not as restricted in compatibility as the Kinect is. In addition, it is way cheaper.

The output technologies mentioned above are restricted to Text-to-Speech products and are therefore comparable in a direct manner. The free available voice synthesizer FreeTTS is based on Java and therefore runnable on all platforms that support the Java Runtime. It can be used as a web service but offers no SDK since it comes as Java library. IVONA is a commercial engine and runs on all major platforms including mobile systems. A SDK is available and the usage of a web service is possible. In contrary to FreeTTS, that only supports the English language, IVONA supports over 16 languages with different voices. Although IVONA has custom (individual) price plans, the Android version of the engine is available for free in the Google Play store, but still in the beta phase (So it might become commercial as well). IVONA is the favorite TTS engine because of its accuracy.

	Microsoft Kinect	Wii Remote	FreeTTS	IVONA
SDK	yes	no	no	yes
Price	Device: € 194.99[1] SDK: free	Device: € 36.75[1]	Free	custom[2]
Platforms	Windows (official) Mac OS X Linux	Windows Mac OS X Linux Android Windows Phone	All supporting Java Runtime	Windows Mac OS X Linux Android iOS Windows Phone others
Web service	via KinectJS	possible	possible	available
Additional information			English only	Support for Dutch, German, English, Romanian, Spanish and others

Table 20: Comparison of I/O technologies

Notes:

1) Price as of 2012-08-17; source: amazon.de
2) Plans and pricing are customized upon inquiry to suit the needs of the project.

Compatibility **Platforms vs. Technologies**	**Samsung Smart TV**	**LG Smart TV**	**Philips NetTV**	**Google TV**	**SAFEVIEW STB**	**Apple TV**	**Android**	**iOS**	**Windows Phone**
Microsoft Kinect	C[2]	C[2]	C[2]	C[2]	C[2]	N[3]	C[2]	C[2]	C[2]
Wii Remote	U	U	U	U	U	N[3]	F	F	F
Free TTS	C[1]	C[1]	C[1]	C[1]	C[1]	N[3]	C[1]	C[1]	C[1]
IVONA TTS	C[1]	C[1]	C[1]	F	C[1]	N[3]	F	F	F

Legend: compatible (F) not compatible (N) conditional compatibility (C) unknown (U)

Table 21: Compatibility chart of I/O technologies

Notes:

1) As web service
2) Additional computer required
3) No 3rd party apps officially permitted yet

5.6 INTEGRATION

The MOBILE.OLD project emphasizes the use of both, Smart TVs and Smartphones, in order to enhance older persons' mobility. The usefulness of the services can be increased significantly, if the implementations for Smart TVs and Smartphones are not isolated from one another, but integrated in a way that facilitates exchange of information and content, for example by transmitting content created on a Smart TV to a Smartphone, whenever the user is outside of their home.

To accomplish this goal, web services are among the preferred methods in use. The following sections present the leading technologies and paradigms used to create such software. Additionally, an approach to synchronize data between Smart TVs and Smartphones is proposed, which includes pairing devices after automatic discovery on the home network.

5.6.1 WEB APPLICATION TECHNOLOGIES

The most common way to exchange information between applications is web services. Servers offer a defined set of operations, which are accessible over a standardized protocol, such as Representational State Transfer (REST) or SOAP.

In RESTful web services, HTTP requests are used to make service calls. The URL normally defines what data to operate on. The HTTP method defines the operation. It is up to the implementation of the web service to decide, which HTTP method causes what kind of action, it is, however, encouraged to abide by the semantics of the HTTP protocol. The format of the transmitted data, aside from the components required by the HTTP protocol, is not standardized. Commonly used formats are XML, JSON, and YAML. For things such as news, established specialized XML dialects like RSS or Atom are a reasonable choice. Being HTTP-based, RESTful web services can utilize the protocol's inherent caching and security (SSL) mechanisms.

Although HTTP is usually used for SOAP web services, SOAP can use any protocol for transport. The available operations are defined in the WSDL file, which is an XML file containing the call interfaces of all available service operations. Calls to the web service and responses are structured as XML documents. The standardized XML definition of interfaces and classes in the WSDL file allows for automatic proxy generation on the client side for some technologies.

SOAP represents requests and data in a very standardized way. This, however, leads to larger amounts of data that has to be transferred over the network, leading to higher power consumption and longer response times. REST, on the other hand, leaves the representation of data to the developer, normally leading to more compact, but less standardized structures.

On the server side, a web service generally has three layers:

1) **Relational database:** Stores data, regulates concurrent access, and manages integrity of data and relations. Data can be accessed and modified using the Structured Query Language (SQL). Since database communication is performed over a network socket, all technologies are compatible with any database. Major vendors, such as Oracle, MySQL, or PostgreSQL, also provide specialized software packages for accessing the database for all important technologies.
2) **Data Access Layer (DAL):** Available data types, features, and even SQL vary between different database vendors. To allow switching to a different database type in the future, and to keep higher layers free of SQL, the DAL is introduced.
3) **Business Logic:** This layer can be compared to the web service interface. Business Logic methods implement certain high-level operations a user of the web service might want to perform.

In the next few sections, the currently most popular technology stacks for developing web services are shown. Please note that, due to the layered nature of well-written web service architectures, some components are interchangeable. An overview is provided at the end.

5.6.1.1 JAVA PLATFORM, ENTERPRISE EDITION (JAVAEE)

In large corporations, JavaEE enjoys high popularity for web application/-service development. Reasons for that are, among others, the high security, scalability and performance of the Java Virtual Machine (JVM), and the availability of existing mature, industry-proven software for a variety of purposes.

JavaEE web applications are based on servlets, which are small programs handling HTTP requests. Higher level web application technologies such as JSP are based on servlets. APIs for SOAP (JAX-WS) and RESTful web services (JAX-RS) are available.

Web applications and -services are packaged in web archives and can be deployed on an application server. Numerous application servers are available, both open source and proprietary. A selection of popular examples is provided in section 5.6.1.4.

JavaEE, despite its general popularity in the enterprise sector, is often criticized for its verbosity, over-engineered architectures, and the comparatively large footprint of small applications due to application server overhead.

5.6.1.2 **ASP.NET**

Microsoft's ASP.NET is the successor of ASP. Contrary to ASP, which was a server-side scripting language, ASP.NET offers the full feature set of the .NET framework, including Windows Forms-style creation of user interfaces that allow event-driven interaction.

The creation of SOAP web services is directly supported by ASP.NET. For RESTful web services, the Windows Communication Foundation (WCF) can be used.

Being based on Microsoft's proprietary software, ASP.NET applications can only be deployed on a Microsoft Internet Information Services (IIS) server.

5.6.1.3 **FASTCGI**

FastCGI is the successor to CGI. Both have in common that parameters and payload of an HTTP request are passed to a program written in almost any programming language – the program's output would be served as a HTTP response to the user. The problem with CGI was that for each request, the program was started in a new process. FastCGI programs, however, must be written in a way that supports handling multiple independent requests in sequence. This leads to a performance improvement by factor 5 compared to CGI (Open Market, Inc., 1996).

Essentially, FastCGI is a convention of how to write a program. The HTTP-Method, -URI, -headers, and –payload are transmitted over a local pipe or a TCP connection (CGI used environment variables, process parameters, and standard input). The FastCGI process is expected to return a valid HTTP response the same way. Since these methods of communication are supported by almost any programming language. Some web-related frameworks and libraries provide higher-level wrappers around FastCGI to make development easier.

5.6.1.4 SUMMARY

The table below lists application servers, programming languages, and relational database management systems compatible with the technologies presented above.

	Application Server	Programming Languages	Databases
Java Enterprise Edition	GlassFish IBM WebSphere JBoss Tomcat	Java Clojure	any JDBC compliant database
ASP.NET	Microsoft IIS	C# F# VB.NET	any database with an ADO.NET provider
FastCGI	Apache Microsoft IIS Lighttpd Nginx	any	depends on language

Table 22: Technologies related to JavaEE, ASP.NET, and FastCGI

5.6.2 INFORMATION EXCHANGE BETWEEN SMART TVS AND SMARTPHONES

Synchronization of information between different devices constitutes significantly improved user experience. Seamless transmission of information from the Smart TV to the Smartphone or vice versa allows for frictionless switching between devices. Scenarios where this is an advantage would be, for example, automatically pushing a route that was planned on the TV to the phone to use navigation on the go, or to send geotagged pictures of landmarks from a previous vacation from the phone to the TV.

Interoperability and data exchange between different devices and applications is improved. Thus, older persons can perceive the functionality provided by Smart TVs and Smartphones as one thing, reducing the confusion of using different devices to accomplish a task.

The following sections discuss technologies and concepts that can be used to accomplish this task.

5.6.2.1 LINK TECHNOLOGIES

If the user wants to transfer content from a Smart TV to a Smartphone, or the other way round, a suitable way to connect those devices needs to be available. In our networked age, a wide variety of technologies is available for this purpose, but support for them is limited on many devices. The following table lists relevant connection methods and their availability across the Smartphones and Smart TVs. The list is based on (TechMediaNetwork.com, 2012) and (TechMediaNetwork.com, 2012)

Technology	Smartphone Availability	Smart TV Availability
Bluetooth	3	1
Ethernet LAN	0	4
Mobile data (GPRS, EDGE, UMTS, HSDPA, LTE)	4	0
Near field communication	1; common in recent devices	0
USB	2; not available to apps[65]	4
Wireless LAN (IEEE 802.11 a/b/g/n; WiFi)	4	4

Legend: ubiquitous (4) majority (3) available, but unusable (2) minority (1) (close to) none (0)

Table 23: Availability of various connectivity technologies across Smartphones and Smart TVs

The table above indicates that the local network has the highest chance of availability, being available via Wireless LAN on Smartphones, and Ethernet or Wireless LAN on Smart TVs. As a fallback, transmitting the data over the Internet, using a cloud service as mediator, is an option.

5.6.2.2 Architectural Concept and Available Technologies

The basic idea is to transmit data over the network. There are two likely scenarios of how the devices are set up, illustrated in Figure 49. On the left, the devices are connected to the same local network using WiFi, for example. Alternatively, as displayed on the right, they might exchange data over the Internet, using a dedicated synchronization service as mediator.

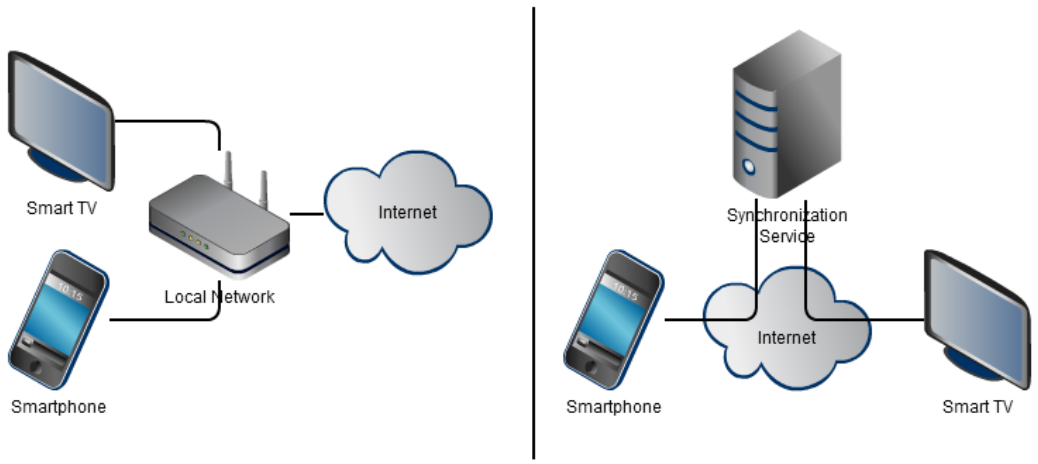

Figure 49: Possible network scenarios

While in the first scenario, the devices can be identified using their MAC address, this information is not available. Thus, a way to identify devices is necessary, so that the synchronization service can notify the correct device. Such a method of identification might be

[65] Apps cannot use USB to communicate with USB devices in general. Only devices developed specifically for use with Android devices, complying with the Android Open Accessory protocol, can be accessed from within apps (Google, 2012).

a Google Account associated with the device, or a GUID, which is assigned by the synchronization service when first contacted by a device.

The existence of the device could not only be announced by manually entering the device ID, but also through discovering devices on the local network, using technologies such as Universal Plug and Play (uPnP) or Zeroconf. Both are technologies which allow devices to announce their existence and purpose on the local network, in order to provide its services to others.

Even if the target device's ID is known by the device that wants to send data, it is a hassle to select and authorize the target device for each transfer. It is therefore desirable to introduce a "handshake" to permanently pair two devices, so effortless communication is possible in the future. A concrete implementation might involve a QR code or a PIN displayed on one of the devices and entered on the other to confirm the intent to pair exactly those devices.

For future connections, it is important to authenticate the devices to avoid impersonation attempts of malicious third parties. This can be accomplished using asymmetric encryption: A public/private key pair is generated by each device during the handshake, and the public keys are exchanged. Future communications are signed using the private key, and possibly encrypted to protect sensitive information, such as personal data or medical records. To avoid malicious abuse of stolen or lost devices, the synchronization service could host a revocation list, which could allow cancellation of pairing to protect the user's privacy. An existing solution with those features is GnuPG[66], which implements the OpenPGP[67] standard.

Figure 50 shows the typical process of sending data from a Smart TV to a Smartphone. All major Smartphone platforms provide a method of sending push notifications, which are small pieces of data, ranging from several bytes to a few kilobytes in size, sent from a push notification server to the phone in order to wake up a dormant application. Since the data to be transmitted is usually larger than the maximum size of a push notification, the recipient fetches the actual data from a server. As opposed to polling, push notifications conserve power because the target application can remain dormant until a notification arrives, and does not use CPU cycles and wireless network connections. The following technologies for push notifications exist on platforms possibly relevant to the MOBILE.OLD project (Willbanks, 2011):

- Android Push Notifications (C2DM; deprecated)
- Google Cloud Messaging (for Android; succeeds C2DM)
- Apple Push Notifications (APNS; for iOS)
- Microsoft Push Notifications (for Windows Phone)

[66] http://gnupg.org/

[67] http://www.ietf.org/rfc/rfc4880.txt

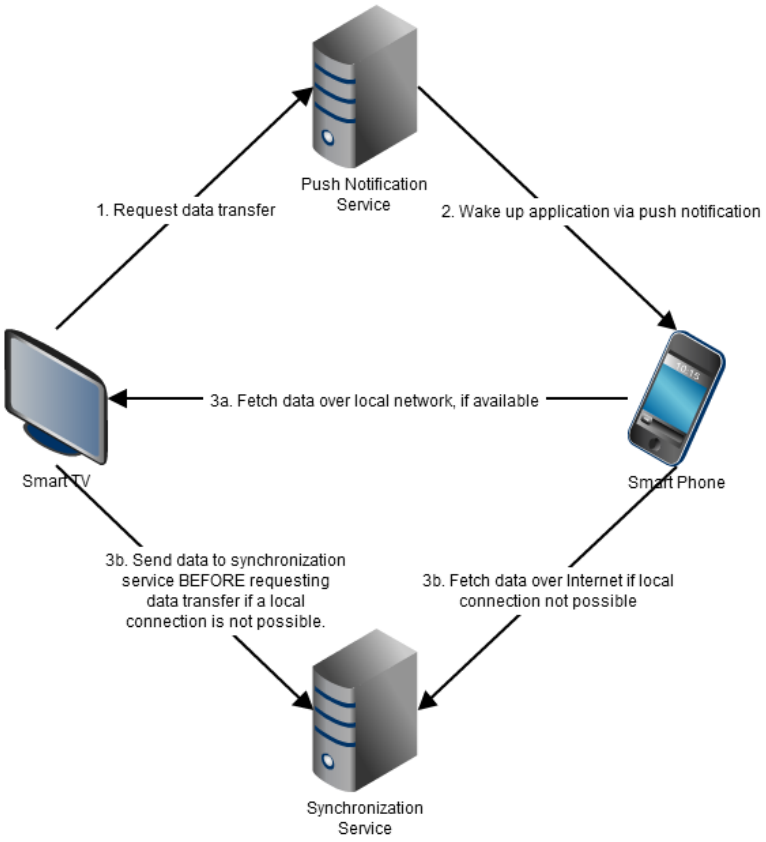

Figure 50: Sending data from the Smart TV to the Smartphone

The process illustrated in Figure 50 mentions direct transmission of data over the local network. To make this possible, one of the devices must host a server the other device can connect to. Due to the problem arising from the fact that not all platforms might provide the possibility to host a server, this option could be omitted in favor of always sending data over the synchronization service, which would simplify implementation significantly, but require an available Internet connection.

Note that the process is similar for sending data the other way, the main difference being that Smart TVs do not necessarily support push notifications, which requires them to poll the synchronization service for new data. Polling is only a problem for devices with limited battery life, though – devices connected to the power grid, such as TVs, do not have this issue. Polling, however, is more data transfer intensive, depending on how often the synchronization service is polled, which poses a problem for users with a limited transfer volume Internet connection. The polling interval must be adjusted accordingly, while considering that push notifications arrive only after a delay of 1 to 3 seconds (Willbanks, 2011).

A viable alternative to polling is, if available on a platform, WebSocket[68] technology, which is currently on track for standardization. The WebSocket protocol is similar to HTTP and is

[68] http://www.ietf.org/rfc/rfc6455.txt

intended for socket-like bi-directional network communication for client-side web applications. It can be used in areas outside of web applications too, though. Although WebSockets are not part of the HTML5 standard, the term HTML5 in the broader sense includes various emerging web technologies – WebSockets among others.

5.6.2.3 EXISTING SOLUTIONS

At this time, there is no software available featuring all of the aspects mentioned above. There is, however, partial solutions with the potential to be expanded.

Google offers the open source **Chrome to Phone** extension[69], which consists of an Android app and an extension for the Google Chrome browser, which allows sending information on a website that has been previously marked using the mouse to the mobile phone at the push of a button. The phone then opens the transmitted data with the appropriate application.

Chrome to Phone is available under the Apache License 2.0, which permits modification and commercial use. The downside of this product is that data can only be sent in one direction from the browser to the phone.

Sharing websites in the other direction, from phone to browser, is possible using **Send to Computer**[70]. Using Android's share function, browser content can be displayed on a computer which has been previously paired with the Smartphone using a QR code, in a similar manner as described 5.6.2.2. In order to automatically open a transmitted web page, a certain URL must be opened in the browser[71]. The service mediating the transfer is cloud-hosted on Google AppEngine.

The project is available under the GNU GPL v2 license, which requires all modifications to be open-sourced, as it is a strict copyleft license.

Although the solutions mentioned above are targeted at Smartphone/Browser communication, they can be adapted to be universally accessible using web services.

5.6.3 SUMMARY

In order to exchange data using a web service, the SOAP and RESTful web services can be implemented. The key advantage of SOAP is its strictly defined XML format, which, on the downside, introduces high verbosity and size of the transferred data. RESTful web services on the other hand are leaner thanks to utilizing all features of the HTTP protocol. The format of the transferred data is not standardized, though, and varies from service to service.

[69] http://code.google.com/p/chrometophone/

[70] http://code.google.com/p/share-to-browser/

[71] http://send-to-computer.appspot.com/

The most popular choices in the enterprise sector for implementing web services are Java EE and ASP.NET. Other technologies are popular especially in Internet-centered companies of all sizes.

Synchronization between Smart TVs and Smartphones can be done over the network using push notifications and, if the former is not available on a platform, polling and WebSockets. The data to be transmitted is actually sent to a transmission server, so the target device can fetch it once it receives the notification. Products implementing parts of this architecture exist, but there is not complete solution to date.

5.7 CONCLUSIONS

The state-of-the-art analysis concentrates on existing and similar platforms in general, mobile platforms, TV-based solutions and the possible integration of them. The survey of mobile platforms exposed Android as the system that fits most, because it supports the majority of the proposed features out of the box and features can be adapted easily to own needs. A survey of Smart TV platforms compared the different types and representatives in this category. This research area reaches from set-top-boxes to middleware systems to internet-enabled TVs. An analysis of representatives of all categories revealed the potential of all devices, but also the restrictions. When it comes to the development, the majority of the platforms are using web based standards like HTML5, CSS or JavaScript or any related languages. The decision for a platform is yet to be made and not an easy one. The choice for a platform also depends on the willingness to use a cross platform approach, although it was ruled out because of the massive drawbacks compared to the gained value. The HOMEdotOLD service platform is important as it is a predecessor of this project. It offers a web-based service that can be accessed via an internet-enabled TV or a PC. It offers input of content providers. A second mentioned framework that could be important is the LT Framework, developed at LFTL in cooperation with UoAS. Although it is currently in development, it might become interesting in near future. The last mentioned service platform is Twilio. It offers a paid web service for sending SMS. When it comes to usability and software for the elderly, the input and output technologies are important to consider. Therefore different I/O channels were described and compared. This includes the Microsoft Kinect, the Nintendo Wii as input devices and FreeTTS and IVONA as text-to-speech engines. The favorite of the TTS-engines is IVONA, as it is widely used, comes as web service or native API version and supports multiple languages.

6 TECHNICAL REQUIREMENTS

Technical requirements are identified by unique identifiers that shall remain constant during the full development process. The pattern is MOBILE.OLD-<Category>-<Number>, where <Category> is a letter identifying the category of the requirement and <Number> a unique number for the category. The categories are:

A……..General Architectural and Equipment Requirements

C……..Connectivity and Communication Requirements

I……..User Interface Requirements

S……..Security Requirements

T……..Technological and Development Requirements

Each requirement is placed in a table respecting the following template:

Requirement Id	Requirement text
	Requirement rationale
	Requirement example

6.1 GENERAL ARCHITECTURAL AND EQUIPMENT REQUIREMENTS

MOBILE.OLD-A-1	The MOBILE.OLD service infrastructure should be based on the public Internet.
	The home and mobile environments should include Internet connectivity.

MOBILE.OLD-A-2	An Internet enabled TV or an STB shall be able to be used as user terminal in the home environment.
	A mechanism is needed for accessing web-based services through the TV. This functionality can be provided by an Internet enabled TV or an STB connected to a conventional TV set.

MOBILE.OLD-A-3	A smartphone device shall be able to be used as user terminal.
	The smartphone device shall be able to run native applications that access web-based services.

MOBILE.OLD-A-4	Remote Control or equivalent input devices shall be used for service access and navigation in the home environment.
	A standard remote control input device should be available for web-based services navigation.

MOBILE.OLD-A-5	Touch input functionality shall be used for service access and navigation in the mobile environment.
	The smartphone device shall feature touch input functionality.

MOBILE.OLD-A-6	Connection to server for data and user preferences store.
	All user generated data along with user preferences should be stored at an external application server.

MOBILE.OLD-A-7	The service logic shall be implemented by the MOBILE.OLD Application Server (AS).

MOBILE.OLD-A-8	Service access shall also be provided over PC/laptop, particularly for friends, family and caregivers.
	Dedicated HMIs providing similar and administrative functionality but from standard PC/laptop environment.

MOBILE.OLD-A-9	GPS functionality supported by the smartphone device.
	The smartphone device shall support GPS for the Location Based Services.

6.2 CONNECTIVITY AND COMMUNICATION REQUIREMENTS

MOBILE.OLD-C-1	Data cache in mobile environment.
	The data fetched from the Internet should be cached locally in the mobile client in order to compensate for connectivity issues.

MOBILE.OLD-C-2	Web-based service access in the home environment.
	The services shall be implemented according to web standards (e.g. HTTP) for accessing from the home environment.

MOBILE.OLD-C-3	The content should be retrieved from the sources upon request.
	The content will be up to date only if it is retrieved when the user requests it.

MOBILE.OLD-C-4	Content sources should be configurable from the mobile and home clients.
	Configurable content sources will allow the provision of targeted content for each user.

MOBILE.OLD-C-5	The MOBILE.OLD Application Server shall send notification messages to the home and mobile client.
	Notification messages shall be sent according to specific services requirements.

6.3 USER INTERFACE REQUIREMENTS

MOBILE.OLD-I-1	The MOBILE.OLD application must include a graphic user interface for configuring the profile and preferences of the elderly in the Transportation News Headlines.
	Determine user preferences.
	See scenario nr 1.1 in Personalized transportation news headlines section.

MOBILE.OLD-I-2	The MOBILE.OLD application must include a graphic user interface on the TV and on the smartphone for displaying the news information about the trip selected by the elderly.
	Inform the elderly about his or her trip.
	See scenario nr 1.1 in Personalized transportation news headlines section.

MOBILE.OLD-I-3	The MOBILE.OLD application must include a graphic user interface on the TV and on the smartphone for sending and receiving text messages.
	Allow elders to communicate on trips and incidents using text messages.
	See scenario nr 1.1 in Personalized transportation news headlines section.

MOBILE.OLD-I-4	The MOBILE.OLD application must include a graphic user interface for displaying an overview of the current news headlines on the transportation based on elder's preferences (without selecting a certain trip). This feature must be available on smart TV and smartphone.
	Inform the elders about news headlines on the transportation.
	See scenarios nr 1.2 and 1.3 in Personalized transportation news headlines section.

MOBILE.OLD-I-5	The MOBILE.OLD application must be able to identify the position of the elder and display details about it on a graphic user interface.
	Inform the elders about their position.
	See scenario nr 2.1 in Trans-national journey planning section.

MOBILE.OLD-I-6	The MOBILE.OLD application must include a graphic user interface for translating sentences to foreign languages.
	Help elders to communicate during trans-national trips.
	See scenario nr 2.2 in Trans-national journey planning section.

MOBILE.OLD-I-7	The MOBILE.OLD application must inform the elder when he or she deviates from the planned route.
	Self-explanatory.
	See scenario nr 3.1 in Geofencing section.

MOBILE.OLD-I-8	The MOBILE.OLD application must alarm the elder (sound, vibrate and display a message on the smartphone) when he or she is heading to a hazardous area.
	Self-explanatory.
	See scenario nr 3.2 in Geofencing section.

MOBILE.OLD-I-9	The MOBILE.OLD application must include a graphic user interface that allows the elder to insert its destination point (the name of the building or its address). After that MOBILE.OLD geofencing feature displays on the smartphone screen a map where are marked the intermediate points (that should be passed in order to get to the destination point), the older person current position and a photo with the next intermediate point (if available).
	Assist the older person to get to a certain location of the journey.
	See scenario nr 3.2 in Geofencing section.

MOBILE.OLD-I-10	The MOBILE.OLD application must include a graphic user interface on the TV that displays the proposed physical exercises based on the profile the older person entered and the selected trip.
	Self-explanatory.
	See scenario nr 4.1 in Physical training section.

MOBILE.OLD-I-11	The MOBILE.OLD application must include a graphic user interface that displays the older person performance after he or she has finished a physical exercise.
	Provide a statistic analysis about old person physical exercises.
	See scenarios nr 4.1 and 4.2 in Physical training section.

MOBILE.OLD-I-12	The MOBILE.OLD application must include a graphic user interface on the TV and on the smartphone that simulates the process of buying a ticket for bus, train etc.
	Self-explanatory.
	See scenario nr 5.1 in Orientation and mobility training section.

MOBILE.OLD-I-13	The MOBILE.OLD application must include a graphic user interface on the TV and on the smartphone that allows the older person to create, edit and view a check list of things that are needed during a journey.
	Self-explanatory.
	See scenario nr 5.1 in Orientation and mobility training section.

MOBILE.OLD-I-14	Elderly shall be provided with a graphical user interface for geotag pictures during a journey using the smartphone.
	Self-explanatory.
	See scenario nr 5.1 in Orientation and mobility training section.

MOBILE.OLD-I-15	Elderly shall be provided with a graphical user interface for displaying on a map the geotagged photos and looking at them, using the smart TV.
	Self-explanatory.
	See scenario nr 5.1 in Orientation and mobility training section.

MOBILE.OLD-I-16	The MOBILE.OLD application must include a graphic user interface that measures in real-time the distance and time passed during a journey.
	Provide a statistic analysis about old person journey.
	See scenario nr 5.1 in Orientation and mobility training section.
MOBILE.OLD-I-17	The MOBILE.OLD application must include a graphic user interface on the TV and the smartphone that provides information about first aid issues (videos, tips, quiz).
	Self-explanatory.
	See use-case nr 5.3 in Orientation and mobility training section.

MOBILE.OLD-I-18	The MOBILE.OLD application must include a graphic user interface on the TV and the smartphone for playing memory and quiz on traffic signs.
	Self-explanatory.
	See use-case nr 5.4 in Orientation and mobility training section.

6.4 SECURITY REQUIREMENTS

MOBILE.OLD-S-1	All data between the Application Server and the clients must be encrypted.
	Data encryption will prevent man-in-the-middle attacks.

MOBILE.OLD-S-2	Login will be required to access the services. Option to remember the login details shall be available.

MOBILE.OLD-S-3	User location data should be shared with interested parties (family, caregivers, etc.) on a need to know basis only.
	Sharing of user moving patterns can introduce additional security concerns.

MOBILE.OLD-S-4	3rd parties (families, caregivers, etc.) should login to the service in order to access user data and information.

MOBILE.OLD-S-5	User data in the database shall be protected from unauthorized access.

6.5 TECHNOLOGICAL AND DEVELOPMENT REQUIREMENTS

MOBILE.OLD-T-1	Remote automatic software update
	The software in the clients should be able to be updated automatically.

MOBILE.OLD-T-2	The MOBILE.OLD platform shall use a database to store user data.

MOBILE.OLD-T-3	The MOBILE.OLD platform shall use an application server in order to host the services application logic and database.

7 CONCLUSIONS

The objective of this document is to find the user requirements in a user centered way. In addition, a state-of-the-art analysis provides insight into useful technologies and frameworks. On this basis, the technological requirements are extracted and can be used for design and evaluation purposes.

Based on a user centered process, the initial user requirements analysis was performed early in the project. With the use of use cases, application scenarios, and personas, interviews were performed, including a first impression of a mobile device in action. The insights of these interviews where fed back into the use cases and application scenarios in order to consider and include the users' needs. The results are a number of user requirements that are important during the following system specification process.

In order to compare the MOBILE.OLD project with existing services, a market survey was performed and discussed in chapter 4. There is a lack of commercial products and MOBILE.OLD type of services and applications in the market. Nevertheless, there is a broad range of similar and comparable products and services, both commercial and non-commercial ones.

The state-of-the-art analysis showed technologies and devices needed and/or interesting for the project. The section covers general, related project, mobile and Smart TV platforms. In addition I/O technologies and techniques for interaction were mentioned. The compatibility of all these technologies is strongly dependent on the hardware and has to be considered if they are going to be used.

The technical requirements emphasize technical measures to facilitate ease of use and frictionless user experience.

List of Figures

List of Tables

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ANNEX I: INTERVIEW GUIDELINE FOR USER REQUIREMENTS COLLECTION

MOBILE.OLD
Interview Guideline

User Requirements Capturing Process August 2012

Contents:

Short introduction of the MOBILE.OLD services (freely held)

1. Personal questions
2. Questions about communication devices
3. Questions about everyday life preferences
4. Open questions regarding Mobility
5. Rating of the MOBILE.OLD services

Discussion of the use-cases and scenarios with the users

User tests with simple game apps on Smartphones with a 5, 3” and a 4, 3” screen

1. Personal Questions

(1) What is your age?

(2) Can you describe your household?

(3) Can you describe your health situation?

(4) Can you describe your mobility situation?

2. Questions about communication devices

(1) Which of the following devices do you own?

- ☐ TV (Smart TV, Flat TV, Tube TV)
- ☐ Computer or Laptop with Internet
- ☐ Mobile phone (Smartphone)

(2) How often do you use these devices?

(3) If you own a computer for what do you use it?

(4) If you have a mobile phone, for what do you use it, (SMS, receiving calls, actively calling, photos, internet, etc...)?

(5) Do you suffer of any barriers/difficulties concerning the usage of these devices?

(6) What do you consider positive/negative aspects of the TV?

(7) What do you consider positive/negative aspects of the Computer/Laptop?

(8) What do you consider positive/negative aspects of the mobile phone (Smartphone)?

(9) Do you use teletext on your TV?

(10) Would you prefer to control the application on the TV via remote control or keyboard/mouse?

(11) Do you like to try out new technology and devices? Why not? Why yes?

3. Questions about everyday life preferences

Open questions: To what extent do you prefer the following social activities?

(1) Call and talk with a friend/relative on the phone

0 1 2 3 4 5 6 7 8 9 10

Not at all Moderately Completely

(2) Face to face contact with a friend/relative

0 1 2 3 4 5 6 7 8 9 10

Not at all Moderately Completely

(3) Participate in sport activities

0 1 2 3 4 5 6 7 8 9 10

Not at all Moderately Completely

(4) Go on a journey abroad

0 1 2 3 4 5 6 7 8 9 10

Not at all Moderately Completely

(5) Go visit friends/relatives

0 1 2 3 4 5 6 7 8 9 10

Not at all Moderately Completely

4. Open questions regarding Mobility

(1) How would you describe your level of mobility? 1-10

(2) For what kind of activities do you plan your travels? (hiking, visiting friends/family, shopping, etc...)?

(3) What are the most common destinations for your travels?

(4) Do you also travel abroad to other countries?

(5) What kind of transportation do you use (car, public transport, train, bus, plane, bicycle, walking, etc...)?

(6) How do you prepare for a trip?

(7) How do you plan your route?

(8) How do you orient yourself during the trip?

(9) Do you tend to forget items which you need when you on a journey?

(10) Do you suffer of any physical problems hampering mobility in your daily routine (walking, stairs, driving car etc...) ?

(11) Would you like to improve your physical shape to maintain your mobility?

(12) Where do you buy your ticket? Do you use ticket vending machines?

(13) Where do you plan your travels (tourist office, internet…)?

5. Rating of the MOBILE.OLD services

Here is the list of services that the MOBILE.OLD-System could provide. Assuming each service would be very easy to use, please rate how interesting they would be for you!

Function	***Very interesting***	***Fairly interesting***	***Un-interesting***	***Don't know***
A personalized access to transportation news headlines which will allow you to be informed about roadworks, problems and /or potential strikes in public transportation, trains, airports etc...				
A transnational journey planning which will provide information on how a specific destination can be reached, given a specific location. Such information shall include the different possibilities for transportation means, timetables, guidelines in changing transportation means, ticket issuing, hotels on location etc...				
A service which will automatically notify your family or friends in case you are lost.				
A physical training service which is based on your individual physical status consisting of a virtual trainer that proposes several physical exercises on the TV.				
A virtual ticket printer application which allows you to do exercises on ticket buying.				
A checklist application which allows you to create various checklists for vacation, shopping etc...				
A first aid application which allows you to get information on behavior patterns in various cases of emergencies (including video lessons).				
A memory and quiz on different traffic signs.				

A orientation application which helps you to navigate to the next points of interest (toilets, restaurants, cash machines…) when you are at the airport, train station etc…

An application which allows you the viewing of pictures (which you have made earlier on with the Smartphone) on the TV over a map.

An application which allows to track your hiking, biking and dander activities on the TV over a map.

An application that would give updated information on the weather related to your trip.

For each of the above services, please tell us:

- in which cases would you use it?
- how often would you use it?
- what would be a necessary pre-condition for using it (e.g. that it is safe, that it is confidential, easy to use, etc...)?
- would you recommend it to your friends / family?
- would you pay for it? If yes, how much would you accept to pay?

