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ABSTRACT

This document contains the usability, programmability and technological evaluation results of the first testing activity. Moreover, an analysis of collected data is performed and some improvement suggestions are provided for the OPEN Migration Service Platform.

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1. INTRODUCTION

In this document the results of the usability, the technological and the programmability evaluations performed during the first testing iteration in the OPEN project are described. As explained in D6.4, the second testing iteration is foreseen for the competition of the OPEN development lifecycle. An accurate analysis of the collected data has been performed, with some improvement suggestions for evaluated prototypes and OPEN Migration Service Platform modules.

This document is made of three main sections:

- Usability Evaluation Results. This chapter contains the results of performed usability exploratory studies and assessment tests.
- Programmability Evaluation Results. This chapter contains the results of performed programmability validation tests and a theoretical analysis of the Server Side Application Logic Reconfiguration module.
- Technological Evaluation Results. This chapter contains the results of performed technological evaluations.

Testing methodologies and test plans described in D6.4 have been applied.

2. USABILITY EVALUATION RESULTS

During the OPEN project development cycle, as described in D6.4, three usability evaluations have been scheduled: an exploratory study, an assessment test, and a validation test (Figure 1).

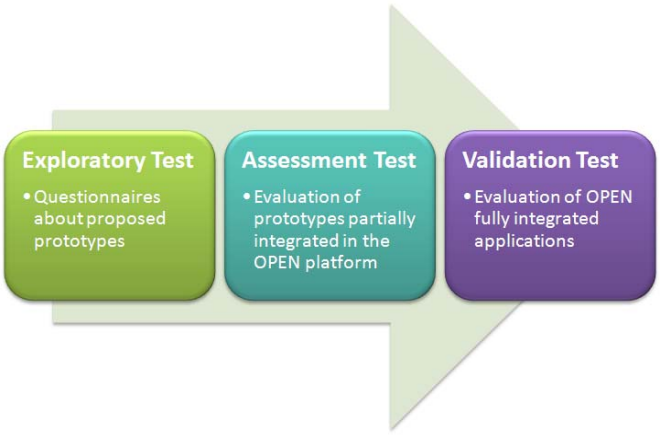

Figure 1: Usability evaluations during the OPEN project development cycle

For the first iteration it was planned to carry out different exploratory studies and assessment tests.

During the **exploratory** study the design of two prototypes, described in D5.1, has been taken into account: Social Game and Emergency. Questionnaires described in D6.4 have been proposed to two selected groups of users. Furthermore, a study has been carried out to review the requirements of the OPEN project described in D1.1. The results of this preliminary study have been used for the elicitation of OPEN final requirements (D1.3).

Assessment tests are conducted either early or midway into the product development cycle, usually after the fundamental or high-level design of the product has been established [HUT]. The objective of this test is to evaluate the user's feelings about the product during the execution of realistic tasks. During this test the following prototypes have been taken into account: Web Migration with Device Selection Map (D2.1 and D3.2), Social Game (D5.2), and Emergency (D5.2). Test plans described in D6.4 have been applied.

This document contains the results of the exploratory study and the assessment test. The **validation** test will be performed on the final version of prototypes, when the OPEN Migration Service Platform and applications development will be completed.

All tests that require the involvement of real users have been carried out by Vodafone employees.

2.1. FROM D1.1: OPEN REQUIREMENTS

2.1.1. INTRO

The Exploratory Study starts verifying if the elicitation of the applications and the platform requirements were carried out taking into account usability aspects. This is done analyzing the D1.1 "Requirements for the OPEN Migration Service Platform", in which the requirements and the methods used for obtaining them is described. The analysis of the deliverable followed the guidelines of the User Centered Design (UCD) approach and highlighted some guidelines for the D1.3: this deliverable, in fact, finalized the requirements for the OPEN Migration Service Platform.

2.1.2. D1.1 EVALUATION: UCD

D1.1 had the purposes of both share with the consortium an initial set of requirements and define the process about how an agreement on this set can be methodologically reached.

The requirements elicitation process was mainly influenced by:

1. The VOLERE methodology by Robertson/Robertson, describing the templates used for the initial requirements
2. The RESCUE methodology by Maiden et. al., inspiring a scenario-driven set-up of the requirements
3. The work of Ben Achour on formally composing, checking and varying scenarios for requirements analysis

To analyze the deliverable in a UCD approach, it is necessary to verify if the needs, wants, and limitations of the end user are given extensive attention at each stage of the requirements design process: this is the basic usability evaluation that can be performed about it.

The deliverable seems to follow this approach since the beginning, since the set of requirements was shaped taking into account user-centered scenarios (each scenario has been described from the end user perspective). The approach from the work of Ben Achour has been useful to define very concrete scenarios, related to different real situations for the end user (e.g. the surgeon in D1.1).

But a key point for the evaluation has been absolutely the organization of a workshop for the scenarios listing and the requirements elicitation: this is a typical process during the design and development phase, with the effect of also improving the overall usability of an application, a product/service and so on.

Some images from the workshop can be quite explicative about the approach that has been followed:

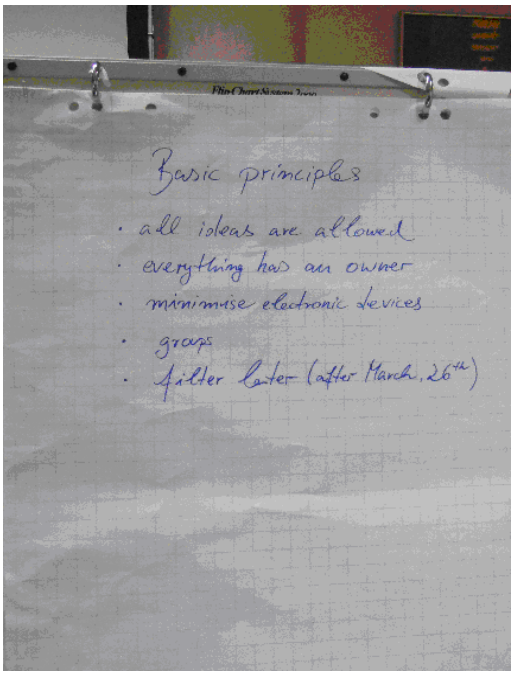

Figure 2: Workshop guidelines, foreseeing no strict constraints, but only indications

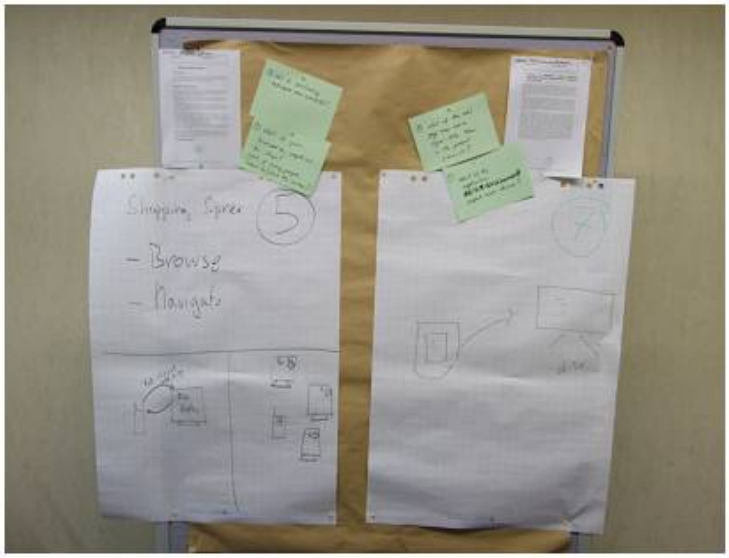

Figure 3: Characterizations of the scenarios

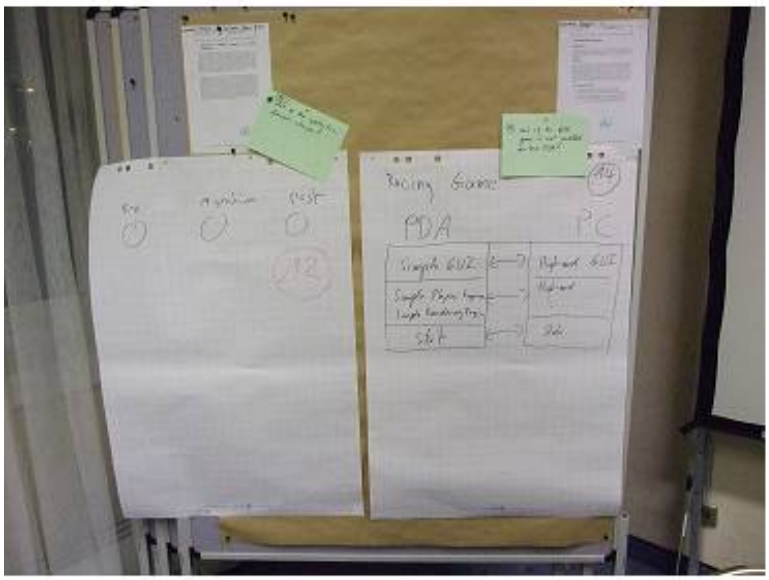

Figure 4: Different devices in the analysis

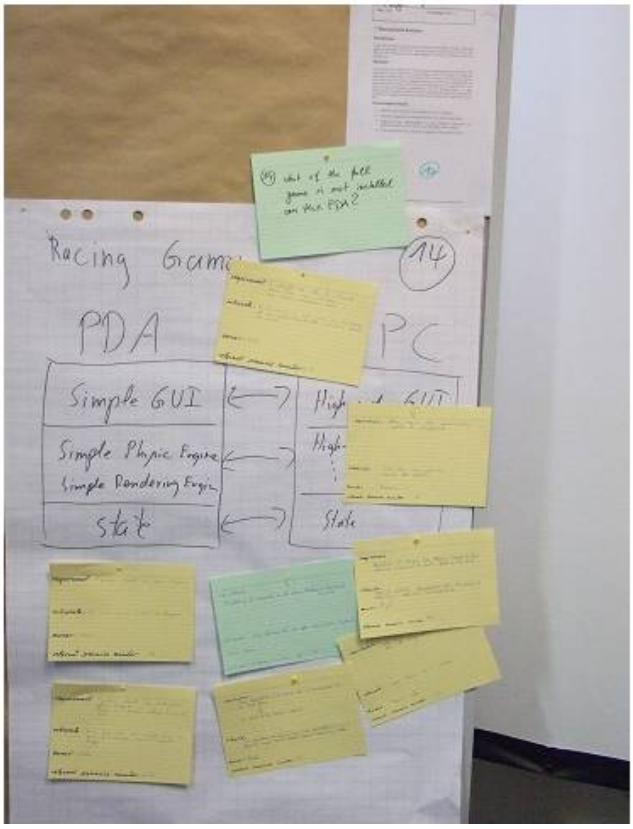

Figure 5: Adaptation of the requirements to the devices

The workshop started with a presentation of one scenario per group. Each scenario has been depicted in a big sheet. The discussion about scenarios was transformed into what-if triggers for the development of scenario variants and requirements (see Figure 3, green small sheets contain scenarios variants). The participants were invited to fill the movable walls with requirements (see Figure 5, yellow small sheets). The requirements description follows the VOLERE template: “description”, “rationale”, “owner”, “scenario that triggers the requirement”. Each requirement was then discussed to produce overall clear requirements.

Importance has been given to the user satisfaction (and of course dissatisfaction) level, when a particular requirement is successfully implemented or not.

The evaluation of the most relevant scenarios description contained in the D1.1 follows:

SAP Research Scenario (Emergency)

The basic emergency situation for this scenario shows the actions that can be made by the end users; since it is a very brief description there are not many references to usability. However, the UCD approach is present when the features to be provided from the wall screen are described

(high resolution and touch screen): these are of course features targeted to user satisfaction, as well as (indirectly) the possibility of changing in a dynamical way the simulation parameters.

The variant scenario helps considering various user profiles in order to satisfy the different needs by using different options.

Vodafone Scenario (IPTV Gaming)

The IPTV gaming scenario starts describing the target user profile, showing an attention to her/his interests, habits and hobbies.

Figure 6: focus on user behavior

Then lot of possible user interactions and migration options for this scenario are described; also the back-up use case (no connectivity) takes into account possible user limitations, to not degrade user experience and satisfaction. Usability goals are very clearly described in the related section, so they are definitively fixed.

2.1.3. REQUIREMENTS USABILITY

Looking to the set of requirements finally elicited in the D1.1, it is possible to remark that many of them are directly related to the user interface and generally to the product usability for the end users too.

From that deliverable, two subsets of the requirements follow:

- The first group consists of requirements directly related to the usability; they mainly belong to the user interface sector.

- The second group can have an indirect effect on it: in fact, even if these are basically functional requirements, when they are not satisfied they can impact in a very negative way on the user experience.

These two collections show that the effect of the OPEN partners' effort from usability and UCD approach point of view produced a good preliminary basis for the developers. Note that the list could be also longer than this one, but some requirements have not been included since they are very quite similar to each other: the scope was not in fact to provide an exhausting list, but to give an idea about the results of such a work in this sense.

Direct requirements:

No.	Requirement	Rationale
65	The user should only get presentations with possible migration options.	Having a general list of 50 items with 40 not working is not fun.
78	Gaming anywhere, anytime, anyhow.	People like to spend time in games.
155	The game must support the pause feature.	The user needs time to change device and UI
117	OPEN enables viewing and browsing of information for different users with different devices at the same time.	Some people in the emergency control center sit in front of a screen, some stand around a high-wall projection.
29	I use the shopping spree because I get information faster than in other ways.	I want to save time.
115	OPEN enables the user to get, what s/he individually can handle, i.e. the information remains not only complete, but in terms of perceived complexity understandable after a migration.	OPEN enables the user to get, what s/he individually needs to know.
116	OPEN enables the user to adjust the (simulation) content (of maps) to different enlargement scales - and this will still hold after a migration	There should be possibilities for any kind of zooming, which can migrate over screens and modalities.
34	Service content should be provided in a context aware manner.	The user should only be presented with information relevant to his current situation.
38	My private information should be kept safe.	I will not use an insecure service.
86	Migration should be triggered by the user.	The user is in control of the game meaning that s/he has the decision.

37	The user should be able to easily control which part is going to be migrated on a public device.	There might be output data the user does not want to be displayed on the public screen (for privacy reasons)
30	Users need to get priority over others when needing a device. That might force a migration of the several users.	Controlling the device
79	The user must be able to instruct the system, not to be interrupted, e.g. by somebody waiting to join. The user wants to control who can join the game, e.g. at play time by a list.	Annie likes to play interactively without interruption.
20	Users need to discover devices in the vicinity.	Better experience.
70	The user must be able to select different input types.	Some input can be more effective for game control.
156	The input devices must be able to support the same actions	If the game need a 4 directions input, all the devices must support it
73	Applications must allow multiple concurrent heterogeneous input sources.	The multi-player variant requires cell-phone and PC keyboard at the same time.
130	Are installation and configuration automatic? Should a custom configuration (folder in which store files…) be allowed?	The user want to have the control of the applications installed in his device
60	The user wants to migrate the game to the devices.	Continuous gaming, better experiences
57	The user must be able to select, which modality is migrated.	The user is in control of the game meaning that s/he has the decision.
61	The user does not want to care about networking aspects when trying to migrate.	Simplify experiences; don't bother with session id, Bluetooth settings…
137	The platform should be able to collect preferences explicitly set by the user and/or learned from observing user behavior. The preferences are related both to device(s) and to migration process.	The user profiling is important to speed migration process
26	Users (plural!) must be enabled to share a device.	Utilizing large video walls.
94	The user should be able to set preferences and defaults for migration.	Doing the same thing over and over again (accepting/denying) is not satisfactory for the user.

56	User profiles and preferences: font size, colors, audio volume, brightness…	Don't want to set up parameters every time.
32	Migration (partial at least) must be fast enough to occur at walking speeds.	Some of the migrations are only useful when the user is walking past the public display.
102	If migration brings a latency users must be helped to wait less.	Users do not want to wait.
77	Users want to store an "intermediate" state for later re-storing, continuation...	Cheating at games…
54	It must be possible to continue my current service seamlessly across multiple devices.	User does not want to log on/off from device a, b, c
159	The UI should be as homogeneous as possible switching from a device to another.	The user should not be disoriented by a different UI
11	Delay of migration should be low.	Long waiting times are not fun.
151	In the multiplayer game the usability must be the same in all the supported platforms	All the users must have the same chance to win.
24	Some graphical user interface or visual clue must be used to 1) trigger a partial migration 2) recover a migration, so the application comes back to your device (pack your application and leave) 3) for intuitiveness sake; this cue must be consistent throughout devices.	Keep the user in control and ensure he understands what's going on.
31	Help / advice from the system, if the user gets stuck.	Users may get lost or are inexperienced in using the system. Elderly people (?). Emergency situations (fire etc.)

Indirectly related:

No.	Requirement	Rationale
1	The user must be enabled to start watching a live IPTV program, stop it, and after some minutes continue watching the program from the point he stopped it.	It must be possible to watch a live program from the beginning to the end without losing parts if the user has to stop it.
7	The user must be enabled to watch a program using his set top box and multiple screens (the one in the living room, the one in the bed room …)	It must be possible for a user to watch a program in all the screens he has.

110	OPEN enables the user (in this case: the emergency control center) to visualize human-generated information, which is important for the further planning.	If i.e. a member of a fire brigade has an ongoing spoken interaction with his/her application the emergency area, it must be possible for the control center to “see” the interaction and the relevant flow of data generated by this interaction - not just to him
22	Users want to get location- and direction- specific services, e.g. navigation signs.	Simplified User Experience
4	The user must be able to split the screen in the IPTV.	It must be possible to play the game and watch the race on the same TV.
112	OPEN enables the user to integrate traffic information given by external providers, e.g. by road traffic authorities.	The emergency control center plans with this information, the fire brigade finds it route according to this information. Again, there might be different devices for the same information (e.g. "show direct route" by voice, differently sized displays) and potential interaction with this information (e.g. "show alternative" by gesture, voice, clicking).
28	I want to use a shopping spree because I find that information only there.	I use it because it is the preferred channel to get that info.
48	Users want to control the input-output, the migration user interface, user permission for each user interface.	Put shopping list on family board, but don't allow changes.
80	Users must be able to accept or deny a migration from a to b.	Users should be in control.
119	OPEN enables the user to know (seamlessly over migrations and in different devices and modalities, in sequence or in parallel), which information is connected to which other information.	It must be possible to explore causalities and to keep interaction paths from a user's perspective, the latter one to minimize learning efforts.
162	The OPEN platform should be able to maintain the data inserted by the user in the source device and show them in a consistent way after migration on the target device	The OPEN platform should be able to preserve the modifications the user has already done before migration
163	The OPEN platform should present the last data inserted by the user on the source device in the first presentation provided to the user in the target device	The user should have the feeling of a continuous interaction

106	OPEN should let me know where my data is. After it has migrated several times.	Users want to be able to delete data from device X.
33	Devices in geographical range (but not network range) should be usable to migrate to	Pre-established connectivity should not be a pre-requisite for migration.
82	Migration should be automatic / system triggered. Based on previous settings by the user.	There may not be enough time or focus to manage manual migration triggers.
160	The users should be made aware of the reasoning done by the OPEN platform for suggesting them the best migration attributes (target device, modality, …); the user should also be able to modify this	The OPEN platform should be make the users aware of the underlying context-dependent reasoning and also be able to take into account their preferences/modifications
35	Continuous context-dependent mobility support by user interface content adaptation	People going can better exploit the devices dynamically available. With a large screen it is possible to provide more details on shops and products.
114	OPEN enables the user to compare different prognoses in different modalities.	The central task force might work on a huge screen and compare by splitting it, on smaller devices splitting might need an alternative.
120	OPEN enables the user to use a typical classification task (e.g. using a tree) in different modalities/devices.	E.g. to classify damages, to classify injured people...
121	OPEN enables the user to highlight in different modalities/devices.	E.g. to highlight parts of a map.
40	Multi-modal input and output.	Keyboard or PDA as input device, graphical or audio output.
58	The open environment should be able to handle, e.g. co-ordinate and synchronize input from different users (multiplayer games).	We want that users can play together in the same game.
152	When several users share the same screen in a multiplayer game, there must be a perfect synchronism in the input elaboration.	All the users must have the same chance to win.
23	Privacy regarding personal information: location, name, address, preferences, habits	Spam degrades user experience; private life has to be protected.
66	The user must be able to specify migration policies, e.g. automatic migration when switched off.	Shut down PC, automatically continue on mobile phone
36	Users must be able to define privacy policies for	Send applications to shared/public

	application on shared/public displays.	devices.
123	OPEN enables the users to have a complete ex-post emergency analysis.	Re-construct the whole emergency as well as measures to support and help, no matter from which sources (device, application, modalities) - probably this re-construction should be visually, maybe enhanced by other media.
64	I migrate the game not to interrupt a game session, so I want to be sure that I never get it lost	There must be some fault-tolerant mechanism in place.
69	The game migration must be as smooth as possible.	The game experience must be preserved.
27	OPEN should clearly show who has control in a multi-user scenario.	User wants to have feedback.
17	Migration should make my work easier in difficult situations.	I must be calm and fast in decisions.

2.1.4. RESULTS AND CONTRIBUTION TO D1.3

The previous comments according to an UCD approach represent a basic evaluation of the D1.1; after that, some further work involved the making of the following D1.3 from usability and UCD point of view. In fact, D1.3 aimed at defining the final set of requirements for the OPEN platform.

Inputs following this approach can be very shortly summarized, since the overall UCD approach of D1.1 was satisfying; this especially because of:

1. The different methods being simultaneously applied during scenarios and requirements definition
2. Useful instruments (e.g. the workshop) that have been employed in order to achieve agreement among the OPEN partners

The specific definition of usability, as from D6.1, includes different aspects:

- Learnability: the system should be easy to learn so that the user can rapidly start getting some work done through it
- Efficiency: the system should be efficient to use, so that once the user has learned it, a high level of productivity is possible
- Memorability: the system should be easy to remember, so that a casual user can be able to come back to it, without having to learn everything from scratch

- Errors: the system should have a low error rate, so the users make few errors using it, and so that if they do make errors they can easily recover from them. Of course, catastrophic errors must not occur
- Satisfaction: the system should be pleasing to use, so that users are subjectively satisfied when using it.

The set of requirements coming out from D1.1 has maybe not completely satisfied these usability attributes: we can suggest focusing on the easiness of using these applications and the migration options.

This is necessary especially in case of services (like gaming) that target people with a not mandatory technical background; in fact, some requirements have specified this important feature for a usable product, but maybe they are not so many as expected. On the other hand, the easiness has been not straightly specified where possible, so being obliquely considered as necessary (without precisely indicating it).

Since the easiness for the end user is a key element to determine the success of an application, the input for D1.3 could be simply summarized into adding some requirements concerning this easiness, or either to directly specify it within some requirements already listed in the previous D1.1. Note that easiness should be related, as it is clear in the usability evaluation definition, not only to the first time use (learnability), but also to the feasibility of improving it after several times (memorability), or in case errors from users occurs.

These findings were incorporated in D1.3, in which the importance of user experience is underlined by dedicating a specific section to the usability requirements [D1.3].

2.2. FROM D5.1: SOCIAL GAME APPLICATION DESIGN

2.2.1. OVERVIEW

An exploratory study has been performed on Social Game application. The study was carried out including the following phases:

- Creation of a document containing:
  - The description of the Social Game (using snapshots and the story board). In this description, the main use cases are illustrated with some images in order to give users a realistic preview of the application.
  - A questionnaire addressing the user's opinions about the Social Game features. The questionnaire contains both closed and open answer questions.

- Selection of the group of users: a group of users has been selected, according to the user profile defined in D6.4. The purpose of the selection is to get a representative sample of the Social Game end users.
- Questionnaires fulfillment: every user has been invited to carefully read the application description and then to complete the questionnaire.

Please read D6.4 for a detailed description of this exploratory study.

2.2.2. ANALYSIS OF COLLECTED DATA

Thirteen users were involved in the exploratory usability testing for the Social Game application; they were all Italian except for an Egyptian and distributed in a range from 19 to 31 years old:

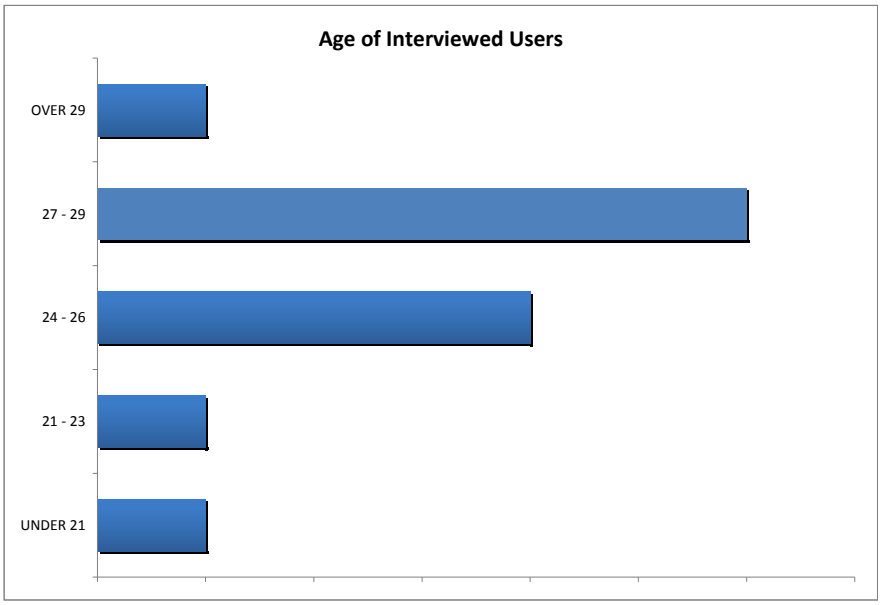

Figure 7: Interviewed Users' Age

The whole set of users is composed by people keen on web applications, but with different attitudes to videogames and Formula 1, in order to have a not completely homogenous group from that side.

Their answers to the questionnaires can be found in A. Appendix: Usability Questionnaires, a summary of their feedback to the Social Game description and screenshots follows.

The functionalities offered by such a prototype generated a great interest in the users, and many of them were enthusiastic of this gaming application. The look and the feel were generally appreciated:

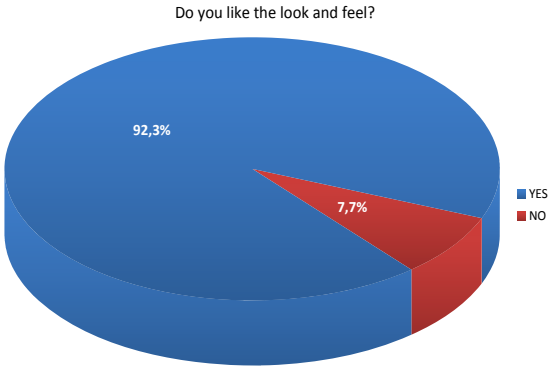

Figure 8

Three open questions aimed to understand if users were interested on using some functionalities of the prototype. The answers have been classified as “positive”, “neutral” or “negative” and represented in the following pie charts (Figure 9, Figure 10, Figure 11) to underline the general users’ feedback.

Please note that negative comments do not refer at all to the realization of single functionality, since the application was not yet implemented when the questionnaires were compiled, but to the importance that users give to it; thus they summarize situations such as the user is not interested in the feature, will not use it, and so on.

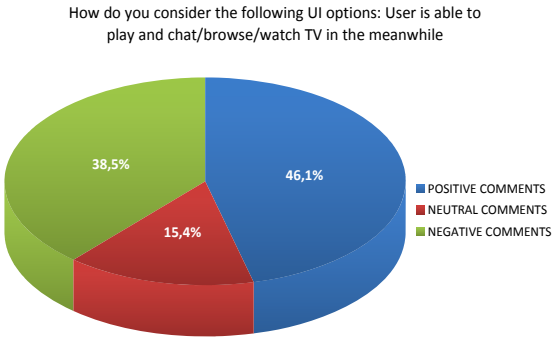

Figure 9

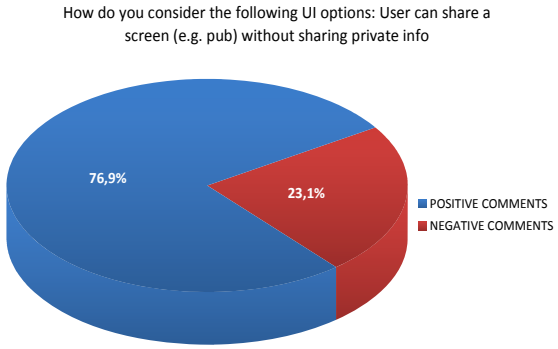

Figure 10

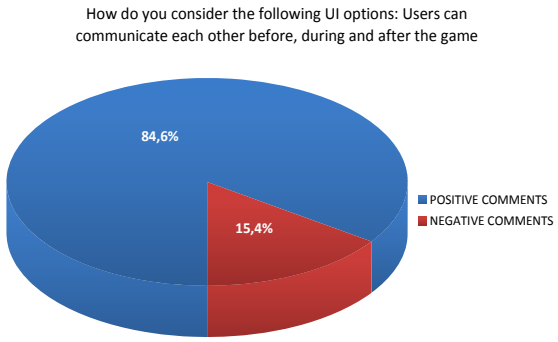

Figure 11

Further than a pure comment about the functionalities, from the answers to these questions a general interest of users about security raised too: it was considered as mandatory for using such an application, and many of them underlined the necessity of betting security, keeping the communication private, do not showing private info neither user's own strategy, etc.

Some open questions aimed at receiving inputs from users for new developments and new environments of utilizations: users actively contributed here to enrich such a game by proposing new functionalities (e.g. pause, race simulation if the user is busy, weather info…), but also aiming at enlarging the prototype rationale to other kind of games and media: not only all the racing simulations, but also team sports (by controlling a single player), arcade games, TV quiz and also "dynamic" movies, such as of action or thriller genres.

2.3. FROM D5.1: EMERGENCY APPLICATION DESIGN

2.3.1. OVERVIEW

An exploratory study has been performed on the Emergency application. The study was carried out including the following phases:

- Creation of a document containing:
    - The description of the Emergency application (using snapshots). In this description, the main use cases are illustrated with some images in order to give users a realistic preview of the application.
    - A questionnaire addressing the user's opinions about the Emergency application features and its main use cases. The questionnaire contains both closed and open answer questions.
- Selection of the group of users. A group of users has been selected, according to the user profile defined in D6.4. The purpose of the selection is to get a representative sample of the Emergency application end users.
- Questionnaires fulfillment: every user has been invited to carefully read the application description and then to complete the questionnaire.

Please refer to D6.4 for a detailed description of this exploratory study.

2.3.2. ANALYSIS OF COLLECTED DATA

For the Emergency application exploratory usability study the number of interviewed users was lower than for the social game (7), since in this evaluation purposes they should belong to the same target area: professional workers, averagely with good technical skills, and belonging to jobs in which coordination and remote control play often an important role; some of them were also familiar with emergency situations in which a fast reaction is necessary. Their ages range from 25 to 43, and their answers to the questionnaires can be found in A. Appendix: Usability Questionnaires. This is the summary of their opinions about the Emergency application description and screenshots.

Pie charts in Figure 12 and in Figure 13 represent the users' feedback on two simple questions about the OPEN-based application and the registration of devices; a general satisfaction was shown about the prototype (Figure 12) and users' votes were around 2 (satisfied) and 3 (average) in scale from 1 to 5:

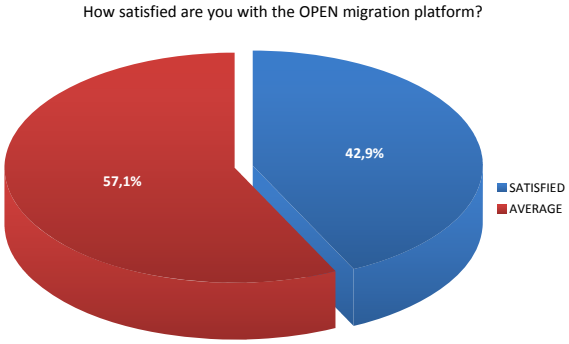

Figure 12

The same happened with their opinions about the registration of devices (Figure 13); in that context someone asked for a simpler registration (without introducing the server addresses every time):

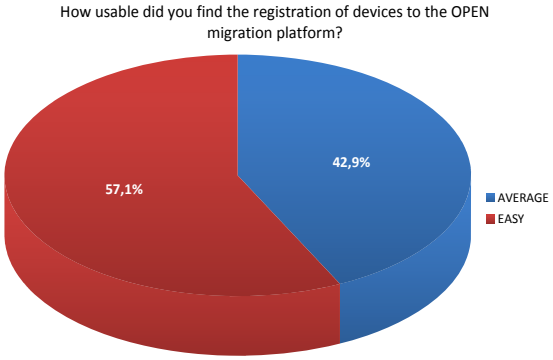

Figure 13

The other questions aimed at receiving some more detailed comments from the users; regarding the graphical interface, they asked for more text and explanations, clearer figures, and the possibility of enlarging or zooming in on the different windows. Most of them did not mind the RIA (Rich Internet Application) platform, while a minor part indicated AJAX as their favorite one.

As for the Social Game, users gave a great contribute to improve the application: many of them underlined their need for some kind of localization, based on GPS, geographical coordinates, or altitude.

Among the possible new fields of applications, several users indicated also other kinds of emergencies (e.g. earthquakes) and topics like surveillance, transport and shipping: generally speaking, they indicated all the possible situations in which there is the need of tracking sensible elements or events. Another possible utilization of the concept developed in this prototype concerns measurements (as electromagnetic field, topography, urban building plans, etc.).

2.4. FROM D2.1 AND D3.2: WEB MIGRATION WITH DEVICE SELECTION MAP

2.4.1. TEST DESCRIPTION

A usability assessment test has been performed for the Web Migration [D2.1] with Device Selection Map [D3.2] prototype.

For the evaluation of the adaptation of web pages for mobile devices, a comparative test has been performed. In particular, some usability parameters of web pages have been evaluated with and without the usage of the web adaptation. Moreover, the web application usability on the PC has been evaluated in order to estimate the usability decrease caused by the usage of a mobile device. As planned in D6.4, in order to perform a careful comparison, two groups of users have been employed. Each group was composed of four users and executed the task list using a different execution order. Selected users, according to the user profile defined in D6.4, are familiar with web applications and PDA devices.

Moreover, an evaluation of the Device Selection Map and of the migration procedure has been performed.

For some technical issues, only a part of the task list proposed in D6.4 has been executed. In particular, some problems on the adaptation of the proposed Wikipedia pages caused by CSS style-sheets made impossible to perform any task on that web application.

Therefore, in order to avoid any technical problem that could have affected the user experience, it has been preferred to perform only the part of the task list planned for the Shopping Assistant website (chosen by the prototype developers), which offers the most reliable behavior.

Moreover, it was not possible to perform a migration from the PDA device to the PC. This kind of migration was only simulated, describing to each user the needed procedure for the triggering the migration.

In Table 1 and in Table 2 it is possible to read the actual task lists executed during the assessment test.

Device / Conditions	Task ID	Task Description
PDA – without OPEN	SH-A-1	Buy the cheapest packet of rice
	-	Complete a questionnaire about the shopping assistant UI used on the PDA without OPEN (A. Appendix: Usability Questionnaires)
PC	SH-A-2	Select the required quantity of the cheapest packet of pasta.
	SH-A-6	Complete a part of the web site user registration form.
	SH-A-7	Migrate to the PDA

PDA – with OPEN	SH-A-8	Complete the form compilation
	-	Complete a questionnaire about the web UI used on the PC (A. Appendix: Usability Questionnaires)
	SH-A-9	Select the required quantity of the most expensive packet of pasta.
	SH-A-11	Simulate the migration of the web application towards the PC.
	-	Complete a questionnaire about the shopping assistant UI used on the PDA (A. Appendix: Usability Questionnaires)
	-	Complete a questionnaire about the migration functionalities (A. Appendix: Usability Questionnaires)

Table 1: Web Migration task list (group A)

Device / Conditions	Task ID	Task Description
PDA – with OPEN	SH-B-5	Select the required quantity of the most expensive packet of pasta.
	SH-B-6	Simulate the migration of the web application towards the PC.
PC	SH-B-8	Select the required quantity of the cheapest packet of pasta.
	SH-B-9	Complete a part of the web site user registration form.
	SH-B-10	Migrate to the PDA
PDA – with OPEN	SH-B-11	Complete the form compilation
	-	Complete a questionnaire about the web UI used on the PDA (A. Appendix: Usability Questionnaires)
	-	Complete a questionnaire about the shopping assistant UI used on the PC (A. Appendix: Usability Questionnaires)
	-	Complete a questionnaire about the migration functionalities (A. Appendix: Usability Questionnaires)
PDA – without OPEN	SH-B-12	Buy the cheapest packet of rice
	-	Complete a questionnaire about the shopping assistant UI used on the PDA without OPEN (A. Appendix: Usability Questionnaires)

Table 2: Web Migration task list (group B)

Users belonging to Group A performed some tasks using the PDA without web pages adaptation, then using the PC, and finally using the PDA with adaptation. Users belonging to Group B, instead, used the PDA with adaptation, later the PC, then the PDA with adaptation (in order to evaluate the state maintenance during the migration from PC to PDA), and finally the PDA without adaptation..

Usability tests have been performed in a Vodafone IT laboratory, while the migration server was located in CNR premises. The prototype has been customized by CNR to allow the migration of devices inside the Vodafone LAN while the migration server was in Pisa. The mobile phone HTC TyTn has been used.

2.4.2. PILOT TEST

A pilot test has been performed before the execution of the usability assessment.

The pilot test has been performed by Mattia Piunti and the test execution time was about 60 minutes long (including the final debriefing session).

No problems related to the task list execution and to the tasks description have been identified. Therefore, no test plan modifications were needed at the end of the pilot test.

2.4.3. ANALYSIS OF COLLECTED DATA

As explained in D6.4, every user was asked to complete a questionnaire for the evaluation of web user interfaces (from PC, from PDA with OPEN adaptation, and from PDA without OPEN adaptation). Moreover, a questionnaire about the migration procedure has been completed.

In Figure 14 and in Table 3, the evaluation results for the shopping assistant UI during the group A testing activity are shown.

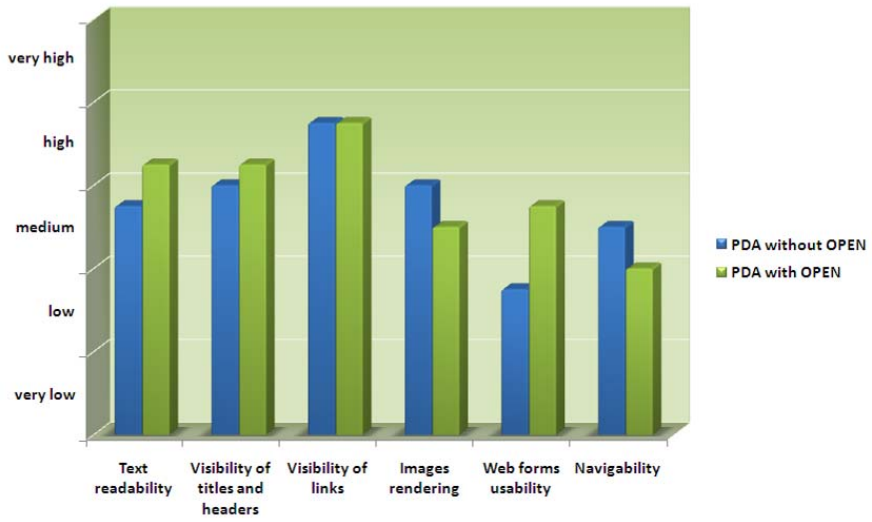

Figure 14: Shopping Assistant usability (group A)

Group A	User	Text readability	Visibility of titles and headers	Visibility of links	Images rendering	Web forms usability	Navigability
PDA without OPEN	User 1	2	3	4	3	2	3
	User 2	2	3	4	2	1	1
	User 3	5	4	5	4	3	5
	User 4	2	2	2	3	1	1
	Mean	**2,75**	**3**	**3,75**	**3**	**1,75**	**2,5**
PC	User 1	4	4	4	2	4	4
	User 2	4	5	5	5	4	4
	User 3	5	5	5	4	3	5
	User 4	3	3	3	3	3	3
	Mean	**4**	**4,25**	**4,25**	**2,5**	**3,5**	**4**
PDA with OPEN	User 1	5	5	5	2	3	4
	User 2	2	3	4	4	3	2
	User 3	5	4	5	3	4	1
	User 4	1	1	1	1	1	1
	Mean	**3,25**	**3,25**	**3,75**	**2,5**	**2,75**	**2**

Table 3: Shopping Assistant usability (group A)

The UI adaptation for PDA devices performed by the tested prototype received a good evaluation except for images rendering (often considered too small) and for the web site navigability. For the latter, users' evaluations were strongly affected by the fact that large web pages are split in two parts and a new page is shown in order to choose whether the main content or the sidebar should be displayed. Often, users did not know what to do at this point. Most of them selected "sidebar" instead of "main content" and then said: "the web application is not working".

In Figure 15 and in Table 4, the evaluation results for the shopping assistant UI during the group B testing activity are summarized.

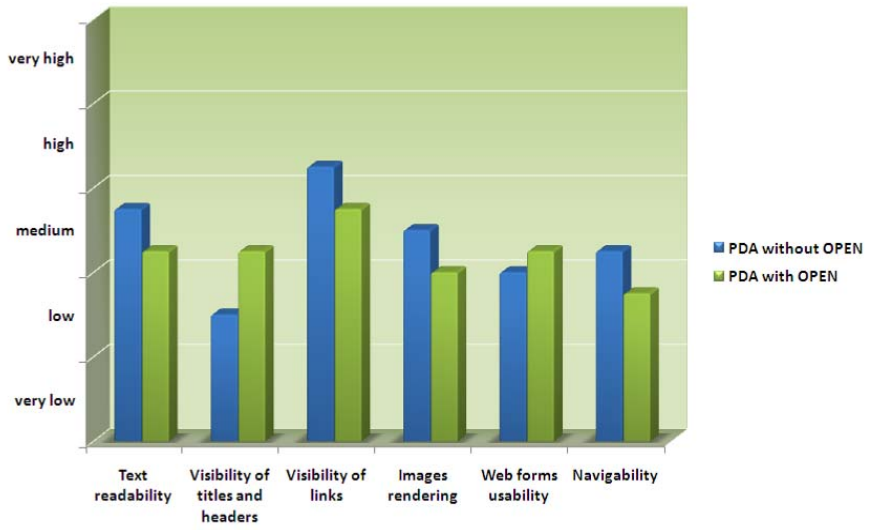

Figure 15: Shopping Assistant usability (group B)

Group B	User	Text readability	Visibility of titles and headers	Visibility of links	Images rendering	Web forms usability	Navigability
PDA without OPEN	User 1	3	2	2	3	2	2
	User 2	3	2	4	3	4	4
	User 3	1	1	3	2	1	1
	User 4	4	1	4	2	1	2
	Mean	**2,75**	**1,5**	**3,25**	**2,5**	**2**	**2,25**
PC	User 1	4	4	4	4	4	4
	User 2	4	4	4	3	2	4
	User 3	2	2	3	3	1	1
	User 4	4	3	4	2	1	1
	Mean	**3,5**	**3,25**	**3,75**	**3**	**2**	**2,5**
PDA with OPEN	User 1	3	4	4	2	3	2
	User 2	1	1	3	2	2	1
	User 3	3	3	3	3	3	3
	User 4	2	1	1	1	1	1

	Mean	**2,25**	**2,25**	**2,75**	**2**	**2,25**	**1,75**

Table 4: Shopping Assistant usability evaluation (group B)

Group B users started using the prototype from a PDA with OPEN adaptation, so this interface has been penalized in comparison with group A test results by a bias issue (please read D6.4 for a detailed description). This difference in usability parameters demonstrates that the task list execution order affects the test results. Hence, for a most precise evaluation, the mean value between group A and group B should be calculated for each usability parameter. Web forms usability evaluation was instead unexpected. In this case, the web UI adaptation has been appreciated very much by end users, who considered web forms displayed on the PDA better than their original versions displayed on the PC.

Figure 16 shows the average usability evaluation of group A and group B users. In this case, the arithmetic mean between the two evaluations compensates the learning process (see D6.4 for a detailed description of the comparative usability test methodology).

Figure 16: Shopping Assistant usability

The web UI adaptation has been appreciated for: text readability, visibility of titles, and web forms usability. The aspects in need of an improvement are: rendering of the images (too small) and web site navigability.

Also the visibility of links is lower in the PDA when OPEN UI adaptation is used, but in this case the difference between the evaluations is very low.

The previous histograms have been obtained by calculating the arithmetic mean of the usability parameters. Such parameters can vary from 1 (very low) to 5 (very high). A limited number of users have been involved in the testing activity (according to the test methodology described in D6.4) and the arithmetic mean could not give an accurate indication because the answer of a single user could affect the

entire result. For this reason, the number of **satisfied users** for every usability aspect has been calculated. A user is considered satisfied if her/his evaluation is greater than or equal to 3 (mean value).

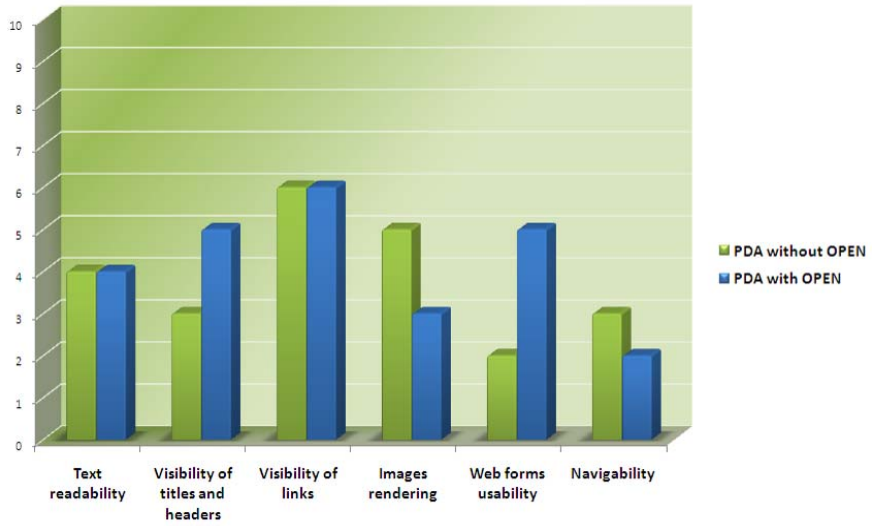

Figure 17: Shopping Assistant satisfied users

In this case (Figure 17), the obtained results are similar to those displayed in the previous graphics. The main difference is related to the values for the visibility of links. The user interface adaptation for PDA does not cause a reduction on the visibility of links. Probably just one low value affected the arithmetic mean considered in Figure 16.

Three usability parameters have been considered for the usability evaluation of the migration process. As displayed in Figure 18 and in Table 5, there are not substantial differences between group A and group B users. The execution order of the task list, as expected, does not affect the migration process evaluation (for a detailed description of tasks execution order effects please read D6.4). The migration process is very simple, so the learning process does not produce any considerable effect. The PDA without the OPEN adaptation has not been used for this evaluation because it is not possible to perform a web migration without using the OPEN platform.

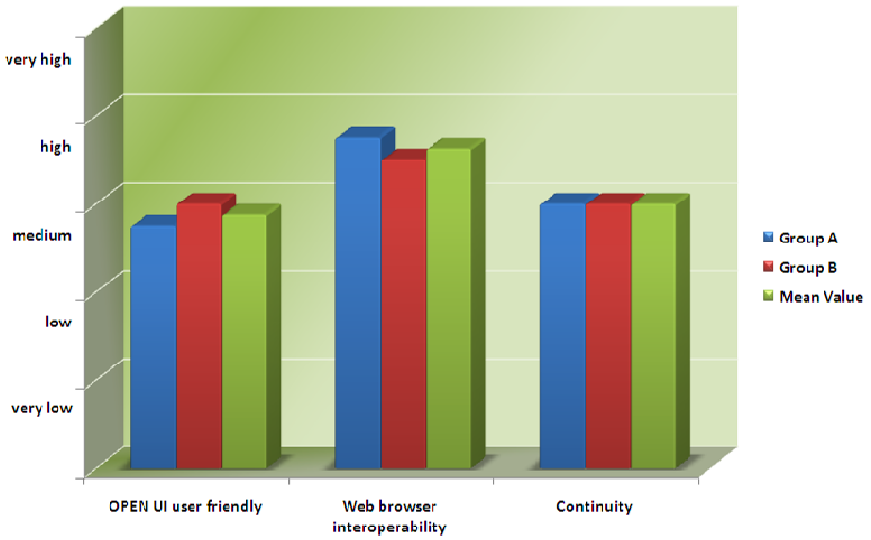

Figure 18: migration process usability

	User	OPEN UI user friendly	Web browser interaction	Continuity
Group A	User 1	3	4	3
	User 2	2	4	2
	User 3	3	3	4
	User 4	3	4	3
	Mean	**2,75**	**3,75**	**3**
Group B	User 1	4	4	3
	User 2	2	4	3
	User 3	3	3	4
	User 4	3	3	2
	Mean	**3**	**3,5**	**3**

Table 5: migration process usability

The migration process has been evaluated in a positive way. This result is even cleaner, if the number of satisfied and unsatisfied users is calculated (Figure 19).

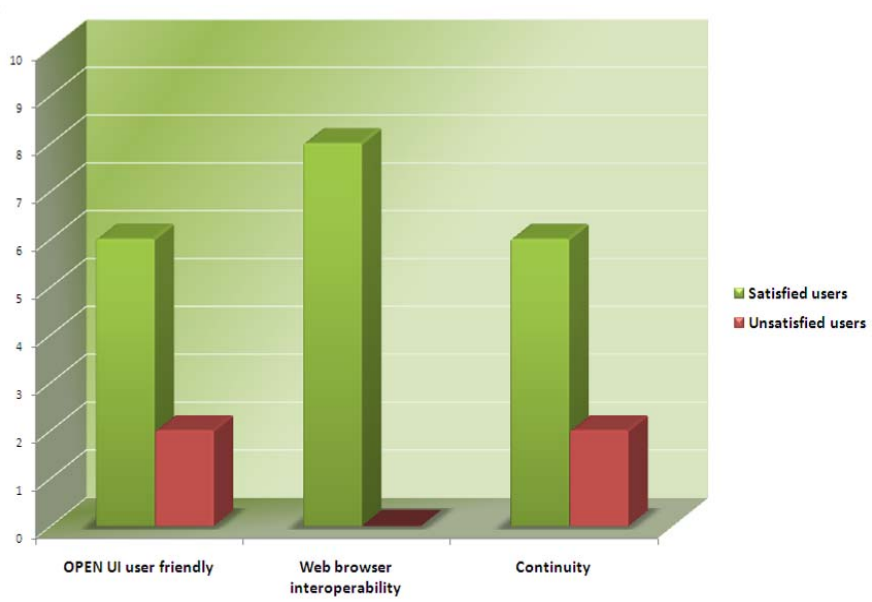

Figure 19: migration process satisfied users

2.4.4. STRONG POINTS

Migration Process. Almost all of the users appreciated the state persistence during the migration and the continuity during the application usage. Moreover, the device selection map was considered a very useful tool.

The only negative opinion about the migration regards the fact that when a migration from PC to PDA is started, two confirmation prompts are displayed on the mobile device. It would be easier to have only one confirmation prompt.

2.4.5. WEAK POINTS

Web site navigability. The web site navigability is deteriorated when pages are adapted by the prototype for a PDA device. As explained during the analysis of collected data, this is strongly related to the splitting procedure. Maybe, a clearer indication of the names of the parts of the pages (instead of “sidebar” and “main content”) could be useful. Moreover, the Web UI Adaptation configuration tool (described in Web UI Adaptation) could be used to modify the splitting procedure, in order to improve the web site navigability.

2.4.6. USERS’ SUGGESTIONS

During the task list executions and the debriefing sessions, users have given the following improvement suggestions:

- When a migration from PC to PDA is required, only two confirmation prompts should be issued. The first one on the PC and the second one on the PDA.
- In the adaptation of a large web page for the PDA, instead of adding a new page with a link called “sidebar” and a link called “main content”, it would be better to directly display the sidebar and to add to it a new link to the page main content. In this way, the web page would be however readable and the web site would be more navigable.
- During the adaptation of the web application for the PDA, a greater font size could make the text more readable.
- When a page is adapted for a PDA, a more efficient usage of the screen could be useful. A decrease of empty parts of the screen could offer to end users the possibility to receive a greater amount of information in a web page.
- During the web page adaptation, images become smaller. This could create some problems for the web application usability. A greater image size should improve the user experience.
- A system for the automatic triggering of migrations could be very useful. In fact, this feature is already foreseen for the OPEN Migration Service Platform, but it is interesting that some users noticed that it would be useful.

2.4.7. FURTHER WORK

When the complete version of the web migration with device selection map will be available, a validation usability test will be performed. During the validation, a more formal evaluation will be performed in order to explore all of the usability aspects (i.e. learnability, efficiency, memorability, errors, and satisfaction). A new task list that covers the most common use cases will be compiled. Moreover, the results of the assessment test will be used to define some reference values (e.g. execution times, error rates, etc.) for usability parameters, in order to perform a more formal evaluation.

2.5. FROM D5.2: SOCIAL GAME PROTOTYPE

2.5.1. TEST DESCRIPTION

An assessment usability evaluation has been performed on the Social Game prototype. The methodology described in D6.4 has been applied.

A comparative test has been performed between the racing game controlled from the PC keyboard and the racing game controlled from a mobile phone. For this comparison, two usability aspects have been taken into account: game controls and game indicators. In order to compensate for the learning process during the usage of the racing game, one group of users started to play from the PC keyboard and then migrated to the mobile phone, while another group of users started using the mobile phone. Moreover, a

usability evaluation has been performed on the application components that did not offer the migration feature. For a detailed description of the test methodology, please read D6.4.

The test was conducted in a Vodafone Italy laboratory and two groups composed of six users have been employed. Users have been selected according to the Social Game user profile defined in D6.4.

There are no relevant differences between the task list described in D6.4 and the actual one.

The major change regards the task called: "**Change IPTV channel**" (SG-A-06 for group A and SG-B-06 for group B). According to the task list proposed in D6.4, this task should have been performed with the IPTV simulator in full screen modality. For a UI design choice made by the prototype development team, it was not possible to use the IPTV simulator control bar in the full screen mode, so this task has been performed with the IPTV simulator in the original size.

Table 6 and Table 7 contain the task lists performed during the usability assessment.

Device / Conditions	Task ID	Task Description
PC	SG-A-01	Login to the Social Game web application.
	SG-A-02	Send a message to the chat
	SG-A-03	Bet 25 € on Felipe Massa
	SG-A-04	Answer the question: who is the racing game winner?
	SG-A-05	Start the full screen view of IPTV simulator
	SG-A-07	Close the full screen view of IPTV simulator
	SG-A-06	Change IPTV channel
	SG-A-08	Start playing on the Racing Game
	SG-A-09	Migrate the controls of the Racing Game to the mobile phone
Mobile Phone	SG-A-10	Continue the race by controlling the car from the mobile phone
	-	Complete a questionnaire (A. Appendix: Usability Questionnaires)

Table 6: Social Game task list (group A)

Device / Conditions	Task ID	Task Description
PC	SG-B-01	Login to the Social Game web application.
	SG-B-02	Send a message to the chat
	SG-B-03	Bet 25 € on Felipe Massa
	SG-B-04	Answer the question: who is the racing game winner?

	SG-B-05	Start the full screen view of IPTV simulator
	SG-B-07	Close the full screen view of IPTV simulator
	SG-B-06	Change IPTV channel
	SG-B-08	Migrate the controls of the Racing Game to the mobile phone
Mobile Phone	SG-B-09	Start playing on the racing game controlling the car from the mobile phone
PC	SG-B-10	Continue playing on the racing game controlling the car from the PC keyboard
	-	Complete a questionnaire (A. Appendix: Usability Questionnaires)

Table 7: Social Game task list (group B)

2.5.2. PILOT TEST

Before the execution of the usability test with two groups of users a pilot test has been performed.

The pilot test has been performed by Agnese Grasselli from Vodafone IT. The test execution time was about 60 minutes (including the debriefing session).

During the pilot test execution, it has been noticed that the description of the task SG-A-04 (SG-B-04 for group B task list) was not clear. The proposed description was: “Answer the question: who completed the fastest lap?”. This formulation of the question was taking into account that the user was already aware that the purpose of the racing game is the completion of the fastest lap, like in Formula 1 qualifications. So, in order to avoid any misunderstanding with end users, the task description was modified in the following way: “Answer the question: who is the racing game winner?”, that does not suppose that the user already knows how the racing game works.

2.5.3. ANALYSIS OF COLLECTED DATA

As described in D6.4, a comparative usability evaluation has been performed for the racing game control from PC and mobile phone. Moreover, a general usability evaluation has been performed for the Social Game prototype components that do not support any kind of migration. Users have evaluated some usability parameters using a numerical value between 1 (very low) and 5 (very high).

Figure 20 and Table 8 show the evaluation results of migrating parts tested by group A.

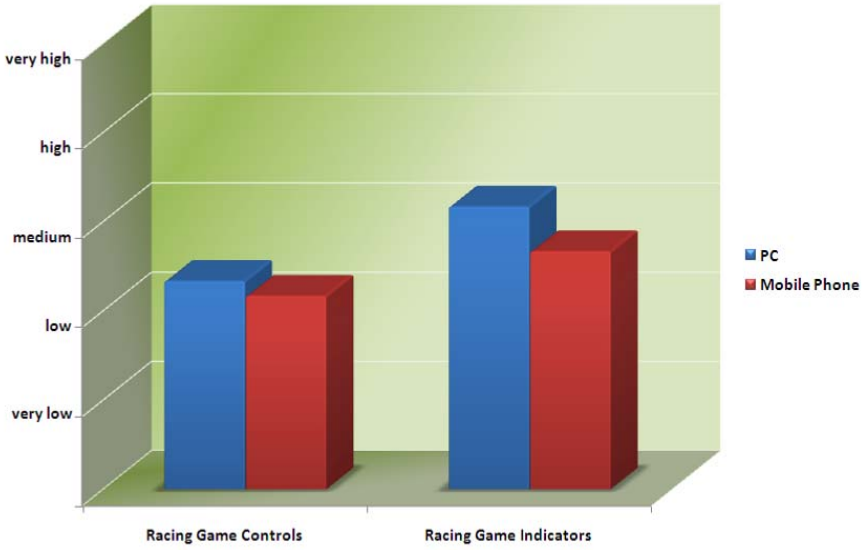

Figure 20: usability of migratory Social Game components (group A)

Group A	User	Racing Game Controls	Racing Game Indicators
PC	User 1	3	4
	User 2	2	4
	User 3	2	3
	User 4	3	3
	User 5	1	3
	User 6	3	2
	Mean	**2,33**	**3,17**
Mobile Phone	User 1	3	2
	User 2	1	5
	User 3	3	4
	User 4	1	3
	User 5	3	1
	User 6	2	1

	Mean	**2,17**	**2,67**

Table 8: usability of migratory Social Game components (group A)

For both of the considered usability parameters there is a usability decrease when the game is controlled using the mobile phone. For the racing game control, that difference is very low, while in the case of the racing game indicators it is a little more relevant.

Figure 21 and Table 9 show the evaluation results of migrating parts tested by group B.

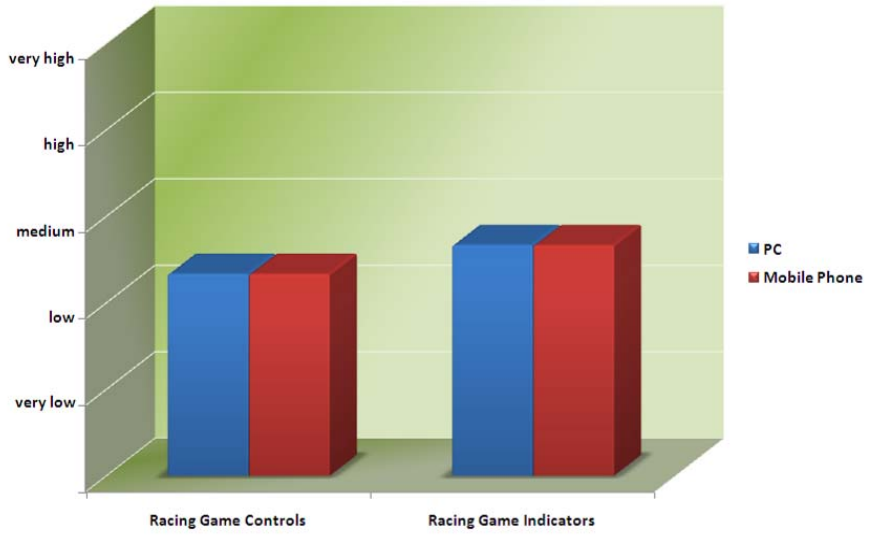

Figure 21: usability of migratory Social Game components (group B)

Group B	User	Racing Game Controls	Racing Game Indicators
PC	User 1	4	4
	User 2	2	3
	User 3	2	3
	User 4	1	1
	User 5	2	3
	User 6	3	2
	Mean	**2,33**	**2,67**

Mobile Phone	User 1	3	4
	User 2	1	4
	User 3	1	2
	User 4	2	2
	User 5	3	2
	User 6	4	2
	Mean	**2,33**	**2,67**

Table 9: usability of migratory Social Game components (group B)

Considering group B users, exactly the same usability result has been obtained for the control of the game from PC and from mobile phone. From the analysis of usability parameters it is possible to notice that, when the user starts the test using the PC keyboard (group A), the usability of the car controls on a mobile phone is lower than that obtained for the group B. This could be caused by the fact that it is quite difficult to control the car during a race and, after using the game with a device, the user gets tired and, then, the second device gets a lower evaluation. However, the employment of two groups of users compensates this effect, as explained in D6.4.

Figure 22 displays the arithmetic mean between group A and group B evaluations.

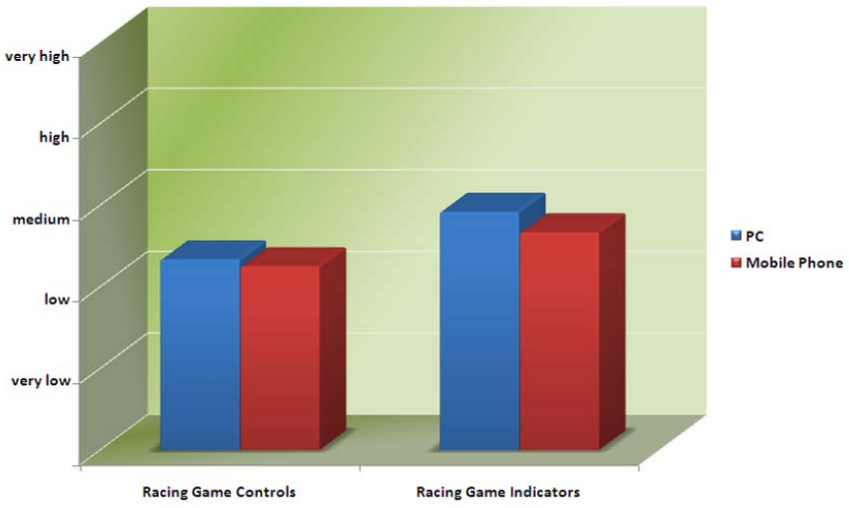

Figure 22: usability of migratory Social Game components

Also in this case the most relevant difference is observed for the racing game indicators.

The previous histograms have been obtained by calculating the arithmetic mean of the usability parameters. Such parameters can vary from 1 (very low) to 5 (very high). A limited number of users have

been involved in the testing activity (according to the test methodology described in D6.4) and the arithmetic mean could not give an accurate indication because the answer of a single user could affect the entire result. For this reason,the number of satisfied users for every usability aspect has been calculated. A user is considered satisfied if its evaluation is greater than or equal to 3 (mean value).

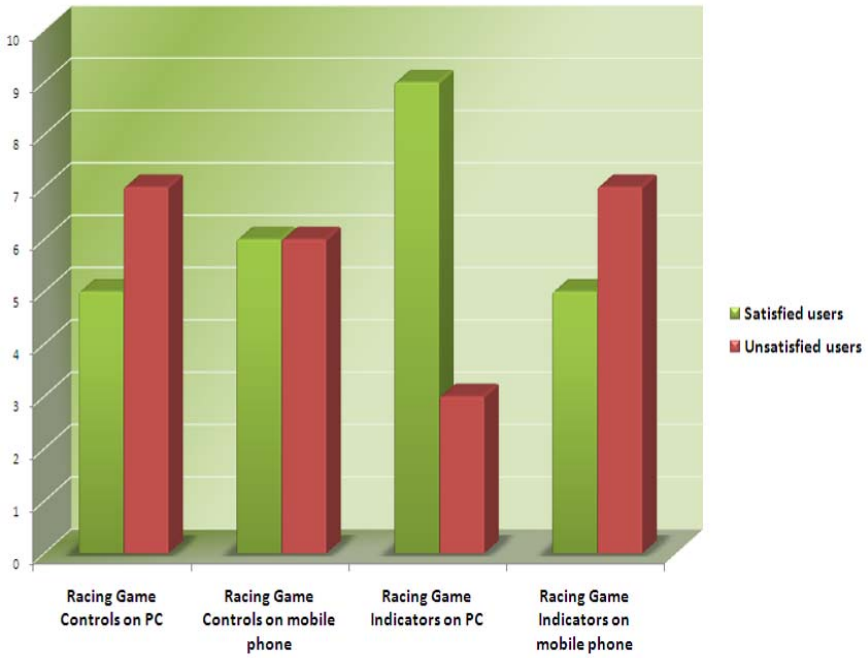

Figure 23: satisfied users for migratory Social Game components

From the observation of Figure 23 it is possible to make two considerations. First of all, the number of satisfied users that use a mobile phone as a racing game control is slightly higher. However, on both mobile phone and PC, an improvement of the game control would be needed.

About the racing game indicators, the overall evaluation is positive, but a slight improvement could be required on the mobile phone.

These results may be affected by the experience that the users have with similar commercial products (e.g. Play Station, X-Box, etc.). The Social Game, being a prototype aimed at research, cannot compete with those products in terms of user experience, hence even if some improvements could be done on the game usability, it unlikely will reach a very high level. Moreover, this is beyond the scope of the project.

Figure 24 and Table 10 summarize the usability evaluation results for the Social Game components that are available only for PC.

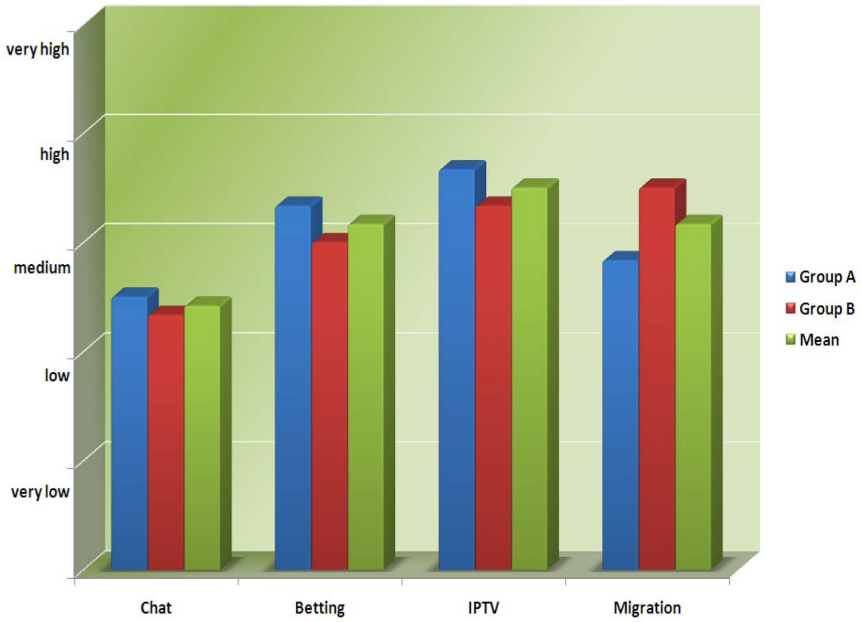

Figure 24: usability of Social Game components running on PC only

	User	Chat	Betting	IPTV	Migration
Group A	User 1	2	3	3	4
	User 2	2	4	5	2
	User 3	2	4	3	4
	User 4	3	3	4	3
	User 5	3	2	3	2
	User 6	3	4	4	2
	Mean	**2,5**	**3,33**	**3,67**	**2,83**
Group B	User 1	4	5	2	5
	User 2	2	4	4	3
	User 3	2	3	4	4
	User 4	1	1	2	2
	User 5	2	2	4	3
	User 6	3	3	4	4

	Mean	**2,33**	**3**	**3,33**	**3,5**

Table 10: usability of Social Game components running on PC only

In this case there are no relevant differences between the usability parameters obtained from group A and from group B. In fact, for components that are used only on a device, tasks execution order should not affect the evaluation.

The obtained usability values, considering that the prototype is not a ready for market application, are quite good. The only component that needs an improvement is the chat. However, the evaluation of this component has been affected by some technical problems with the refresh of the list of sent / received messages after a message post. Often, when a user sent a message s/he was not able to know if the message was really delivered.

Considering the number of satisfied users, data shown in Figure 25 have been obtained.

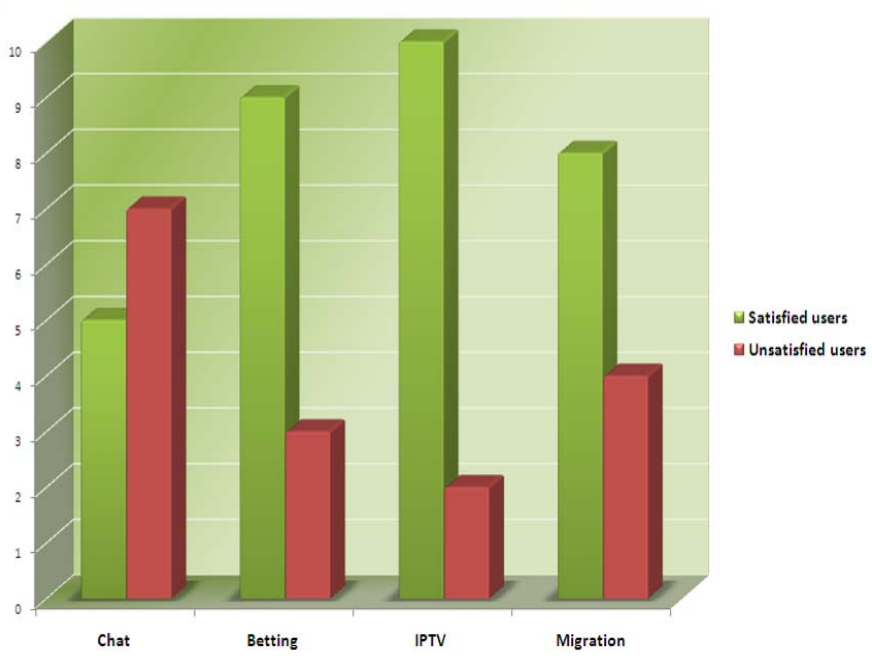

Figure 25: satisfied users for Social Game components running on PC only

Analyzing the number of satisfied users, there is a very good result for betting, IPTV, and migration. In fact, only a minority of the employed users gave a bad usability evaluation on that component. Instead, as already explained, the chat component needs some improvement. It is worth noting that users are familiar with more complex chat clients (e.g. Skype, MSN, etc.) and have high expectations from tools with similar functionalities. On the other hand, betting is not so common, so users' expectations are lower. Regarding the IPTV, it is a well known component slightly modified, so it does not imply particular issues in the usage. Finally, the migration is a completely new feature and users do not have particular expectation on it.

If the mean value of the percentage of satisfied users is calculated for all of the usability parameters, the majority of users evaluated in a positive way the Social Game prototype (Figure 26).

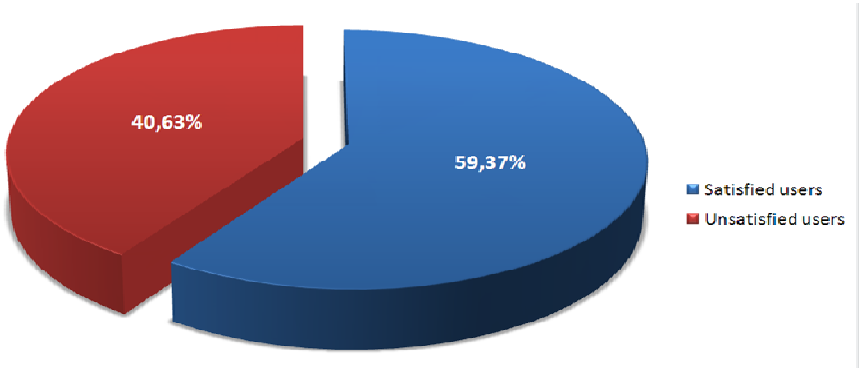

Figure 26: Social Game satisfied users

2.5.4. STRONG POINTS

Betting. Most of the employed users evaluated in a very positive way the betting component. They used it without any problem and they were very interested in its usage, offering constructive improvement suggestions.

IPTV. Almost every user evaluated the IPTV component usability in a positive way. It is very easy to use and interviewed users considered it very useful.

Migration. Even if only a simulation of the actual migration was available, users liked it very much and considered it as a very good idea.

2.5.5. WEAK POINTS

Chat. The chat component needs an improvement. In particular it should be fundamental that the refreshing of the component is performed as soon as a new message is sent. Also the automatic message list scrolling should be more efficient.

Racing Game control. It is very difficult for a user to control the car. At every curve of the track it is almost impossible to control the car. Only one user was able to complete a lap of the proposed Grand Prix.

2.5.6. USERS' SUGGESTIONS

During the task list executions and the debriefing sessions, users have given the following improvement suggestions:

- The login confirmation pop-up is not needed.

- It would be possible to login using the “enter” key. At the moment it is possible to login only using the “login” button.
- Social Game application components should offer the option to be resized, moved or closed. For example, a user could use the betting component to bet on his preferred driver, and then close it when it is no longer needed.
- The chat should offer the option to view a buddy list with the status of every buddy.
- Old messages of the chat should be put in a message history. Moreover, the date/time of sent /received messages should be displayed.
- A voice chat could be very useful during a race.
- A list of emoticons should be offered by the chat component.
- The chat should have the option to send a private message to other users.
- All of the users were not able to use the **reverse gear**. Sometimes the car goes out of the track, and, without the reverse gear it is impossible to continue the race. It is very frustrating to arrive almost at the end of a lap and to not be able to complete it. So, a clearer procedure for the insertion of the reverse gear (for example using the “down” directional key) could be very useful.
- It would be useful to control the car using the mobile phone accelerometer instead of the directional pad.
- A map of the track with the current user position would be very useful. In this way, if the car spins right round and the user resumes the race, s/he can see if s/he is driving in the right direction or not.
- In the PC keyboard users should have the option to configure racing game control keys. Some users, for example, prefer to use “A” key as accelerator instead of “UP” directional key.
- The racing game should offer the option to use it in full screen modality.
- It would be useful to have some sound effects for the racing game, with the option to have a background music or the car sound.
- In the racing game there should be an indication when the car is approaching a curve of the track.
- The racing game should be paused during migrations and at the web application startup.
- A start menu on the racing game would be very useful. In this way the user would be able to select her/his name and preferences.
- An indication should be displayed when the user is driving the car in the wrong direction.

- The racing game should be paused during other components' usage.
- It could be useful to move the racing game classification inside the game component. Currently it is located in another part of the page.
- In the racing game classification, besides the user position, also the time employed to complete a lap should be indicated.
- An indication of the number of users that are currently using the racing game could be useful.
- In the racing game mobile phone client, the indication of the current gear is missing.
- The option to control the car using a joystick could be very useful.
- Racing game indicators on the mobile phone should be customizable.
- A clearer indication of the selected **championship** (Best Lap, Pole Position, Winner, or Fastest Lap) could be helpful when a user starts a bet.
- During the betting procedure there is no "back" button for the modification of inserted data.
- A confirmation SMS for betting payment via mobile phone could be useful.
- The betting component should display the list of performed bets.
- The betting component should offer an indication of the amount of money that the user could win with his/her bet.
- It could be nice to see the list of bets performed by other users.
- It is not clear which kind of bet (best lap, winner, etc.) is considered in the quote indication.
- In the betting component, the "Submit" button function is not clear. It would be better to call it "Next".
- "+" and "-" buttons on the IPTV control bar are in the wrong order ("-" should be at the left).
- IPTV should have a menu for the direct access to the selected channel. A menu with channel previews would be very nice.
- IPTV controls should have a tool tip.

2.5.7. FURTHER WORK

When the complete version of the Social Game will be available, a validation usability test will be performed. During the validation, a more formal evaluation will be performed in order to explore all of the usability aspects (i.e. learnability, efficiency, memorability, errors, and satisfaction). A new task list

that covers the most common use cases will be compiled. Moreover, the results of the assessment test will be used to define some reference values for usability parameters, in order to perform a more formal evaluation.

At last, using the experience that was gained during assessment tests, the expected execution time will be calculated for every task.

2.6. FROM D5.2: EMERGENCY PROTOTYPE

2.6.1. TEST DESCRIPTION

A usability assessment test has been performed on the Emergency Prototype. The test plan described in D6.4 has been applied. In this case, only one group of users has been employed because, in the tested version of the prototype, it is possible to migrate two simulations and to merge them in another device, but it is not possible to start from a merged simulation and to split it in two devices.

Using the Emergency prototype user profile defined in D6.4, eight users have been selected for the evaluation. Usability tests have been performed in a Vodafone IT laboratory.

The task list described in D6.4 has been executed (Table 11). No changes were needed.

Device / Conditions	Task ID	Task Description
PC 1	BS-01	Start the flooding simulation
	BS-02	Migrate the flooding simulation to the second PC
	BS-03	Start the traffic simulation
	BS-04	Migrate the traffic simulation to the second PC
PC 2	BS-05	Start the merged simulation
	-	Complete a questionnaire (A. Appendix: Usability Questionnaires)

Table 11: Emergency prototype task list

2.6.2. PILOT TEST

Before the execution of the usability test with the selected group of users a pilot test has been performed.

The pilot test was performed by Mattia Piunti from Vodafone IT. The test execution time was about 30 minutes (including the debriefing session).

During the execution of the pilot test no problems have been noticed with the tasks description and with their execution. The usability questionnaire has been judged as clear and direct. So, no change of the test plan has been performed at the end of the pilot test.

2.6.3. ANALYSIS OF COLLECTED DATA

As described in D6.4, four usability parameters have been considered. Every user first evaluated available simulations (i.e. flooding and traffic) separately, and then in the merged view at the end of a migration towards another PC. Moreover, the migration process usability has been evaluated.

Figure 27 and Table 12 show usability parameters mean values.

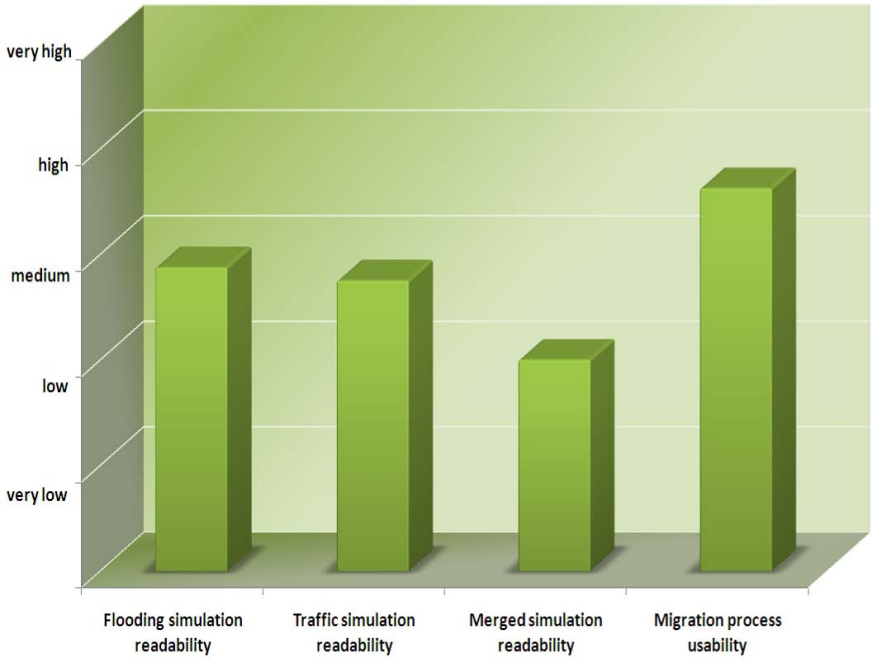

Figure 27: Emergency prototype usability

User	Flooding Simulation Readability	Traffic Simulation Readability	Merged Simulation Readability	Migration process usability
User 1	2	3	1	1
User 2	3	2	1	4
User 3	3	2	2	4
User 4	4	2	3	3

User 5	2	3	1	3
User 6	3	3	3	5
User 7	3	4	3	4
User 8	3	3	2	5
Mean	**2,875**	**2,75**	**2**	**3,625**

Table 12: Emergency prototype usability

Traffic and flooding simulations have been evaluated by the employed users with almost the same level of readability. Instead, the merged simulation has been considered to have a poor readability. This is probably related to the fact that the flooding simulation is represented using a soft color and it is covered by the traffic simulation. Moreover, several users noticed that the driving time simulation covers the map and makes it impossible to see street names and other details.

Almost all users appreciated the migration process because it is direct, quick and with a very good perceived continuity. Only one user gave a very negative evaluation of the migration process. This was due to a technical issue with the migration of the driving time simulation. In particular, if the user migrates the flooding simulation to another PC and then he moves the map on the target device, when the driving time simulation is migrated, it is modified by the migration. Even if this was not a technical test, the presence of this bug affected the user opinion.

The graphic in Figure 27 have been obtained by calculating the arithmetic mean of the usability parameters. Such parameters can vary from 1 (very low) to 5 (very high). A limited number of users have been involved in the testing activity (according to the test methodology described in D6.4) and the arithmetic mean could not give an accurate indication because the answer of a single user could affect the entire result. For this reason, the number of **satisfied users** for every usability aspect has been calculated (Figure 28). A user is considered as satisfied if its evaluation is greater than or equal to 3 (mean value).

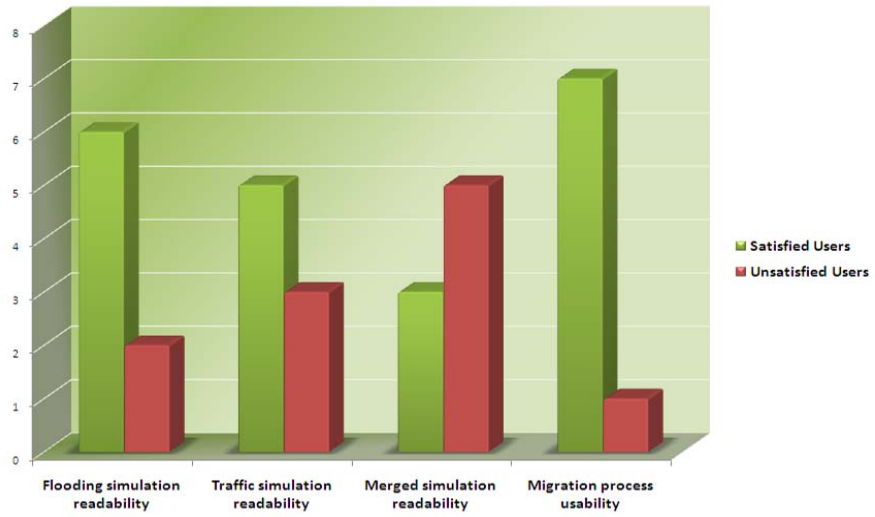

Figure 28: Emergency prototype satisfied users

As expected, the aspect of the prototype that is in need of an improvement is the merged simulation. In particular, it seems that simulations are simply superimposed, and in some points of the map the result is not readable.

A very good evaluation has been received by the migration process; it was appreciated by the end users for its usefulness and for its easiness.

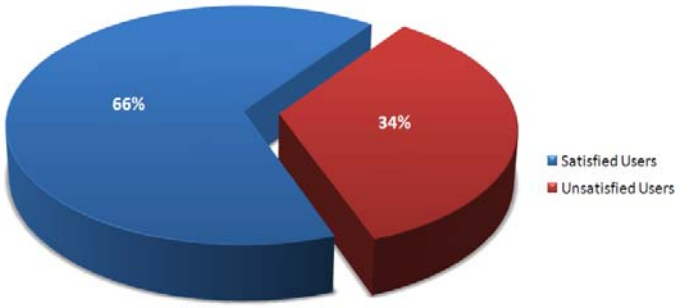

Figure 29: Emergency prototype satisfied users (mean value)

If the arithmetic mean is calculated for the percentage of satisfied users for all of the usability parameters (Figure 29), it can be noted that 66 % of the users is satisfied with the prototype usability.

Considering that the development cycle of this product is not completed, this result is very good.

2.6.4. STRONG POINTS

Migration procedure. The migration process offers an optimal usability level and it was appreciated by almost all of the employed users.

Flooding simulation. It was very readable and direct. Some users noticed that a legend could be needed, but all of them correctly understood the meaning of the displayed map.

2.6.5. WEAK POINTS

Merged simulation. The merge of traffic and flooding simulations does not offer a good level of readability. Often users were a bit confused by the displayed information. For example, when a heavy traffic condition is superimposed on a flooded area, some users asked: “how is it possible that cars are going on a flooded street?”.

Driving time simulation. Many users found the driving time simulation incomprehensible. A legend with the indication of calculated driving times and with an explanation of the simulation usage could be useful. Moreover, many users were unable to disable the simulation.

2.6.6. USERS’ SUGGESTIONS

During the task list executions and the debriefing sessions, users have given the following improvement suggestions:

- A strongest color for flooded areas would make the flooding simulation more clear. Moreover, flooded areas and the map should have contrasting colors.
- Even if the flooding simulation usage is direct, a legend could be useful.
- Some additional data about the flooding simulation could be useful (for example, water level, weather conditions, etc.)
- Traffic simulation on / off indications. Sometimes, users were not able to know if the traffic simulation was active or not. An additional indication could help in that situation.
- The traffic simulation legend should be a bit wider and it should be inserted into the map.
- A legend for the driving time simulation should be displayed in order to clarify the simulation meaning and its usage.
- As explained in the analysis of data paragraph, the driving time simulation covers the map, and thus it is impossible to see where the street it is referring to is located. The usage of transparent colors should fix this problem.

- A button used only to hide the driving time simulation could be useful. Many users, in the attempt to hide the driving time, started another driving time simulation because they were thinking that after a second pressure of the start simulation button it would be stopped.
- In order to help users to use the driving time simulation, the option to center the map on the selected point could be useful (the driving time simulation is performed from the center of the map).

2.6.7. FURTHER WORK

When the complete version of the Emergency application will be available, a validation usability test will be performed. During the validation, a more formal evaluation will be performed in order to explore all of the usability aspects (i.e. learnability, efficiency, memorability, errors, and satisfaction). A new task list that covers the most common use cases will be compiled. Moreover, the results of the assessment test will be used to define some reference values for usability parameters, in order to perform a more formal evaluation.

At last, using the experience that was gained during assessment tests, the expected execution time will be calculated for every task.

3. PROGRAMMABILITY EVALUATION RESULTS

3.1. CONTEXT MANAGEMENT FRAMEWORK

3.1.1. TEST DESCRIPTION

According to the test plan described in D6.4, a programmability validation test has been performed on the Context Management Framework (CMF) module. The information collected during the Programmability Assessment [D6.4] has been used and the Programmability Assessment template was completed with parametric and qualitative evaluations. The final version of the Programmability Assessment table of this module is available in B. Appendix: Programmability assessment tables.

In order to allow the CMF module to manage a new context variable (in the performed test it was the battery level of a device, represented by an integer value) the following steps have been performed:

- Development of a **Retriever**.
- Modification of the **DSAM** (Data Source Abstraction Manager) configuration file.
- Execution of a **CALA query** and of a **CALA subscription**.

SIAFU context generator has not been used, because the developed retriever was already able to generate the needed context information.

For a detailed description of the CMF please read D3.1.

THE CONTEXT RETRIEVER

A context retriever has been developed for the execution of the programmability validation.

It is a Java application, consisting of three classes:

- **Access Component**. In this class, a set of properties of the retriever is defined. The CMF, at the start-up, initializes these properties using the values defined in the DSAM configuration file. Moreover, the CMF uses the *init()* method of this class to instantiate the *Source* class.
- **Source.** This class retrieves the context variable. In particular, a method for the battery level retrieving has been developed.
- **Mapper.** This class is used to define the values returned by the CMF when CALA queries or CALA subscriptions are performed.

THE DSAM CONFIGURATION FILE

The DSAM configuration file is an XML file that is used by the CMF when it is started in order to initialize all implemented retrievers. It contains a *<retriever>* section for each retriever.

The following retriever definition has been added to the configuration file, in order to support the new context variable publication:

```
<retriever>
    <ac name="Simone" implClass="Vodafone.BatteryLevel.ac.BatteryLevelAccessComponent">
        <param name="sourceName">BatteryLevelSource</param>
        <param name="hostName">VodafonePC</param>
        <param name="minPollInterval">20000</param>
    </ac>

    <mapper id="batteryMapper"
        implClass="Vodafone.BatteryLevel.mapper.BatteryMapper">
    </mapper>

    <map attributeName="hasBatteryLevel" entityType="Battery"
            mapper="batteryMapper"
            source="BatteryLevelSource"
            type="http://www.w3.org/2001/XMLSchema#int">
    </map>
</retriever>
```

In this section, the Access Component and the Mapper that will be used for the management of the new context information are defined. Moreover, *minPollInterval*, *hostname*, and *sourceName* attributes have been defined for the access component (all of these parameters have been defined in the Access Component class). The *minPollInterval* value is 20000, in order to update the context information every 20 seconds.

CALA QUERY AND SUBSCRIPTION

A CALA query and a CALA subscription have been executed by the CMF module in order to verify that the new context variable was correctly retrieved and updated.

The CALA query has been used to retrieve the current battery level of the PC. The following query has been executed:

```
<query>
  <entityIdentifierSelector>
      <hasIdentifier>VodafonePC</hasIdentifier>
      <entityType>Battery</entityType>
      <attributeName>hasBatteryLevel</attributeName>
  </entityIdentifierSelector>
  <scope>
```

```
        <networkScope>NODE</networkScope>
    </scope>
    <options></options>
</query>
```

The *<entityIdentifierSelector>* section is used to select the attribute *hasBatteryLevel* of the device called "*VodafonePC*".

The CALA subscription has been used to automatically receive the battery level of the PC, when it changes. The following subscription has been performed:

```
<Subscription>
    <entityIdentifierSelector>
        <hasIdentifier>VodafonePC</hasIdentifier>
        <entityType>Battery</entityType>
        <attributeName>hasBatteryLevel</attributeName>
    </entityIdentifierSelector>
    <onChangeSubscriptionCondition>
        <kind>0</kind>
        <changeType>insertupdatedelete</changeType>
        <attributeName>hasBatteryLevel</attributeName>
    </onChangeSubscriptionCondition>
    <scope>
        <networkScope>NODE</networkScope>
    </scope>
    <options></options>
</Subscription>
```

The *<entityIdentifierSelector>* section is used as in the previous query. The *<onChangeSubscriptionCondition>* section contains the kind of event that will be notified. In this case, a notification should be received when *hasBatteryLevel* attribute changes.

3.1.2. TEST RESULTS

The test case contained in Table 13 has been executed. It has been defined in D6.4, but some minor changes have been performed. In particular, it was not needed to use the SIAFU context information generator and besides the CALA query, also a CALA subscription has been performed.

ID	Programmability_CMF_1- TEST PASSED
Module	CMF

Description	The objective of the test is verifying that the CMF properly collects and makes the context information available.
Input	• A new context Retriever is developed for the publication of a new context variable. In particular, the property *hasBatteryLevel* is defined for a device. • The CMF is configured using a proper XML file in order to acquire this new variable. • Execution of a CALA query and of a CALA subscription.
Expected output	The CMF should return the battery level when the CALA query is executed. The CMF, after the CALA subscription execution, should return the battery level at every change.
Actual output	The following output is obtained after the CALA query execution: *<entities> <entity> <hasIdentifier>VodafonePC</hasIdentifier> <entityType>Battery</entityType> <attribute> <name>hasBatteryLevel</name> <type>http://www.w3.org/2001/XMLSchema#int</type> <value> <Integer>2</Integer> </value> <metadata> <name>timestamp</name> <type>MetaData</type> <value> <string>1256560082806</string> </value> </metadata> </attribute> </entity> </entities>* The expected value (hasBatteryLevel=2) is returned. The following output is obtained after the CALA subscription at every change of the battery level: *Notification no 5 has been received:* *<Notification> <globalSubscriptionId>*

	<subscriptionId>0</subscriptionId> <nodeIdentifier>192.168.1.60:8002</nodeIdentifier> </globalSubscriptionId> <entities> <entity> <hasIdentifier>VodafonePC</hasIdentifier> <entityType>Battery</entityType> <attribute> <name>hasBatteryLevel</name> <type>http://www.w3.org/2001/XMLSchema#int</type> <value> <Integer>5</Integer> </value> <metadata> <name>changeType</name> <type>MetaData</type> <value> <string>insert</string> </value> </metadata> <metadata> <name>timestamp</name> <type>MetaData</type> <value> <string>1256559961541</string> </value> </metadata> </attribute> </entity> </entities> <options/> <SourceNodeIdentifier>192.168.1.60:8002</SourceNodeIdentifier> <DestinationNodeIdentifier>192.168.1.60:8002</DestinationNodeIdentifier> </Notification> The expected value is returned.
General considerations	The CMF correctly managed the new context variable during the CALA query and the CALA subscription execution.

Table 13: test case Programmability_CMF_1

The results of the performed test case are positive because the expected results have been obtained during both CALA query and CALA subscription execution.

PARAMETRIC EVALUATION

As stated in D6.4, the following parameters have been taken into account:

- **Consistency**: the module behavior is compliant with the parameters defined in the configuration file. Vodafone team gave the module consistency the following numerical evaluation: **5/5**.
- **Robustness**: the module offers an average level of robustness. Two robustness tests have been performed. During the first one, a CALA query containing an unrecognized tag has been executed. The CMF did not return the required value (as expected) but, after the wrong query execution it was still up and running. This behavior was considered correct because the error affected only the CALA query and did not affect any other aspect of the module. During the second test, an error has been added in the DSAM file (a wrong class name has been defined for the new Access Component). When the CMF has been started, some error messages were displayed, and not only (as expected) the retriever with the wrong configuration was not available, but also the CMF module start-up failed. This behavior was not considered correct because the CMF propagated a configuration error from a single retriever to the entire node. In order to fix this problem, and to improve the module robustness, one of the following solutions could be applied:
    1. The simplest solution is to modify the CMF in order to handle DSAM file errors, by loading the retrievers with a correct configuration and discarding the other ones. The usage of the OSGi environment would be helpful, because if a retriever fails for some reason, it will not cause the Context Agent to fail as it does in this version (i.e. the OSGi also provides some shielding from faulty sub components).
    2. Another solution, that would also make easier the module configuration, is to implement a graphical tool for the DSAM editing. In this way, the new retriever parameters could be verified at the moment they are inserted and they would be saved only when there are no errors.

    Vodafone team gave the module robustness the following numerical evaluation: **3/5**.
- **Runtime efficiency**: no specific measuring tools are available for the runtime efficiency evaluation. However, the definition of a new retriever does not have any effect on the CMF performances that the end user could notice. It was not possible for the Vodafone team to give the module efficiency a numerical evaluation.
- **Extensibility**: a very good level of extensibility has been reached by this module. Vodafone team gave this parameter the following numerical evaluation: **5/5**.

QUALITATIVE EVALUATION

During the programmability evaluation of the CMF module, the following characteristics have been identified:

- Flexibility. The CMF module offers a good level of flexibility. It is possible to define new variables and they are correctly managed by the module. Moreover, the mechanism provided for the definition of new variables is consistent and it does not seem to have any effect on the module performances.
- Simple mechanism for a variable request. It is very simple to get a variable from the CMF module. In particular, only a CALA query or a CALA subscription is needed to get the required variable. Moreover, this value is returned in a simple XML format.
- Java retriever needed. In the tested version, a developer is forced to implement the retriever using Java. A programmability enhancement of the module could be the definition of a

mechanism that allows the application developer to choose which language to use (for example using XML-RPC or SOAP).

Parametric and qualitative evaluation results have been used for the completion of the Programmability Assessment performed in D6.4. The complete version of the Programmability Assessment table of this module is available in B. Appendix: Programmability assessment tables.

3.1.3. FURTHER WORK

At the end of the module development cycle, as stated in D6.4, a new programmability evaluation will be performed.

The programmability results of the evaluation performed on the current version of the CMF are quite good, and a further improvement of the module is expected for the next evaluation. In fact, CMF is the key module for the definition of new variables in the OPEN Migration Service Platform and its programmability is very important.

The version of the module that will be used for the next evaluation will employ the OSGI technology that will make possible to add/remove a retriever without the restart of the CMF and to enhance the module flexibility.

3.2. WEB UI ADAPTATION

3.2.1. TEST DESCRIPTION

As planned in D6.4, a programmability validation has been performed on the Web UI Adaptation module. The information collected during the Programmability Assessment [D6.4] has been used and the parametric and qualitative evaluation is added.

This module, as described in D6.4, has a configuration tool that offers the option to set some parameters used during the application of splitting and mapping rules.

The main purpose of a **splitting** rule is to define when a web page has to be split in two or more parts to improve its readability on a mobile phone. A **mapping** rule, instead, regulates the modification of a web page element. Two examples of mapping are the transformation of a radio-button in a pulldown-menu and the resizing of an image.

The test plan described in D6.4 has been applied to the module configuration tool, in order to evaluate its conciseness, usability, fulfillment, and consistency. Moreover, an additional test case has been added in order to test the mapping parameter “minimum_Font_Size”.

3.2.2. TEST RESULTS

The following test cases have been performed. The first three of them have been defined in D6.4, while the last one has been added for the testing of a new mapping rule. Not performed test cases are available in C. Appendix: Not Performed Programmability Test Cases.

ID	Programmability_WebUIAdaptation_2- TEST PASSED
Module	Web UI Adaptation
Description	The objective of the test case is verifying the effect of modifying a **mapping rule** in the Web UI Adaptation module (when passing from desktop to mobile). In particular, the concerned rule allows specifying the maximum dimension that images can have when doing the adaptation from a desktop UI to a mobile one. In particular, the concerned rule takes in input **Image_MaxDim**, which is supposed to represent the **maximum dimension that images can have on the mobile UI=(MaxWidth, MaxHeight).** This rule can transform the various images existing in the desktop UI by resizing them according to the specified size value **Image_MaxDim**, defined in terms of width and height). This resizing process should be carried out in such a way that the original image aspect ratio will be preserved, and the size of the adapted image should be equal (or less) than the specified parameter **Image_MaxDim.**
Input	**Image_MaxDim** Maximum image dimension that images can have on the mobile device. It is specified through a couple of integers (Image_MaxWidth, Image_MaxHeight) representing the maximum width and the maximum height (in pixels) that an image can assume on the mobile target platform.
Expected output	For each image belonging to the desktop UI: if the dimension of the considered image is bigger than Image_MaxDim, the considered image is resized according to the specified dimension Image_MaxDim. Otherwise, the considered image maintains its own dimension on the mobile target platform (then, no resizing transformation is performed).

Actual output	Images are correctly resized according to the maximal height and the maximal width indicated. Images aspect ratio is not preserved.
General considerations	It is strongly recommended to add images aspect ratio preservation to the prototype. In fact, this feature could be quite important for the usability level of adapted web pages.

ID	Programmability_WebUIAdaptation_3- TEST PASSED
Module	Web UI Adaptation
Description	The objective of the test case is to understand the effect of modifying a **splitting rule** in the Web UI Adaptation module (when passing from desktop to mobile). The assumption is that **Height_Resolution** is the resolution of the actual height of the mobile screen expressed in pixels. This rule allows for modifying the height resolution associated with the mobile target device, by multiplying the device screen's actual height of a factor (namely, the **Tolerance** parameter). In this way, the height associated with the device screen is considered as "extended" through this tolerance factor to this newly calculated screen height, so as to be able to include more UI objects in the same presentation, and also enabling a number of (vertical) scrolling actions on a presentation. If the total cost of the presentation (namely, the sum of the costs of the various objects contained in the same presentation, let's call it **Total_Cost**) exceeds the "extended" capability of the mobile device, then a splitting transformation is carried out. This means that multiple pages are created on the mobile platform (starting from the original desktop single presentation), together with additional links for navigating between the newly created pages. Otherwise the presentation is not split.
Input	**Tolerance** This integer value represents the factor according to which the height resolution of the mobile device screen is multiplied. The goal is to enable an increased tolerance towards the device screen's height, in order to allow that more UI objects are

	contained in the same presentation, which can be accessed through a number of scrolling actions (on the vertical axis). Then, if Tolerance>1, a vertical scrolling is enabled in the target mobile UI. **Height_Resolution** This integer is the resolution of the actual height of the mobile screen expressed in pixels
Expected output	If ((**Tolerance** * **Height_Resolution**)> **Total_Cost**) then the presentation is split in multiple presentations, otherwise a single presentation is maintained on the target device.
Actual output	Web pages are correctly split according to the height and tolerance parameters. In the current implementation of the configuration tool, the Height_Resolution parameter is called device_Resolution_Height.
General considerations	

ID	Programmability_WebUIAdaptation_4- TEST PASSED
Module	Web UI Adaptation
Description	The objective of the test case is to understand the effect of modifying a splitting rule in the Web UI Adaptation module (when passing from desktop to mobile). In particular, the concerned rule focuses on the adaptation of a presentation containing a textual interactor, and how it can vary in a programmable way. More specifically, in this rule it is shown to what extent the cost of a certain textual element can vary depending on the values of the specified programmable input parameters manipulated by the concerned splitting rule (namely, such parameters are ExpectedScreenWidth and LineCost, see below). Such a variation of the cost associated with the textual interactor might lead to a *possible* splitting (since such a

	splitting also depends on the costs of the other UI elements included in the presentation) of the presentation containing such interactor.
Input	ExpectedScreenWidth The number of characters that are expected to be contained in a single line of the screen. This property might be found within the list of device capabilities, but the user can also specify a value for it. LineCost The cost assigned to a single line. The idea is that it should correspond to the height resolution of the text expressed in pixels. It is worth pointing out that in the current version of the prototype for handling the programmability configuration it is not possible to specify directly a value for this parameter. Indeed, this value is calculated depending on the current values of: i)the **current_Font_size** used in the desktop presentation (which is not a programmable parameter), and ii)the programmable input parameter **minimum_Font_Size.** Then, the algorithm for determining the value for the parameter LineCost is the following: If **(current font size)> minimum_Font_Size** **then LineCost= current_Font_size** **else LineCost= minimum_Font_Size**
Expected output	If we consider a textual interactor we can calculate its cost in the following way: TextualInteractorCost = (NumLines * Line Cost) where NumLines is the number of characters contained in the textual interactor, divided by ExpectedScreenWidth. Since the total cost of the presentation containing the textual interactor can also contain other UI elements, the total cost of the presentation can be calculated in the following way: TotalCost = TextualInteractorCost + (Cost of the remaining part of the presentation)

	If TotalCost > (HeightResolution of the mobile device screen) then a splitting is carried out, and the original single presentation is transformed into multiple presentations on the mobile device. Otherwise no splitting action is performed.
Actual output	In the tested version of the configuration tool the ExpectedScreenWidth parameter was substituted by the numCharsLine parameter (keeping the same meaning). However, the module behavior was coherent with the parameter values.
General considerations	

ID	Programmability_WebUIAdaptation_5- TEST PASSED
Module	Web UI Adaptation
Description	The objective of the test case is verifying the effect of modifying a **mapping rule** in the Web UI Adaptation module (when passing from desktop to mobile). In particular, the concerned rule allows for specifying the minimum font size to be used during the adaptation from a desktop UI to a mobile one. In particular, the concerned rule takes in input **minimum_Font_Size**, which is supposed to represent the minimum font size that text can have on the mobile UI.
Input	**minimum_Font_Size** Minimum font size that text can have on the mobile UI.
Expected output	Web pages should be adapted for a mobile phone, using the following rule: • the text of the original web page with font size greater than minimum_Font_Size is not modified

	• the text of the original web page with font size lower than minimum_Font_Size is resized and a font size equal to minimum_Font_Size is used.
Actual output	Text is correctly resized, according to minimum_Font_Size value.
General considerations	

PARAMETRIC EVALUATION

The following parameters have been evaluated by Vodafone Team:

- **Conciseness** (capability of specifying the module behaviour in a synthetic way): *5/5* (weight: 1). The web adaptation configuration tool offers a good level of conciseness. In fact, a very simple and easy to use tool is provided for the modification of adaptation parameters.

- **Fulfilment** (capability of specifying the required workflow patterns): *2*/5 (weight: 3). The web adaptation configuration tool offers the option to set a restrict set of parameters. Moreover, it is not possible to associate a rule to a set of mobile phones (for example, it is not possible to use a different set of adaptation parameters for mobile phones with a touch-screen), but every rule is applied to every device. However, at this stage of the module development lifecycle, this behaviour is acceptable and the first version of the configuration tool shows that an important work has been done to offer some programmable features.

- **Usability** (usability of the provided tool): *4/5 (*weight: 2). The web adaptation configuration tool offers a good level of usability. It is a web application with a simple user interface that is very direct and very easy to learn. The only missing thing is a user guide but, for the most of the use cases it is not needed. In Figure 30 it is possible to see the configuration tool user interface.

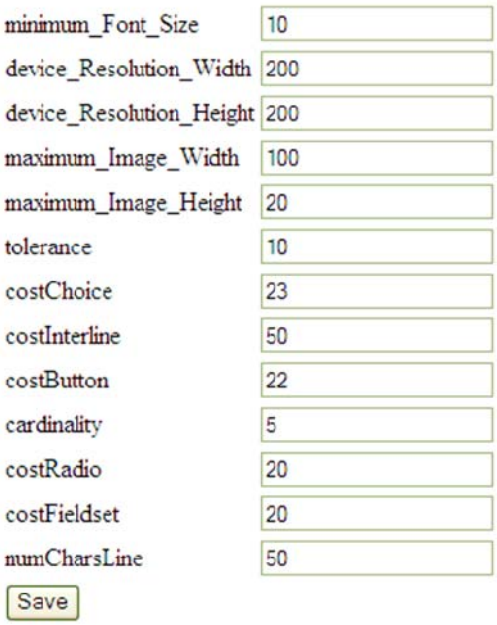

Figure 30: Web Adaptation configuration tool

Using the weights defined in D6.4, the value **3.17** has been obtained as a mean value between Conciseness, Fulfilment and Usability. Considering that the tested prototype is still under development, this can be regarded as a good result.

QUALITATIVE EVALUATION

The configuration tool offered by the Web UI Adaptation module is very easy to use and every supported feature of the configuration tool is consistent with the expected behavior.

In the tested version only a restricted set of parameters was available and it was not possible to create a new rule (for example, when several devices are using the module, the following rule could be defined: the max image height must be half of the device screen height, with the device height that is automatically retrieved from the WURFL repository).

No efficiency measure has been performed on the Web UI Adaptation in order to evaluate the effects of the reconfiguration on the module performances. However, no relevant problem has been noticed during the testing activity.

Considering that the application development lifecycle had not been completed, the Web UI Adaptation module offers a good programmability level.

Parametric and qualitative evaluation results have been used for the completion of the Programmability Assessment performed in D6.4. The complete version of the Programmability Assessment table of this module is available in B. Appendix: Programmability assessment tables.

3.2.3. FURTHER WORK

During the next testing iteration a new programmability evaluation will be performed on the Web UI Adaptation module. A new test plan will be created and then executed in order to test the main features of the final and complete version of the configuration tool.

3.3. SERVER SIDE APPLICATION LOGIC RECONFIGURATION

3.3.1. OVERVIEW

This module is responsible for the adaptation of the application logic during runtime. Application logic is realized by components which interact through interfaces. Thus, the task of this module is to change the wiring of the components and their internal behavior like introduced in D4.1. OSGi technology has been employed and application components are implemented as OSGi bundles.

This module is the key module for enabling the OPEN applications programmability. For that reason, even if no programmability validation was foreseen, as stated in D6.4, a theoretical programmability analysis will be performed in this chapter.

The Programmability Assessment performed in D6.4 on the Server Side Application Logic Reconfiguration has been used as a starting point for this analysis. For that reason, the Programmability Assessment table of the module has been included in B. Appendix: Programmability assessment tables. The current version of the module does not offer any configuration tool, so no validation test has been executed.

The purpose of the performed analysis is to suggest some programmability requirements for the Application Logic Reconfiguration module and to suggest some guidelines on how programmability could be implemented.

The following programmability aspects could be addressed by the Application Logic Reconfiguration module fit with the scope of our analysis:

- Application Configuration. An easy and flexible way could be implemented for the definition or the modification of an application configuration. Two use cases are taken into account: the creation of a new application and the modification of an existing one.
- Rewiring rules. An easy and flexible procedure could be available for the definition of the conditions (for example a low battery level, outdoor/indoor location, etc.) that could trigger a modification of the application configuration. Two use cases are taken into account: the creation of a new rule and the application of an existing rule to a new application.

- Bundles quality of service. It could be possible to modify in an easy way the bundle quality of service. This part is up to the application developers, but the development of some guidelines could grant a good level of programmability. Two use cases are taken into account: the creation of a new bundle and the modification of an existing application.

3.3.2. APPLICATION CONFIGURATION

OPEN application developers should be able to define all of the available configurations for their applications.

The first use case is the creation of a new application. The following steps are taken into account:

- A new application is developed
- The application has at least two configurations (for example “Energy saving configuration” and “High performance configuration”)
- Application configurations are defined in the Application Logic Reconfiguration module

- **Current status:**

  In the current implementation of the module, new application configurations are created using the Java language. The module development team is currently creating a new version of the module, where a configuration file is employed.

- **Improvement proposals:**

  In this use case, the definition of application configurations should have a very low impact on the application development. Moreover, application developers do not have to know in details how the application logic reconfiguration works, but they just have to learn an easy way to use a development pattern and/or a configuration tool for application configuration definition. Please take into account that this point is very important for the application configuration usefulness because, if a configuration definition is too difficult, part of the advantage of the usage of an application reconfiguration module is compromised. For example, if the configuration definition is very complicated, for a simple application it would be easier to develop two distinct versions than to create two configurations of the same one.

The second use case is related to the modification of an existing OPEN application. The following steps are taken into account:

- An OPEN application with at least two configurations (for example “Energy saving configuration” and “High performance configuration”) already exists
- The application is modified (for examples, two bundles used by the previous “Energy saving configuration” are replaced by a new single bundle)

- Application changes require a modification of one or more application configurations (for example, “Energy saving configuration” needs to be modified)
- Application configurations are updated in the Application Logic Reconfiguration module

- **Current status:**

  In the current implementation of the module, application configurations can be updated editing the Java code of the application. The module development team is currently creating a new version of the module, where a configuration file is employed.

- **Improvement proposals:**

  In this use case it must be possible to edit the application configuration in the easiest way. It could be useful to create or to edit an application configuration using a graphical tool or at least a configuration file. It would be preferable to avoid the hardcoding of configurations in order to not force developers to modify their application when only a new configuration is required.

3.3.3. REWIRING RULES

When some context information changes, an OPEN application could be in need of a reconfiguration. For example, when a device battery level is lower than an expected threshold, the application could be reconfigured for an energy saving mode.

The first use case is the creation of a new rewiring rule. The following steps are taken into account:

- An OPEN application with at least two configurations is available (for example “Energy saving configuration” and “High performance configuration”)
- A new rewiring rule is created for the application (for example: if the device battery level is lower than 50% then use “Energy saving configuration”)

- **Current status:**

  In the current implementation, the module is not able to handle context information in a generic way. If context information has to be used (for example the battery level), it has to be hard-coded into the components. The module development team is currently creating a new version of the module that handles context information using the Context Management Framework.

- **Improvement proposals:**

  The availability of a configuration tool for the creation of new rules is very important for the module programmability. Moreover, the definition of new rules should be independent from the application development because in any time new context information could become available and the platform manager or the end user her/himself could be in need to define a new rule. Please note that the definition of new rules is also required by the other modules (for example the Trigger Management) of

the platform and, for that reason, a common configuration tool could be useful for the definition of rules in the OPEN Migration Service Platform.

The second use case is the application of an existing rule to a new application. The following steps are taken into account:

- the application A with an “Energy Saving A” configuration and with a “High Performance A” configuration is used in an OPEN Migration Service Platform.
- the following rewiring rule is defined for the application A: if the device battery level is lower than 50% then use “Energy Saving A” configuration, otherwise use “High Performance A” configuration.
- the application B needs to be configured in order to use a battery saving configuration when the battery level is lower than 50% and a high performance configuration when the battery level is grater or equal to 50%

- **Current status:**

  In the current implementation it is not possible to reuse the rewiring rules.

- **Improvement proposals:**

  It would be useful to create a mechanism for the reuse of already defined rules. In this way, the following advantages could be obtained:

  - It would be not necessary to repeat the rule creation for every application. This is important because some events (as the battery level or the user location) can be used by several applications
  - If a rule is modified and the same one is used by more than one application, only one modification is needed. For example, if the user buys a new device, with a higher battery life, s/he would be in need of changing the battery level threshold from 50% to 30%. If the same rule is used by 10 applications, only a modification is needed to change the behavior of 10 applications.

3.3.4. BUNDLES QUALITY OF SERVICE

Developers of OPEN applications can define, for every bundle, a value of quality of service. A proper procedure for the definition of these values must be provided to application developers, in order to make sure that a good level of programmability is granted.

The first use case is the creation of a new application. The following steps are taken into account:

- A new OPEN application that uses the Application Logic Reconfiguration module is created.

- For each bundle of the application, a quality of service value is defined.

- **Current status:**

  In the current implementation Quality of Service is hardcoded in application bundles.

- **Improvement proposals:**

  It is very important for this use case to make itpossible to define the QoS in an easy way. Moreover, this procedure should not require an in-depth knowledge neither of the OPEN architecture nor of the application logic reconfiguration module.

The second use case is the modification of an OPEN application. The following steps are taken into account:

- An OPEN application that uses the Application Logic Reconfiguration module already exists.
- A modification of the application (for example the development of a new bundle) requires that the quality of service of bundles is changed.

- **Current status:**

  In the current implementation, Quality of Service is hardcoded in application bundles. So, in order to modify its value it is needed to edit and then recompile application bundles.

- **Improvement proposals:**

  In order to grant a good level of programmability in this case, the hardcoding of quality of services is strongly discouraged.

  A good solution should be to define, for every OPEN application, a configuration file or a configuration tool, in order to change quality of services in a very easy way and without recompiling the application. Even if OPEN applications are not developed by Application Logic Reconfiguration developers, the definition of a simple and easy to learn development pattern for the definition of quality of services could grant a good level of flexibility.

4. TECHNOLOGICAL EVALUATION RESULTS

This section lists the technological evaluation results for the prototypes tested in the first iteration.

For each of them, some general information is presented (e.g. date/time of testing, partners, etc.), with an overview of the results. Then, the detailed report follows, with the results of each test case scheduled. The last paragraph is dedicated to a possible further work (if there) for the particular prototype: future development and possible contributes to it, need for a deeper evaluation, etc..

As explained in the previous D6.4, some prototypes were selected for the first iteration of this technological evaluation, according to different criteria, from the feasibility of a testing based on the approaches previously described in both D6.3 and D6.4, to the relevance of the prototype for the following development within the OPEN project: the overall aim was to perform an effective technical test experience, giving a real added value to the project.

Therefore, three prototypes have been finally evaluated during this first testing experience:

Web migration is the basis for the OPEN platform middleware, it allows to migrate web applications between different devices, and it includes several modules:

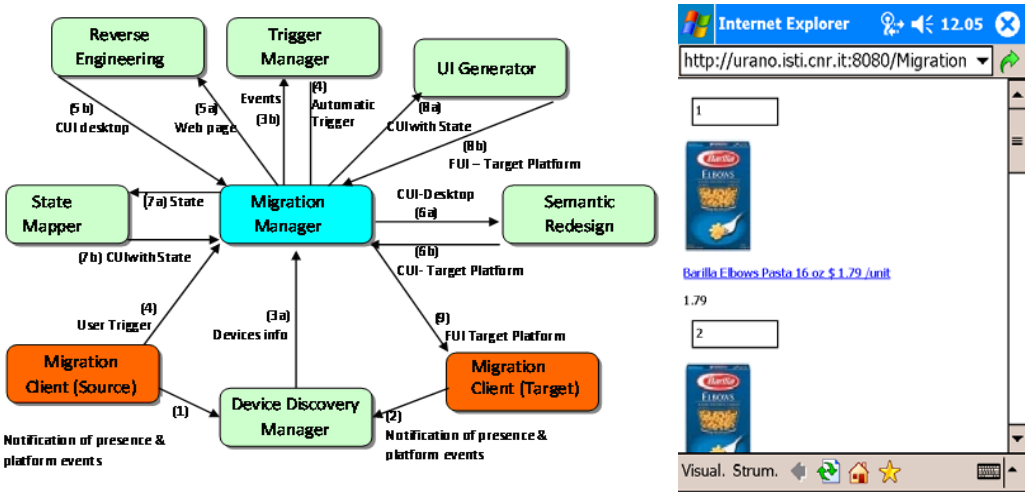

Figure 31: Modules involved in the web migration / An adapted web page

The other two prototypes to test are aimed at supporting the application migration; there is a third prototype within D3.2, but it mainly concerns the configurability area and especially the application logic reconfiguration, hence the technological test has been considered not relevant at this stage of development. The solutions considered for a technological evaluation are currently working more or less independently, but they represent a strong basis for further work, since in the future they will work together in the integrated OPEN platform (in fact the consortium already developed partially integrated prototypes for the second review meeting).

Trigger management and context information management, within the migration support stream, allows the migration of a video-streaming application based on context information, thus realizing the context aware management of the mobility:

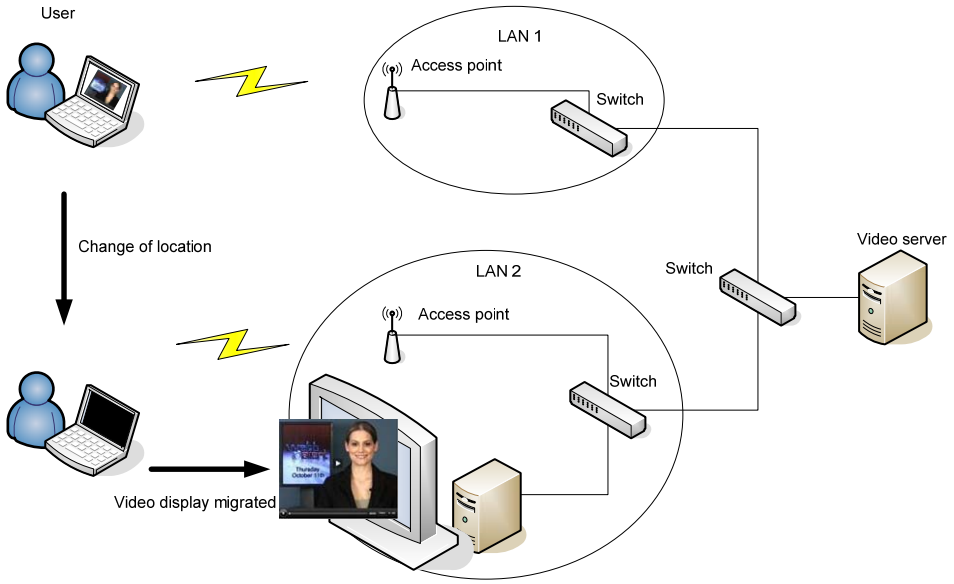

Figure 32 Trigger management for video-streaming migration

Device selection map is for the web migration prototype the graphical support to discover and target the available and compatible devices, being embedded on the OPEN-client.

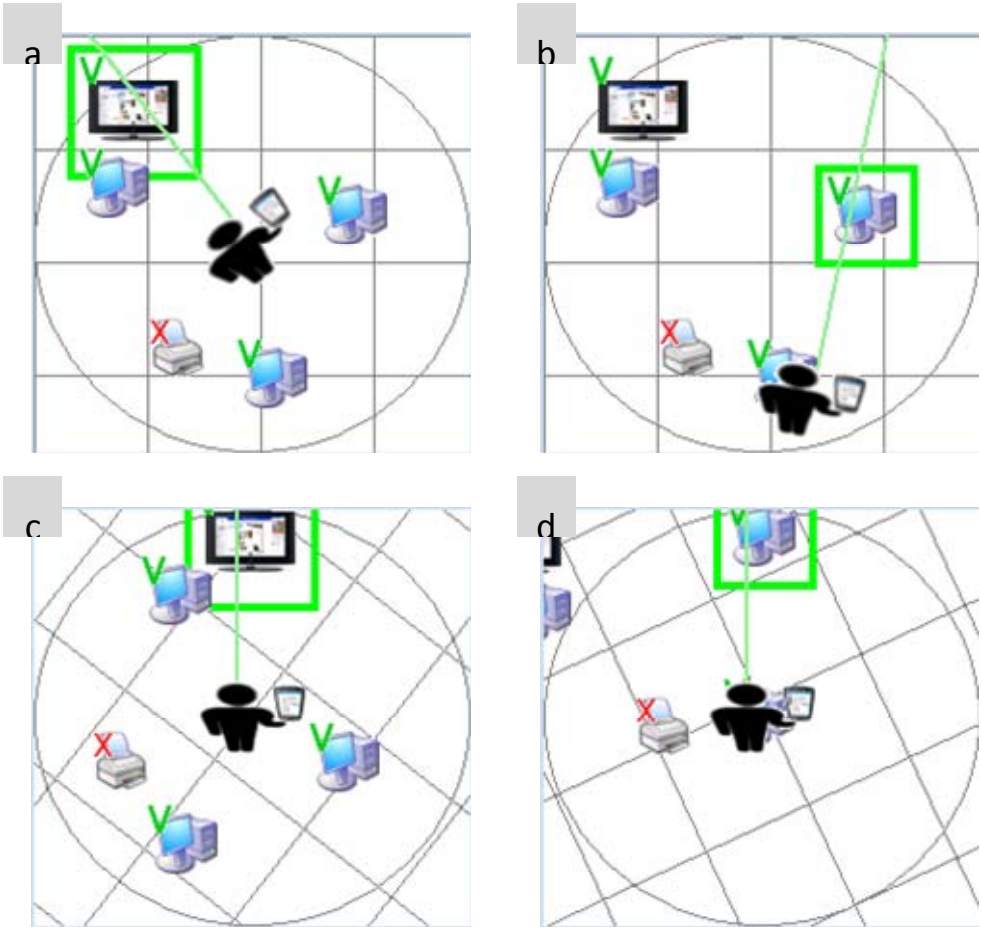

Figure 33: Graphical choices for device selection map

The evaluation results for each of these prototypes follow.

4.1. FROM D2.1: WEB MIGRATION

4.1.1. GENERAL INFO

Date/time of testing:	W29-W31 -July 2009
Testing	Vodafone Italy (tester) and CNR (prototype owner)

partners:	
Testing environment:	TSCC lab (Vodafone Italy), with remote connection to CNR server in Pisa. The connection was based on private addresses internally to the lab, with NAT to public addresses in Vodafone Italy network in order to reach destination peer in Pisa.
Other notes:	

4.1.2. OVERVIEW

This test needed a long period of setup: in fact, the network security policies, the consequent implementation of NAT in VF-IT lab, and some necessary prototype configurations and adjustment from CNR, require a consistent spent of time.

The Y/N requirements and some indicators (accessibility and adherence to the standards) were fully tested, while the evaluation of performance indicators, due to the still missing stability of the prototype was skipped. This part will be postponed to the further phase of testing.

About the behavior of the prototype, the test experience was mainly impacted by a major issue: the missing migration from the PDA to the PC; in fact, while the migration from PC to PDA worked well, in the opposite way the migration did not take place after that the user accepted it. This was the only concrete reason for not passing (or partially passing) the test cases performed.

The other functionalities foreseen in the application description, concerning the adaptation and other functional requirements (e.g.: user registration), were fully accomplished, as for the specific OPEN requirements mentioned in the test list.

The levels of accessibility and adherence to the standards were evaluated on five application web pages (see E. Appendix: Accessibility and Adherence to the Standards Test Report for their report) by respectively using Wave and W3C tools: the level of accessibility was good (only one error and in only one page), while some errors raised about W3C specs, to be avoided during the next phase of development.

Some test cases (e.g. context management integration, system-triggered migration) were not performed since they were not supported at this development stage. Not performed test cases are described in D. Appendix: Not Performed Technological Test Cases.

4.1.3. TEST REPORT

This is the list of the test cases foreseen for the Web migration prototype, with the results.

The outcome for the Y/N requirements to be checked is displayed in Figure 34.

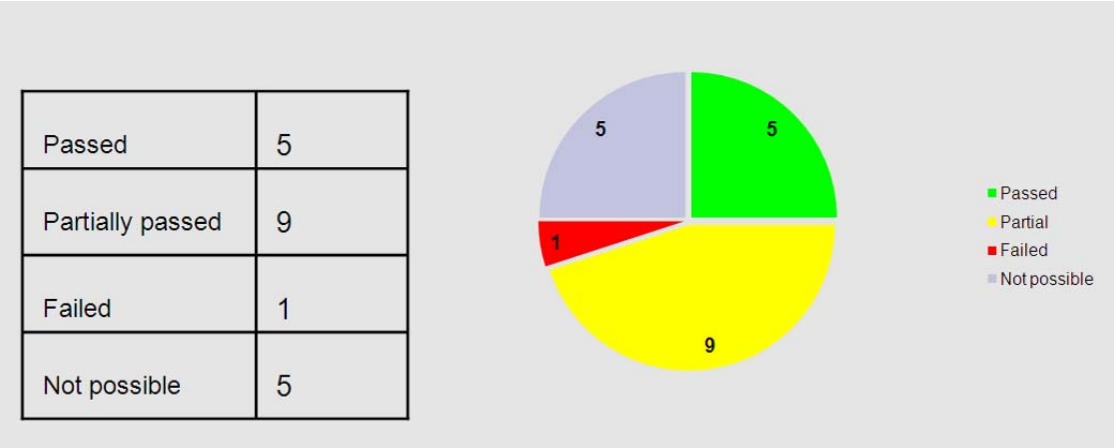

Figure 34: test results

On the other hand, each of the indicators measured can be found in the specific test cases.

Naming convention used for the following test cases:

- Application: since the planned tests follow the "Black Box testing" method, with "application" we mean the final Web UI prototype, composed by the shopping list application and the middleware modules enabling the migration and adaptation. However, the requirements that will be tested explicitly refer to migration and adaptation aspects implemented by the prototype modules that will be the bases of the final OPEN middleware. In fact, the aim of the testing activity is validating the middleware behavior rather than the application on top of it.
- OPEN platform: since the test cases have been elicited starting from the requirements and they aim to be further reused for the second testing iteration, they are formulated referring to the "OPEN platform", but in the evaluated prototype only some modules that will be part of the OPEN platform have been developed. Hence, we refer to these modules when introducing tests referring to the OPEN platform.

Web Migration test cases:

ID	OPEN Technological test plan Web migration TC1 – FAILED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 86 - Migration should be triggered by the user
Input	Step 1:

	The application is being run on the device A (PC) The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC)
Expected output	Step 1: The application migrates from device A to device B Step 2: The application migrates from device B to device A
Actual output	Step 1: The application migrates from device A to device B Step 2: The application does not migrate from device B to device A
General considerations	The migration is not performed, even if the user accepts when he/she see the confirmation window.

ID	OPEN Technological test plan Web migration TC5 - PASSED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 157 - The OPEN platform should be installed and listening for any device requesting migration
Input	Step 1: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC)
Expected output	Step 1: The application shows (e.g. with a message) it has received the request Step 2: The application shows (e.g. with a message) it has received the request
Actual output	Step 1: The application shows (e.g. with a message) it has received the request

	Step 2: The application shows (e.g. with a message) it has received the request
General consideration	

ID	OPEN Technological test plan Web migration TC6 – PARTIALLY PASSED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 54 - It must be possible to continue my current service seamlessly across multiple devices
Input	Step 1: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC)
Expected output	Step 1: The application migrates from device A to device B maintaining its current state (same web content showed, same user profile, same items bought…) Step 2: The application migrates from device B to device A maintaining its current state (same web content showed, same user profile, same items bought…)
Actual output	Step 1: The application migrates from device A to device B maintaining its current state (same web content showed, same user profile, same items bought…) Step 2: The application does not migrate from device B to device A
General consideration	This TC has been considered as partial passed since the missing migration is already included in the result of TC1

ID	OPEN Technological test plan Web migration TC8 – PARTIALLY PASSED

Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 162 - The OPEN platform should be able to maintain the data inserted by the user in the source device and show them in a consistent way after migration on the target device
Input	Step 1: The application is being run on the device A (PC) Insertion of user data The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) Insertion of user data The user asks for migrating on the device A (PC)
Expected output	Step 1: The application migrates from device A to device B maintaining the user data previously inserted Step 2: The application migrates from device B to device A maintaining the user data previously inserted
Actual output	Step 1: The application migrates from device A to device B maintaining the user data previously inserted Step 2: The application does not migrate from device B to device A
General consideration	This TC has been considered as partially passed since the missing migration is already included in the result of TC1

ID	OPEN Technological test plan Web migration TC9 - PARTIALLY PASSED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 163 - The OPEN platform should present the last data inserted by the user on the

	source device in the first presentation provided to the user in the target device
Input	Step 1: The application is being run on the device A (PC) The user selects an item/completes a purchase (Item 1) The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) The user selects an item/completes a purchase (Item 2) The user asks for migrating on the device A (PC)
Expected output	Step 1: The application migrates from device A to device B showing the item selected/a purchase complete message concerning Item 1 Step 2: The application migrates from device B to device A showing the item selected/a purchase complete message concerning Item 2
Actual output	Step 1: The application migrates from device A to device B showing the item selected/a purchase complete message concerning Item 1 Step 2: The application does not migrate from device B to device A
General consideration	This TC has been considered as partially passed since the missing migration is already included in the result of TC1

ID	OPEN Technological test plan Web migration TC11 - PASSED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 61 - The user does not want to care about networking aspects when trying to migrate
Input	Step 1: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC)

Expected output	Step 1: The application doesn't ask any network parameter (ports, addresses…) before to migrate Step 2: The application doesn't ask any network parameter (ports, addresses…) before to migrate
Actual output	Step 1: The application doesn't ask any network parameter (ports, addresses…) before to migrate Step 2: The application doesn't ask any network parameter (ports, addresses…) before to migrate
General consideration	

ID	OPEN Technological test plan Web migration TC12 – PARTIALLY PASSED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 115 - OPEN enables the user to get, what s/he individually can handle, i.e. the information remains not only complete, but in terms of perceived complexity understandable after a migration
Input	Step 1: The application is being run on the device A (PC) The user selects an item/completes a purchase (Item 1) The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) The user selects an item/completes a purchase (Item 2) The user asks for migrating on the device A (PC)
Expected output	Step 1: The application migrates from device A to device B showing in a clear way, fully understandable by the user, the item selected/a purchase complete message concerning Item 1 Step 2:

	The application migrates from device B to device A showing in a clear way, fully understandable by the user, the item selected/a purchase complete message concerning Item 2
Actual output	Step 1: The application migrates from device A to device B showing in a clear way, fully understandable by the user, the item selected/a purchase complete message concerning Item 1 Step 2: The application does not migrate from device B to device A
General consideration	This TC has been considered as partially passed since the missing migration is already included in the result of TC1

ID	OPEN Technological test plan Web migration TC13 - PASSED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 156 - The input devices must be able to support the same actions
Input	Step 1: The application is being run on the device A (PC) The user completes a transaction (log in, search, offer, buy, pay, log out) Step 2: The application is now being run on the device B (PDA) The user completes a transaction (log in, search, offer, buy, pay, log out)
Expected output	For all the functionalities: if one is supported by the device A, it is supported also by device B, and vice versa.
Actual output	For all the functionalities: if one is supported by the device A, it is supported also by device B, and vice versa.
General consideration	

ID	OPEN Technological test plan Web migration TC14 – PARTIALLY PASSED
Item	Specific requirements

Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 80 - Users must be able to accept or deny a migration from a to b
Input	Step 1: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA) The application shows the choice to accept/deny User denies Step 2: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA) The application shows the choice to accept/deny User accepts Step 3: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC) The application shows the choice to accept/deny User denies Step 4: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC) The application shows the choice to accept/deny User accepts
Expected output	Step 1: The application doesn't migrate from device A to device B Step 2: The application migrates from device A to device B Step 3: The application doesn't migrate from device B to device A Step 3: The application migrates from device B to device A
Actual output	Step 1: The application doesn't migrate from device A to device B Step 2: The application migrates from device A to device B Step 3: The application doesn't migrate from device B to device A Step 4: The application DOESN'T migrate from device B to device A

General consideration	This TC has been considered as partial passed since the missing migration is already included in the result of TC1

ID	OPEN Technological test plan Web migration TC15 - PASSED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 20 - Users need to discover devices in the vicinity.
Input	Step 1: Device B (PDA) is switched off The application is being run on the device A (PC) The user asks for devices to migrate, receiving no target device Device B is switched on The user asks for devices to migrate Step 2: Device A (PC) is switched off The application is being run on the device B (PDA) The user asks for devices to migrate, receiving no target device Device A is switched on The user asks for devices to migrate
Expected output	Step 1: The system shows that now it is possible to migrate to the device B Step 2: The system shows that now it is possible to migrate to the device A
Actual output	Step 1: The system shows that now it is possible to migrate to the device B Step 2: The system shows that now it is possible to migrate to the device A
General consideration	

ID	OPEN Technological test plan Web migration TC16 – PARTIALLY PASSED
Item	Specific requirements

Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: A1 - Image size must fit the screen of every kind of device allowed
Input	Step 1: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC)
Expected output	Step 1: The application migrates from device A to device B fitting the device B screen Step 2: The application migrates from device B to device A fitting the device A screen
Actual output	Step 1: The application migrates from device A to device B without splitting the web page Step 2: The application DOESN'T migrate from device B to device A
General consideration	This TC has been considered as partially passed since the missing migration is already included in the result of TC1

ID	OPEN Technological test plan Web migration TC17 – PARTIALLY PASSED
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: A2 - Page has to be entirely loaded for a good user experience
Input	Step 1: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA) Step 2: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC)
Expected output	Step 1: The application migrates from device A to device B without splitting the web page

	Step 2: The application migrates from device B to device A without splitting the web page
Actual output	Step 1: The application migrates from device A to device B without splitting the web page Step 2: The application DOESN'T migrate from device B to device A
General consideration	This TC has been considered as partially passed since the missing migration is already included in the result of TC1

ID	OPEN Technological test plan Web migration TC18
Item	Availability
Description	Availability is monitored recording possible failures and their lasting while executing the prototype.
Input	Prototype is actively used during the whole working day and left in background during the following night, with an internal tool recording every kind of issue: migration failures, application failure, and so on
Expected output	There is no target value; the result will be evaluated after the closure of the testing timeframe.
Actual output	
General consideration	Due to the still missing stability of the prototype, this test case is skipped and demanded to the further phase of testing.

ID	OPEN Technological test plan Web migration TC19
Item	Reliability
Description	Reliability is monitored recording possible failures during a complete E2E execution of the prototype.
Input	A complete execution of the prototype (e.g. the access to a product and a following migration) is performed as many times as possible during the whole working day, with an internal tool recording every kind of issue. The percentage of complete executions without issues is the final result.

Expected output	There is no target value; the result will be evaluated after the closure of the testing timeframe.
Actual output	
General consideration	Due to the still missing stability of the prototype, this test case is skipped and demanded to the further phase of testing.

ID	OPEN Technological test plan Web migration TC20
Item	Performance
Description	Timings and possible failures will be monitored and recorded for: Triggering, Migration, Application
Input	Execution of the prototype is performed while recording the internal logs during the whole working day. Values to measure: triggering time, migration time, application delay and jitter. Events to record: trigger failures, migration failures.
Expected output	There is no target value; the result will be evaluated after the closure of the testing timeframe.
Actual output	
General consideration	Due to the still missing stability of the prototype, this test case is skipped and demanded to the further phase of testing.

ID	OPEN Technological test plan Web migration TC21 - PASSED
Item	Accessibility
Description	This test case aims to underline possible lacks of Web content accessibility.
Input	Web contents of the application are submitted to the accessibility analysis of Magenta tool; if no lacks of accessibility raise, further tools from D6.3 can be applied (W3C Validator, WAVE Web Access Evaluation Tool, Web Access Checker at ATRC).
Expected output	These tools should not discover any accessibility issues.
Actual output	Five application web pages analyzed. Outcome from Wave tool:

	Pg.1 = no errors Pg.2 = no errors Pg.3 = no errors Pg.4 = no errors Pg.5 = 1 error x 10 times (empty label)
General consideration	

ID	OPEN Technological test plan Web migration TC22 – PARTIALLY PASSED
Item	Adherence to the Standard
Description	This test case verifies the respect of W3C standards concerning (X)HTML tags.
Input	Web content is checked through the W3C website, verifying possible errors towards its specs.
Expected output	No incompatibilities with W3C specs should arise.
Actual output	Five application web pages analyzed. Outcome from W3C website tool: Pg.1 = 5 errors Pg.2 = 15 errors Pg.3 = 6 errors Pg.4 = 9 errors Pg.5 = 38 errors
General consideration	See E. Appendix: Accessibility and Adherence to the Standards Test Report for the errors list. The test case has been considered as passed since most of errors are caused by the previous ones, and they generally can be easily corrected in a further phase of development.

4.1.4. FURTHER WORK

The testing experience detected some issues in the prototype mainly concerning only one-way migration (from PDA to PC), while underlined a good working from the adaptation side. So, after the conclusion of the testing timeframe, this feedback was communicated to the development team in CNR: now the issue is under analysis and resolution, and we plan to perform further tests during the second iteration.

This second iteration will also involve those indicators not tested at this stage, due to the not sufficient level of stability of the prototype: reaching a higher grade of stability will allow conducting also the performance evaluation; to this end, it will be worth that application developers provide a logging tool for the execution of required measurements concerning availability, reliability and performance.

4.2. FROM D3.2: TRIGGER MANAGEMENT AND CONTEXT INFORMATION MANAGEMENT

4.2.1. GENERAL INFO

Date/time of testing:	W38-W39 September 2009 W42-W43 October 2009
Testing partners:	Vodafone Italy (tester) and Aalborg (prototype owner)
Testing environment:	TSCC lab (Vodafone Italy), with the prototype completely locally managed. No Internet connection was needed for this testing. Three devices are involved: A and C are 2 PCs, B is the necessary PDA. A and C are connected by Wi-Fi and 15 m far from each other; when B is “far” from A and it is “near” to C, a migration to C is triggered. The position of B is detected using its Bluetooth signal strength (a threshold value equals to -1 has been used). For traffic simulation the Paessler Netflow generator (v 1.0) have been used.
Other notes:	

4.2.2. OVERVIEW

After the necessary setup procedures, the test started on the 21th of September (week 39) by verifying the preliminary conditions (Test case 0) to go ahead with the other tests. Even if the migration time was a bit longer than it was expected, the prototype was regarded as suitable to perform the other test cases.

The technological testing was performed during Week 39 as far as the functional requirements are concerned, whereas the indicators measurements were demanded to October, after the project review meeting.

About these requirements, some functionalities were not yet available at that time (or it was chosen not to implement them in the Trigger management prototype): this happened for example for the choice of accept/deny a migration, for the specification of migration policies and for the migration only of some parts of the applications. Not performed test cases are described in D. Appendix: Not Performed Technological Test Cases. On the other hand, the prototype satisfied the overall aim of managing the migration within the mobility, basing on the coverage.

The indicators testing took place in October and the main issue was represented from not having the possibility to monitor the indicators in the developer side. Thus, some values have been manually taken, such as the number of failures, and some measurements have been recorded only by using TCPDump or Wireshark, hence with a partial accuracy. On the other hand, the different network traffic conditions could have been simulated by the generator tool.

The main problems coming out from the overall testing of the prototype follow:

a. A high number of not requested migrations occured, for the reliability measurement they were 28 in 4 hours

b. A too high mean migration time was recorded. During the prototype initial test the measured migration time was 6 seconds (higher than expected, but still acceptable), and then, during the performance evaluation, the mean migration time was 15 seconds (too high, considering that the expected value is 4 seconds)

c. As the traffic grows, the prototypes crashe after a smallertime interval

4.2.3. TEST REPORT

This is the list of the test cases foreseen for the Trigger Management prototype, with the results.

The outcome for the Y/N requirements to be checked is displayed in Figure 35.

Passed	4
Partial pass	2
Failed	0
Not possible	7

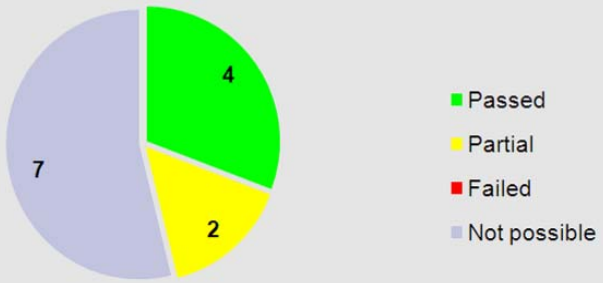

Figure 35: test results

On the other hand, each of the indicators measured can be found in the specific test cases.

Naming convention used for the following test cases:

- Application: since the planned tests follow the "Black Box testing" method, with "application" we mean the Migration management prototype. However, the requirements that will be tested explicitly refer to migration implemented by the prototype modules that will be the bases of the final OPEN middleware. In fact, the aim of the testing activity is validating the middleware behavior rather than the application on top of it.
- OPEN platform: Since the test cases have been elicited starting from the requirements and they aim to be further reused for the second testing iteration, they are formulated referring to the "OPEN platform" but in the evaluated prototype only some modules that will be part of the OPEN platform have been developed. Hence, we refer to these modules when introducing tests referring to the OPEN platform.

Trigger management test cases:

ID	OPEN Technological test plan Trigger management TC0 – PARTIALLY PASSED
Item	Prototype Initial Test
Description	This test case aims to validate the basic prototype operation. It consists of a set of YES/NO questions that verify if the prototype is carrying out or not the task which was designed for: video migration. The result of the test case will be PASSED if the response to all the questions are yes, NOT PASSED if any of them is no, or PARTIALLY PASSED if the response to all the questions are yes, but some problems are noticed during the test execution.

Input	Connect the source and destination prototype devices to the test scenario network by following carefully the prototype setting up instructions. Answer the following set of questions with YES or NOT: i) Is it possible to visualize the streaming video at the source device? ii) Is the streaming audio synchronized with the video at the source device? iii) Does the video/audio stream skip, cut out or buffer? Trigger the migration application as indicated in the instructions and answer the following questions with YES or NOT: iv) Does the migration take longer than 4 seconds? v) Is it possible to visualize the streaming video at the target device? vi) Is the streaming audio synchronized with the video at the target device? vii) Does the video/audio stream (at the target device) skip, cut out or buffer?
Expected output	The expected output is YES for all questions.
Actual output	All the questions have ”YES” answers, but the migration process lasted for 6 s.
General consideration	Despite of this migration time, the prototype is supposed to be suitable for the next testing procedures.

ID	OPEN Technological test plan Trigger Management TC1 – PASSED
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 7 - The user must be enabled to watch a program using his set top box and multiple screens. This test case is applied to the current prototype considering only the usage of multiple screens (i.e. with a configuration that does not include a set top box).
Input	Application starts on device A (PC1), while device B is in the Bluetooth coverage of both device A and device C (PC2).
Expected output	The video is played in both device A and C.
Actual output	The video is played in both device A and C.
General consideration	

ID	OPEN Technological test plan Trigger Management TC3 – PASSED
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 82 - Migration should be automatic / system triggered. Based on previous settings by the user
Input	Step 1: The application is being run on the device A (PC1) The user moves the device B (PDA) from the Bluetooth coverage of the device A to the coverage of device C (PC2) Step 2: The application is being run on the device C (PC2) The user moves the device B (PDA) from the Bluetooth coverage of the device C to the coverage of device A (PC1)
Expected output	Step 1: The application migrates from device A to device C Step 2: The application migrates from device C to device A
Actual output	Step 1: The application migrates from device A to device C Step 2: The application migrates from device C to device A
General consideration	Migration is triggered when user moves the devices B (PDA) into the Bluetooth coverage of device C (PC2).

ID	OPEN Technological test plan Trigger Management TC4 – PARTIALLY PASSED
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement:

	54 - It must be possible to continue my current service seamlessly across multiple devices
Input	Step 1: The application is being run on the device A (PC1) The user moves the device B (PDA) from the Bluetooth coverage of the device A to the coverage of device C (PC2) Step 2: The application is being run on the device C (PC2) The user moves the device B (PDA) from the Bluetooth coverage of the device C to the coverage of device A (PC1)
Expected output	Step 1: The application migrates from device A to device C and the video resumes from the point it has been left Step 2: The application migrates from device C to device A the video resumes from the point it has been left
Actual output	Step 1: The application migrates from device A to device C but the video skips several seconds, necessary to migrate Step 2: The application migrates from device C to device A but the video skips several seconds, necessary to migrate
General consideration	

ID	OPEN Technological test plan Trigger Management TC6 – PASSED
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 61 - The user does not want to care about networking aspects when trying to migrate
Input	Step 1: The application is being run on the device A (PC1) The user moves the device B (PDA) from the Bluetooth coverage of the device A to the coverage of device C (PC2)

	Step 2: The application is being run on the device C (PC2) The user moves the device B (PDA) from the Bluetooth coverage of the device C to the coverage of device A (PC1)
Expected output	Step 1: The application migrates from device A to device C and the user doesn't need to perform any action on the network or to consider any network parameter. Step 2: The application migrates from device C to device A and the user doesn't need to perform any action on the network or to consider any network parameter.
Actual output	Step 1: The application migrates from device A to device C and the user doesn't need to perform any action on the network or to consider any network parameter. Step 2: The application migrates from device C to device A and the user doesn't need to perform any action on the network or to consider any network parameter.
General consideration	

ID	OPEN Technological test plan Trigger Management TC11 – PASSED
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: A1 - Image size must fit the screen of every kind of device allowed
Input	Step 1: The application is being run on the device A (PC1) The user moves the device B (PDA) from the Bluetooth coverage of the device A to the coverage of device C (PC2) Step 2: The application is being run on the device C (PC2) The user moves the device B (PDA) from the Bluetooth coverage of the device C to the coverage of device A (PC1)
Expected output	Step 1: The application migrates from device A to device C fitting its screen

	Step 2: The application migrates from device C to device A fitting its screen
Actual output	Step 1: The application migrates from device A to device C fitting its screen Step 2: The application migrates from device C to device A fitting its screen
General consideration	

ID	OPEN Technological test plan Trigger Management TC13
Item	Technical Measurements: Availability
Description	The goal in this test case is to measure the performance of the system in terms of: - Availability → % of time in which the service is available. This performance will be measured under 3 different network conditions: dedicated network (no traffic), shared network and overloaded network.
Input	General input for indicators testing: Execution of the prototype is performed while recording the internal logs during the whole working day. Values to measure: triggering time, discovery time, migration time and application delay, jitter and synchronization. Events to record: jitter, number of fails, trigger failures, discovery failures, and migration failures. Repeat the previous step but adding the following network conditions: - Network utilization by other applications: 50% - Network utilization by other applications: 90% Traffic can be generated using LAN Tornado, Paessler NetFlow generator or other traffic generation software.
Expected output	Measurements of the commented parameters. (No expected target values in this phase).
Actual output	Measurement time: 4h Number of faults: 8 (necessary server reset) Total outage: 3 min Availability: 98,75%
General consideration	Since this prototype is very unstable with a network utilization equals to 50% or to 90% (please read TC15), only the test with a dedicated network has been performed.

ID	OPEN Technological test plan Trigger Management TC14
Item	Technical Measurements: Reliability
Description	The goal in this test case is to measure the performance of the system in terms of: - Reliability → % of successful migrations This performance will be measured under 3 different network conditions: dedicated network (no traffic), shared network and overloaded network.
Input	General input for indicators testing: Execution of the prototype is performed while recording the internal logs during the whole working day. Values to measure: triggering time, discovery time, migration time and application delay, jitter and synchronization. Events to record: jitter, number of fails, trigger failures, discovery failures, and migration failures. Repeat the previous step but adding the following network conditions: - Network utilization by other applications: 50% - Network utilization by other applications: 90% Traffic can be generated using LAN Tornado, Paessler Net Flow generator or other traffic generation software.
Expected output	Measurements of the commented parameters. (No expected target values in this phase).
Actual output	Measurement time: 4h Number of migrations: 40 Migrations successful: 40 Reliability: 100% Not requested migrations: 28 Reliability including false positives: 58,8%
General consideration	Since this indicator not seems to depend from network, traffic simulations have not been made. Problem: high number of not requested migrations. Attention: the mean migration time is 15 seconds, probably too high for an adequate user experience.

ID	OPEN Technological test plan Trigger Management TC15
Item	Technical Measurements: Performances
Description	The goal in this test case is to measure the performance of the system in terms of: - Delay → Timings and possible failures will be monitored and recorded for: trigger, discovery, migration and application.

	- Jitter This performance will be measured under 3 different network conditions: dedicated network (no traffic), shared network and overloaded network.
Input	General input for indicators testing: Execution of the prototype is performed while recording the internal logs during the whole working day. Values to measure: triggering time, discovery time, migration time and application delay, jitter and synchronization. Events to record: jitter, number of fails, trigger failures, discovery failures, and migration failures. Repeat the previous step but adding the following network conditions: - Network utilization by other applications: 50% - Network utilization by other applications: 90% Traffic can be generated using LAN Tornado, Paessler Net Flow generator or other traffic generation software.
Expected output	Measurements of the commented parameters. (No expected target values in this phase).
Actual output	No traffic condition: 1) Mean migration time: 15 seconds 2) Max Jitter: 244 ms 50% traffic condition: 1) Mean migration time: 15 seconds 2) Max Jitter: 181 ms 3) The prototype crashes after 4 minutes 90% traffic conditions: 1) Mean migration time: 15 seconds 2) Max Jitter: 180 ms 3) The prototype crashes after 40 seconds
General consideration	By using Wireshark only the incoming packets could be monitored, so the set of measurements is not so accurate and complete, but can be only an indication to developers.

4.2.4. FURTHER WORK

During this testing activity some performance parameters have not been evaluated and only estimation has been performed for the other ones because the prototype did not offer any log files.

The following parameters have been measured during this testing activity:

- migration failures
- migration time
- jitter (estimation of its maximum value)

On the other hand, it was not possible to perform the following measurements:

- triggering time
- discovery time
- application delay
- trigger failures
- discovery failures

Moreover, it was not possible to evaluate the prototype availability (% of time in which the service is available) using a shared and an overloaded network because the prototype is not stable enough at this early stage of development.

For the next testing iteration a complete and stable version of the prototype will be evaluated. Moreover, with the support of the application development team, a more accurate and complete set of measurements will be performed.

4.3. FROM D3.2: DEVICE SELECTION MAP

4.3.1. GENERAL INFO

Date/time of testing:	W31 -July 2009
Testing partners:	Vodafone Italy (tester) and CNR (prototype owner)
Testing environment:	TSCC lab (Vodafone Italy), with remote connection to CNR server in Pisa. Connection was based on private addresses internally to the lab, with NAT to public addresses in Vodafone Italy network in order to reach destination peer in Pisa.

Other notes:	

4.3.2. OVERVIEW

Since this prototype is foreseen to be used together with the Web migration, its testing experience was also impacted by the period of setup due to the network security policies, the consequent implementation of NAT in VF-IT lab, and some necessary prototype configurations and adjustment from CNR.

The technological testing was performed for the Y/N requirements to be verified, while the evaluation of technical performance indicators was postponed to the second phase of testing, in order to reach a higher grade of stability within the prototype.

The device selection map shows an overall correct behavior, reaching the scope it has been developed to and respecting all the specific OPEN requirements foreseen to be verified in the test list: the only test case not passed, in fact, does not depend on the device selection map, but on the missing migration previously described in the Web migration testing report.

4.3.3. TEST REPORT

This is the list of the test cases foreseen for the Device selection map, with the results.

The outcome for the Y/N requirements to be checked is displayed in Figure 36.

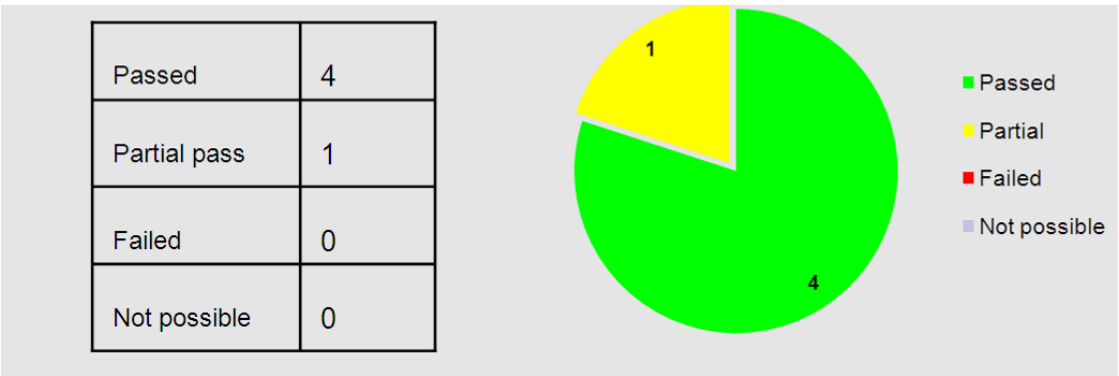

Figure 36: test results

On the other hand, each of the indicators measured can be found in the specific test cases.

Naming convention used for the following test cases:

- Application: the final Device Selection map is used together with the Web migration prototype. The requirements to be tested aim at verifying the interoperability between the Device Selection map and the middleware modules enabling the migration developed in the Web UI prototype.
- OPEN platform: Since the test cases have been elicited starting from the requirements and they aim to be further reused for the second testing iteration, they are formulated referring to the "OPEN platform" but in the evaluated prototype only some modules that will be part of the OPEN platform have been developed. Hence, we refer to these modules when introducing tests referring to the OPEN platform.

Device selection map test cases:

ID	OPEN Technological test plan Device selection map TC1 – PARTIALLY PASSED
Item	Specific requirements
Description	Device selection map testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test aims to verify this requirement: 86 - Migration should be triggered by the user
Input	Since the Device Selection map is fully integrated with the Web migration prototype, the execution of this test case is the same than Web migration TC1, where users use the device selection map too to migrate. Step 1: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA), displayed in the device selection map Step 2: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC), displayed in the device selection map
Expected output	Step 1: The application migrates from device A to device B Step 2: The application migrates from device B to device A
Actual output	Step 1: The application migrates from device A to device B Step 2:

	The application DOESN'T migrate from device B to device A
General consideration	This test cases is considered as partially passed since the problem does not concern the device selection map, but it is impacted from the web migration prototype

ID	OPEN Technological test plan Device selection map TC2 – PASSED
Item	Specific requirements
Description	Device selection map testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test aims to verify this requirement: 157 - The OPEN platform should be installed and listening for any device requesting migration
Input	Since the Device Selection map is fully integrated with the Web migration prototype, the execution of this test case is the same than Web migration TC1, where users use the device selection map to communicate the device migration request.
Expected output	Step 1: The application shows (e.g. with a message) it has received the request Step 2: The application shows (e.g. with a message) it has received the request
Actual output	Step 1: The application shows (e.g. with a message) it has received the request Step 2: The application shows (e.g. with a message) it has received the request
General consideration	

ID	OPEN Technological test plan Device selection map TC3 – PASSED
Item	Specific requirements
Description	Device selection map testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test aims to verify this requirement: 61 - The user does not want to care about networking aspects when trying to

	migrate
Input	Step 1: The application is being run on the device A (PC) The user asks for migrating on the device B (PDA), displayed in the device selection map Step 2: The application is now being run on the device B (PDA) The user asks for migrating on the device A (PC), displayed in the device selection map
Expected output	Same than Web migration TC11, networking parameters should not be displayed in the device selection map or, if present, should not be necessary for the migration
Actual output	Networking parameters are not displayed in the device selection map
General consideration	

ID	OPEN Technological test plan Device selection map TC4 – PASSED
Item	Specific requirements
Description	Device selection map testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test aims to verify this requirement: 63 - OPEN should work with and without internet connection
Input	Step 1: The application is being run on the device A (PC) Device A (PDA) is not connected to the Internet, but in the vicinity to the device B The user asks for displaying the device selection map Step 2: : The application is being run on the device A (PC) Device A (PDA) is connected to the Internet in the vicinity to the device B The user asks for displaying the device selection map Step 3: The application is being run on the device B Device B is not connected to the Internet, but in the vicinity to the device A The user asks for displaying the device selection map Step 4:

	The application is being run on the device B Device B is connected to the Internet in the vicinity to the device A The user asks for displaying the device selection map
Expected output	Step 1: Device B is displayed in the device selection map Step 2: Device B is displayed in the device selection map Step 3: Device A is displayed in the device selection map Step 4: Device A is displayed in the device selection map
Actual output	Step 1: Device B is displayed in the device selection map Step 2: Device B is displayed in the device selection map Step 3: Device A is displayed in the device selection map Step 4: Device A is displayed in the device selection map
General consideration	

ID	OPEN Technological test plan Device selection map TC5 – PASSED
Item	Specific requirements
Description	Device selection map testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test aims to verify this requirement: 20 - Users need to discover devices in the vicinity.
Input	Same than Web migration TC15
Expected output	Step 1: Device B is displayed in the device selection map Step 2: Device A is displayed in the device selection map
Actual output	Step 1:

	Device B is displayed in the device selection map Step 2: Device A is displayed in the device selection map
General consideration	

ID	OPEN Technological test plan Device selection map TC6
Item	Availability
Description	Availability is monitored recording possible failures and their lasting while executing the prototype.
Input	Prototype is actively used during the whole working day and left in background during the following night, with an internal tool recording every kind of issue, mainly discovery failures.
Expected output	There is no target value; the result will be evaluated after the closure of the testing timeframe.
Actual output	
General consideration	Due to the still missing stability of the prototype, this test case is skipped and demanded to the further phase of testing.

ID	OPEN Technological test plan Device selection map TC7
Item	Reliability
Description	Reliability is monitored recording possible failures during a complete E2E execution of the prototype.
Input	A complete execution of the prototype (e.g. the access to a product and a following migration) is performed as many times as possible during the whole working day, with an internal tool recording every kind of issue. The percentage of complete executions without issues is the final result.
Expected output	There is no target value; the result will be evaluated after the closure of the testing timeframe.
Actual output	

General consideration	Due to the still missing stability of the prototype, this test case is skipped and demanded to the further phase of testing.

ID	OPEN Technological test plan Device selection map TC8
Item	Performance
Description	Timings and possible failures will be monitored and recorded for: Device discovery.
Input	Execution of the prototype is performed while recording the internal logs during the whole working day. Values to measure: discovery time. Events to record: discovery failures.
Expected output	There is no target value; the result will be evaluated after the closure of the testing timeframe.
Actual output	
General consideration	Due to the still missing stability of the prototype, this test case is skipped and demanded to the further phase of testing.

4.3.4. FURTHER WORK

The testing experience did not detect particular issues due to the device selection map, but it was impacted only by Web migration problems, and the resolution from that side will allow a fully correct execution of the prototype.

Again, a higher grade of stability will allow during the second testing iteration the performance evaluation too, better if with logging tools provided by the developers.

5. CONCLUSIONS

The purpose of the first testing iteration was not only the evaluation of the OPEN Migration Service Platform and the developed prototypes, but also to provide support to development teams for the creation of a final version of the product that offers a good level of usability, programmability and technical quality.

During the usability evaluation three prototypes have been taken into account: Web Migration with Device Discovery Map, Emergency, and Social Game. Five groups of users have been involved in the testing activity, and each user evaluated several usability aspects and gave some improvement suggestions. At the end of the testing activity a set of strong points, weak points and suggestions have been elicited. These results have been shared with the prototypes developers. In the next testing iteration, a more formal approach will be employed, in order to evaluate the usability level of the final prototypes considering all of the usability aspects.

At the end of this usability evaluation, the following results have been obtained:

- For every prototype, interviewed users expressed a great interest on the migration functionality and they used available migration procedures without any problem. Moreover, a very good continuity was offered during migrations.
- The application adaptation performed during migrations could be in need of some improvements. In particular, some slight modifications (for example a different color of the flooding in a merged Emergency simulation or a different splitting mechanism for the Web UI Adaptation) could considerably improve the user experience.
- Almost all the interviewed users were able to autonomously complete the assigned task lists. This means that, even if some improvements could be implemented, tested prototypes are not affected by any serious usability problems.

A programmability validation has been performed on two modules (Web UI Adaptation, and Context Management Framework). For both of them, some test cases have been executed, leading to a parametric and a qualitative evaluation, with some improvement suggestions. Moreover, a theoretical evaluation has been performed on the Server Side Application Logic Reconfiguration module. In particular, a set of programmability aspects have been analyzed and some suggestions have been provided to the development team.

At the end of the programmability validation, the following results have been obtained:

- The Context Management Framework is able to correctly manage newly defined context variables. Variables retrieving (using CALA language) is very simple, while for a context variable publishing a Java retriever must be implemented.

- The Context Management Framework does not offer a good level of robustness for errors in the DSAM configuration file. However, some improvements are currently under development (using the OSGi technology).

- It is possible to set some parameters for the mapping and the splitting rules used by the Web UI Adaptation module, but it is not possible to create new rules.

During the programmability validation, a separate analysis has been carried out for the listed modules. However, we would like to elicit in the programmability evaluation also some suggestions that address programmability of the platform as a whole. In fact, in the assumption that the platform will be commercialized, it is important to consider some capabilities that can enhance the platform usage from the point of view of the Service Provider. Possible improvements could be:

- It should be possible to manage new variables and new rules in the OPEN Migration Service Platform in the easiest way (using preferably a graphical tool). This would encourage external application developers to use OPEN.

- There must be a clean separation between the OPEN Migration Service Platform implementation details and the platform configuration. In particular, the platform configuration tool should be easy to learn and it should not be subject to changes if some implementation details of the platform are modified by a following version.

- There must be decoupling between the OPEN Migration Service Platform architecture and the platform configuration. This means that for the platform configuration it should not be needed the knowledge of the platform modules and their connections. If possible, a single tool should be offered for the platform configuration, without the need to separately configure each module.

The technological evaluation addressed the three prototypes as expected, detecting for each one both functionalities and issues; the feedback of this evaluation was given to the developers teams in order to analyze and correct any kind of issues, in order to continue the development path within the OPEN project.

Analyzing the technological evaluation results, the following improvement suggestions can be elicited:

- Completion of supported features. Several features of the prototypes were not available in the tested versions. For the next testing iteration, more OPEN requirements should be implemented.

- Improvement of prototype stability. For the next testing iteration, a more stable version of the prototypes should be available. Current test results could be used as a starting point for the solving of some errors.

- Logging tools. Complete logging tools should be implemented in order to perform a careful analysis of detected errors and to provide performance measurements. During the creation of the next iteration test plans, a detailed description of the required logging tool will be provided for every prototype.

6. REFERENCES

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A. APPENDIX: USABILITY QUESTIONNAIRES

SOCIAL GAME EXPLORATORY QUESTIONNAIRE ANSWERS

USER A

Age: 21 From: Palermo (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never □ Rarely □ Weekly ■ Almost daily
2	Which kind of game do you prefer?	□ First Person Shooter □ Racing □ Strategy □ Arcade ■ Other, specify - ***Soccer***
3	Which kind of device do you prefer?	□ Portable console ■ Fixed console ■ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online ■ Both □ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily
6	Are you keen on Formula 1 and other racing sports	□ Not so much □ A bit ■ A lot
7	Would you be interested in mixing these two application areas?	□ Not so much □ A bit ■ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	□ yes, specify ■ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**Not expected it was possible to realize!**

13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**Mandatory to make user do it**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**Important to maintain the conversation private**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, specify – **All racing sports, for team sports we could use a particular player** □ no
17	Are there additional relevant environments to describe?	■ yes, specify – **Arcade games for action movies** □ no

USER B

Age: 26 From: Roma (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never □ Rarely □ Weekly ■ Almost daily
2	Which kind of game do you prefer?	■ First Person Shooter □ Racing □ Strategy ■ Arcade ■ Other, specify - **Soccer**
3	Which kind of device do you prefer?	□ Portable console ■ Fixed console ■ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online □ Both ■ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily
6	Are you keen on Formula 1 and other racing sports	■ Not so much □ A bit □ A lot

7	Would you be interested in mixing these two application areas?	□ Not so much □ A bit ■ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	■ yes, weather info real time □ no
11	Do you like the look and feel?	■ yes, but be careful to not divide too much the screen □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**Of course it can be very useful, but I'm not so interested**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**More than about security, it can be used to unexpected game effects on gaming friends**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**I don't mind using it during the game**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, specify – **Soccer game in which you use 1 player** □ no
17	Are there additional relevant environments to describe?	□ yes, specify – ■ no

USER C

Age: 26 From: Roma (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never ■ Rarely □ Weekly □ Almost daily
2	Which kind of game do you prefer?	□ First Person Shooter ■ Racing ■ Strategy □ Arcade □ Other, specify

3	Which kind of device do you prefer?	□ Portable console ■ Fixed console ■ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online □ Both ■ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily
6	Are you keen on Formula 1 and other racing sports	□ Not so much □ A bit ■ A lot
7	Would you be interested in mixing these two application areas?	□ Not so much □ A bit □ A lot ■ **It depends on not decreasing too much the attention on the real race**
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	□ yes, specify ■ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**It is a good idea, but it is important to not lose the attention on the game**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**Not only for privacy, but also to not share the user own game strategy**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**Nice social effects on gaming (invitation to play, jokes…)**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, specify – **All the racing games** □ no
17	Are there additional relevant environments to describe?	■ yes, specify – **TV Quiz Shows** □ no

USER D

Age: 27 From: Perugia (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never ■ Rarely □ Weekly □ Almost daily
2	Which kind of game do you prefer?	□ First Person Shooter ■ Racing □ Strategy □ Arcade □ Other, specify - Soccer
3	Which kind of device do you prefer?	□ Portable console ■ Fixed console □ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online □ Both ■ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never ■ Rarely □ Weekly □ Almost daily
6	Are you keen on Formula 1 and other racing sports	□ Not so much ■ A bit □ A lot
7	Would you be interested in mixing these two application areas?	□ Not so much ■ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	□ yes ■ no, specify why? **It's not clear that I'm driving my car against the real F1 GP drivers**
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	□ yes, specify ■ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**I don't think that the user really need to watch the TV or chat while he's driving his car**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**thanks god!**

14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**I think it could be really funny to joke your friend live during the game**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, specify – **MOTO GP** □ no
17	Are there additional relevant environments to describe?	□ yes, specify – ■ no

USER E

Age: 27 From: Perugia (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never ■ Rarely □ Weekly □ Almost daily
2	Which kind of game do you prefer?	□ First Person Shooter □ Racing □ Strategy ■ Arcade □ Other, specify
3	Which kind of device do you prefer?	□ Portable console □ Fixed console □ PC ■ Mobile phone
4	Do you usually play online or offline?	□ Always online □ Both ■ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely ■ Weekly □ Almost daily
6	Are you keen on Formula 1 and other racing sports	■ Not so much □ A bit □ A lot
7	Would you be interested in mixing these two application areas?	■ Not so much □ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?

10	Are there additional functionalities you would like?	□ yes, specify ■ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**Very unusual, it could be funny!**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**sharing a screen can be useful or funny but I really don't want that private information will be displayed!**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**I think it could be really funny**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	□ yes, specify – ■ no
17	Are there additional relevant environments to describe?	□ yes, specify – ■ no

USER F

Age: 27 From: Avellino (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never ■ Rarely □ Weekly □ Almost daily
2	Which kind of game do you prefer?	□ First Person Shooter □ Racing ■ Strategy □ Arcade □ Other, specify - Soccer
3	Which kind of device do you prefer?	□ Portable console ■ Fixed console □ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online ■ Both □ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily

6	Are you keen on Formula 1 and other racing sports	□ Not so much ■ A bit □ A lot
7	Would you be interested in mixing these two application areas?	□ Not so much ■ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	■ yes, **E-MAIL (downloaded from provider)** □ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**Very interesting! But when?**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**Not very interesting because it's possible that in same time two o more people could share it! It's better if I can see inside on my mobile the pub info for example!!**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**Good during, but in these cases a bit of people communicate after the game! They will become a new one!**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes, **if my private info is protected.** □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, **arcade or adventure** □ no
17	Are there additional relevant environments to describe?	□ yes, specify – ■ no

USER G

Age: 19 From: Roma (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never □ Rarely ■ Weekly □ Almost daily

2	Which kind of game do you prefer?	■ First Person Shooter □ Racing □ Strategy □ Arcade □ Other, specify -
3	Which kind of device do you prefer?	□ Portable console ■ Fixed console □ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online □ Both ■ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily
6	Are you keen on Formula 1 and other racing sports	□ Not so much ■ A bit □ A lot
7	Would you be interested in mixing these two application areas?	■ Not so much □ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	□ yes, specify ■ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**Can be too difficult/not comfortable for the user**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**Mandatory to respect privacy and security**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**Can be funny especially during**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	□ yes ■ no, **I'd like to have more info about security during betting**
16	Would you like to enlarge the game to other sports?	□ yes, specify – ■ no
17	Are there additional relevant environments to describe?	□ yes, specify ■ no

USER H

Age: 25 From: Roma (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never □ Rarely ■ Weekly □ Almost daily
2	Which kind of game do you prefer?	■ First Person Shooter ■ Racing □ Strategy □ Arcade ■ Other, specify – **Soccer, Wii**
3	Which kind of device do you prefer?	□ Portable console ■ Fixed console ■ PC ■ Mobile phone
4	Do you usually play online or offline?	□ Always online □ Both ■ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily
6	Are you keen on Formula 1 and other racing sports	□ Not so much ■ A bit □ A lot
7	Would you be interested in mixing these two application areas?	□ Not so much ■ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	■ yes, **something to have as many real time updates as it is possible** □ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**Attention: people could not like this**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**Of course it is good**

14	How do you consider the following UI options: Users can communicate each other before, during and after the game	
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, specify – **Of course all racing sports, soccer (using only one player?)** □ no
17	Are there additional relevant environments to describe?	□ yes, specify ■ no

USER I

Age: 29 From: Lecce (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never ■ Rarely □ Weekly □ Almost daily
2	Which kind of game do you prefer?	□ First Person Shooter ■ Racing □ Strategy □ Arcade □ Other, specify -
3	Which kind of device do you prefer?	□ Portable console □ Fixed console ■ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online ■ Both □ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely ■ Weekly □ Almost daily
6	Are you keen on Formula 1 and other racing sports	□ Not so much □ A bit ■ A lot
7	Would you be interested in mixing these two application areas?	■ Not so much □ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?

9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	□ yes, specify ■ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**difficult to use**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**useful**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**useful**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	□ yes, specify – ■ no
17	Are there additional relevant environments to describe?	□ yes, specify – ■ no

USER L

Age: 28 From: La Spezia (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never ■ Rarely □ Weekly □ Almost daily
2	Which kind of game do you prefer?	□ First Person Shooter □ Racing □ Strategy ■ Arcade □ Other, specify -
3	Which kind of device do you prefer?	□ Portable console ■ Fixed console □ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online □ Both ■ Always offline

5	How often do you use other services like chat, betting, video streaming?	□ Never ■ Rarely □ Weekly □ Almost daily
6	Are you keen on Formula 1 and other racing sports	■ Not so much □ A bit □ A lot
7	Would you be interested in mixing these two application areas?	■ Not so much □ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	□ yes ■ no, **betting is not clear**
10	Are there additional functionalities you would like?	□ yes, specify ■ no
11	Do you like the look and feel?	□ yes ■ no, **too many windows**
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**useful, but not fundamental**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**useful**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**useful**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, **soccer** □ no
17	Are there additional relevant environments to describe?	□ yes, specify – ■ no

USER M

Age: 31 From: Torino (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never ■ Rarely □ Weekly □ Almost daily

2	Which kind of game do you prefer?	□ First Person Shooter □ Racing ■ Strategy □ Arcade □ Other, specify -
3	Which kind of device do you prefer?	□ Portable console □ Fixed console ■ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online ■ Both □ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily
6	Are you keen on Formula 1 and other racing sports	■ Not so much □ A bit □ A lot
7	Would you be interested in mixing these two application areas?	□ Not so much ■ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	□ yes, specify ■ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**I don't think user really needs an application to chat/browse/watch TV in the meanwhile because he already can using different means or a pc with more than one window**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**quite useful**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**I don't think it can be very useful**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?

16	Would you like to enlarge the game to other sports?	■ yes, specify **other racing sorts like bike, moto etc…** □ no
17	Are there additional relevant environments to describe?	□ yes, specify – ■ no

USER N

Age: 28 From: Potenza (Italy)

Question	Description	Answers
1	How often do you play video games?	□ Never ■ Rarely □ Weekly □ Almost daily
2	Which kind of game do you prefer?	□ First Person Shooter □ Racing □ Strategy ■ Arcade □ Other, specify -
3	Which kind of device do you prefer?	□ Portable console □ Fixed console □ PC ■ Mobile phone
4	Do you usually play online or offline?	□ Always online □ Both ■ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily
6	Are you keen on Formula 1 and other racing sports	□ Not so much □ A bit ■ A lot
7	Would you be interested in mixing these two application areas?	□ Not so much ■ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	□ yes ■ no, specify why? **It is possible bet only or playing with F1 cars like with PS2 too?**
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	□ yes, specify ■ no

11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	**OK**
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**KO. In a pub the screen shall not shared with people that are using their own applications.**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**OK**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, specify – **Football** □ no
17	Are there additional relevant environments to describe?	□ yes, specify – ■ no

USER O

Age: 24 From: Egypt

Question	Description	Answers
1	How often do you play video games?	□ Never □ Rarely □ Weekly ■ Almost daily
2	Which kind of game do you prefer?	■ First Person Shooter □ Racing □ Strategy □ Arcade ■ Other, specify – **Soccer, Wii**
3	Which kind of device do you prefer?	□ Portable console ■ Fixed console ■ PC □ Mobile phone
4	Do you usually play online or offline?	□ Always online ■ Both □ Always offline
5	How often do you use other services like chat, betting, video streaming?	□ Never □ Rarely □ Weekly ■ Almost daily

6	Are you keen on Formula 1 and other racing sports	□ Not so much ■ A bit □ A lot
7	Would you be interested in mixing these two application areas?	□ Not so much ■ A bit □ A lot □ It depends on… specify
8	Is it clear the game concept?	■ yes □ no, specify why?
9	Are the services around the game (chat, betting, TV, web) clear?	■ yes □ no, specify why?
10	Are there additional functionalities you would like?	■ yes, **Pause functionality, with buffer for resume the F1 GP** □ no
11	Do you like the look and feel?	■ yes □ no, specify why?
12	How do you consider the following UI options: User is able to play and chat/browse/watch TV in the meanwhile	
13	How do you consider the following UI options: User can share a screen (e.g. pub) without sharing private info	**I wouldn't use this functionality**
14	How do you consider the following UI options: Users can communicate each other before, during and after the game	**I'd like also that if I cannot play during a GP, the system simulates it and updates me about the result**
15	Do you appreciate the level of security? Has it an acceptable impact on the applications proceeding (betting security, access to STB and screens…)?	■ yes, **I'd add a limited duration to betting credit and betting passwords** □ no, specify why?
16	Would you like to enlarge the game to other sports?	■ yes, specify – **Soccer**
17	Are there additional relevant environments to describe?	■ yes, specify – **"Dynamic" movies, like action, thriller, Eros** □ no

EMERGENCY EXPLORATORY QUESTIONNAIRE ANSWERS

USER A

Age: 33

Question	Description	Rationale	Answers
1	Which job category do you belong to?		**Telco**

2	How many years of work experience did you make?		□ 0-5 □ 5-10 ■ 10-20 □ More than 20
3	How would you define your technical background?		□ Very basic □ Average ■ Good □ Expert
4	Which kind of device do you use at work?		■ Mobile phone □ PC □ PDA ■ Other, specify – **Video call**
5	Are you ever in dangerous situations at work, requiring a fast reaction?		□ Never □ Almost never ■ Could happen
6	What do you think about the importance (in such situations) of simulations, remote access and control, coordination		□ Not so high ■ High □ Extremely high
7	Is it clear the application concept?	General user feeling	■ yes □ no, specify why?
8	How satisfied are you with the OPEN migration platform?	The user is asked for his overall impression of the usability of the OPEN migration platform.	□ 1 - Very satisfied □ 2 - Satisfied ■ 3 - Average □ 4 - Disappointed □ 5 - Very disappointed
9	How usable did you find the registration of devices to the OPEN migration platform?	This more concrete question aims at subjective feelings of how easy it was to register the video wall.	□ 1 - Very easy ■ 2 - Easy □ 3 - Average □ 4 - Hard □ 5 - Very hard
10	Would you prefer migrating application user interfaces to display information locally?	In this question we ask the user whether the OPEN migration platform as a whole package is useful for his/her work.	■ yes □ no

11	What application elements are missing in order to boost performance in the EOC?		**More Text interface**
12	Which RIA platform do you prefer?		□ AJAX □ FLEX □ Silverlight ■ Indifferent/Don't know
13	Do you like the look and feel of EOC-application?		■ yes □ no, specify why?
14	Are there additional functionalities you would like to add?		■ yes, specify – **geographical coordinates according to different standards** □ no
15	Would you like to enlarge the application to other environments?		■ yes, specify – **Security** □ no
16	Comments	Here the user can enter free style comments. User comments might give useful hints towards specific usability problems, not foreseen in the design of the evaluation or of the original OPEN migration platform.	

USER B

Age: 26

Question	Description	Rationale	Answers
1	Which job category do you belong to?		**Urban excavations**
2	How many years of work experience did you make?		□ 0-5 ■ 5-10 □ 10-20 □ More than 20

3	How would you define your technical background?		□ Very basic ■ Average □ Good □ Expert
4	Which kind of device do you use at work?		■ Mobile phone ■ PC □ PDA ■ Other, specify - **GPS**
5	Are you ever in dangerous situations at work, requiring a fast reaction?		□ Never ■ Almost never □ Could happen
6	What do you think about the importance (in such situations) of simulations, remote access and control, coordination		□ Not so high ■ High □ Extremely high
7	Is it clear the application concept?	General user feeling	■ yes □ no, specify why?
8	How satisfied are you with the OPEN migration platform?	The user is asked for his overall impression of the usability of the OPEN migration platform.	□ 1 - Very satisfied □ 2 - Satisfied ■ 3 - Average □ 4 - Disappointed □ 5 - Very disappointed
9	How usable did you find the registration of devices to the OPEN migration platform?	This more concrete question aims at subjective feelings of how easy it was to register the video wall.	□ 1 - Very easy □ 2 - Easy ■ 3 - Average □ 4 - Hard □ 5 - Very hard
10	Would you prefer migrating application user interfaces to display information locally?	In this question we ask the user whether the OPEN migration platform as a whole package is useful for his/her work.	□ yes ■ no
11	What application elements are missing in order to boost performance in the EOC?		**GPS (or other ways) localization of actors involved**

12	Which RIA platform do you prefer?		□ AJAX □ FLEX □ Silverlight ■ Indifferent/Don't know
13	Do you like the look and feel of EOC-application?		■ yes □ no, specify why?
14	Are there additional functionalities you would like to add?		□ yes, specify ■ no
15	Would you like to enlarge the application to other environments?		■ yes, specify – **Not only emergency management, but mapping of sensible elements to avoid them** □ no
16	Comments	Here the user can enter free style comments. User comments might give useful hints towards specific usability problems, not foreseen in the design of the evaluation or of the original OPEN migration platform.	

USER C

Age: 40

Question	Description	Rationale	Answers
1	Which job category do you belong to?		**Telco**
2	How many years of work experience did you make?		□ 0-5 □ 5-10 ■ 10-20 □ More than 20
3	How would you define your technical background?		□ Very basic □ Average □ Good ■ Expert

4	Which kind of device do you use at work?		■ Mobile phone ■ PC □ PDA ■ Other, specify – **Video call, cams**
5	Are you ever in dangerous situations at work, requiring a fast reaction?		□ Never □ Almost never ■ Could happen
6	What do you think about the importance (in such situations) of simulations, remote access and control, coordination		□ Not so high ■ High □ Extremely high
7	Is it clear the application concept?	General user feeling	■ yes □ no, specify why?
8	How satisfied are you with the OPEN migration platform?	The user is asked for his overall impression of the usability of the OPEN migration platform.	□ 1 - Very satisfied □ 2 - Satisfied ■ 3 - Average □ 4 - Disappointed □ 5 - Very disappointed
9	How usable did you find the registration of devices to the OPEN migration platform?	This more concrete question aims at subjective feelings of how easy it was to register the video wall.	□ 1 - Very easy ■ 2 - Easy □ 3 - Average □ 4 - Hard □ 5 - Very hard
10	Would you like to migrate user interfaces in our daily applications?	In this question we ask the user whether the OPEN migration platform as a whole package is useful for his/her work.	■ yes, **e.g. electromagnetic field misurations** □ no
11	What application elements are missing in order to boost performance in the EOC?		**Automatic introduction of the OPEN server address, prioritize the devices**
12	Which RIA platform do you prefer?		■ AJAX □ FLEX □ Silverlight □ Other, specify □ Indifferent/Don't know

13	Do you like the look and feel of EOC-application?		■ yes □ no, specify why?
14	Are there additional functionalities you would like to add?		■ yes, specify – **Localization on the map (GPS) with coordinates** □ no
15	Would you like to enlarge the application to other environments?		■ yes, specify – **Surveillance, transport & shipping** □ no
16	Comments	Here the user can enter free style comments. User comments might give useful hints towards specific usability problems, not foreseen in the design of the evaluation or of the original OPEN migration platform.	

USER D

Age: 43

Question	Description	Rationale	Answers
1	Which job category do you belong to?		**Telco**
2	How many years of work experience did you make?		□ 0-5 □ 5-10 ■ 10-20 □ More than 20
3	How would you define your technical background?		□ Very basic □ Average ■ Good □ Expert
4	Which kind of device do you use at work?		■ Mobile phone ■ PC □ PDA ■ Other, specify – **Video station**

5	Are you ever in dangerous situations at work, requiring a fast reaction?		■ Never □ Almost never □ Could happen
6	What do you think about the importance (in such situations) of simulations, remote access and control, coordination		□ Not so high ■ High □ Extremely high
7	Is it clear the application concept?	General user feeling	■ yes □ no, specify why?
8	How satisfied are you with the OPEN migration platform?	The user is asked for his overall impression of the usability of the OPEN migration platform.	□ 1 - Very satisfied □ 2 - Satisfied ■ 3 - Average □ 4 - Disappointed □ 5 - Very disappointed
9	How usable did you find the registration of devices to the OPEN migration platform?	This more concrete question aims at subjective feelings of how easy it was to register the video wall.	□ 1 - Very easy □ 2 - Easy ■ 3 - Average □ 4 - Hard □ 5 - Very hard
10	Would you like to migrate user interfaces in our daily applications?	In this question we ask the user whether the OPEN migration platform as a whole package is useful for his/her work.	■ yes □ no
11	What application elements are missing in order to boost performance in the EOC?		**The controls could dynamically enlarge/reduce waving the mouse in a dedicated area so the a larger part of screen is dedicated to actual simulation results (map, statistics, video streams) instead than coexist with the controls**

12	Which RIA platform do you prefer?		□ AJAX □ FLEX □ Silverlight □ Other, specify ■ Indifferent/Don't know "who cares"
13	Do you like the look and feel of EOC-application?		■ yes □ no, specify why?
14	Are there additional functionalities you would like to add?		■ yes, specify **Multiple/simultaneous views of the simulation** **Live images from the emergency area** □ no
15	Would you like to enlarge the application to other environments?		■ yes, specify – **Collaboration applications** □ no
16	Comments	Here the user can enter free style comments. User comments might give useful hints towards specific usability problems, not foreseen in the design of the evaluation or of the original OPEN migration platform.	**After the migration, I suppose from a PC to the wall screen, the migration control disappear, why? What should I do to let it appear again?**

USER E

Age: 38

Question	Description	Rationale	Answers
1	Which job category do you belong to?		**Telco**
2	How many years of work experience did you make?		□ 0-5 □ 5-10 ■ 10-20 □ More than 20

3	How would you define your technical background?		□ Very basic □ Average ■ Good □ Expert
4	Which kind of device do you use at work?		■ Mobile phone ■ PC □ PDA □ Other, specify –
5	Are you ever in dangerous situations at work, requiring a fast reaction?		□ Never ■ Almost never □ Could happen
6	What do you think about the importance (in such situations) of simulations, remote access and control, coordination		□ Not so high □ High ■ Extremely high
7	Is it clear the application concept?	General user feeling	■ yes □ no, specify why?
8	How satisfied are you with the OPEN migration platform?	The user is asked for his overall impression of the usability of the OPEN migration platform.	□ 1 - Very satisfied ■ 2 - Satisfied □ 3 - Average □ 4 - Disappointed □ 5 - Very disappointed
9	How usable did you find the registration of devices to the OPEN migration platform?	This more concrete question aims at subjective feelings of how easy it was to register the video wall.	□ 1 - Very easy ■ 2 - Easy □ 3 - Average □ 4 - Hard □ 5 - Very hard
10	Would you like to migrate user interfaces in our daily applications?	In this question we ask the user whether the OPEN migration platform as a whole package is useful for his/her work.	■ yes, **video call and video streaming** □ no
11	What application elements are missing in order to boost performance in the EOC?		**Possibility to don't insert the address, but find it and click**

12	Which RIA platform do you prefer?		□ AJAX □ FLEX □ Silverlight □ Other, specify ■ Indifferent/Don't know
13	Do you like the look and feel of EOC-application?		□ yes ■ no, specify why? **I'd like to enlarge the map and reduce the options panel**
14	Are there additional functionalities you would like to add?		□ yes, specify – ■ no
15	Would you like to enlarge the application to other environments?		■ yes, specify – **Detectors at home and in the car** □ no
16	Comments	Here the user can enter free style comments. User comments might give useful hints towards specific usability problems, not foreseen in the design of the evaluation or of the original OPEN migration platform.	

USER F

Age: 25

Question	Description	Rationale	Answers
1	Which job category do you belong to?		**Housebuilding**
2	How many years of work experience did you make?		□ 0-5 ■ 5-10 □ 10-20 □ More than 20

3	How would you define your technical background?		□ Very basic □ Average ■ Good □ Expert
4	Which kind of device do you use at work?		■ Mobile phone ■ PC □ PDA ■ Other, specify – **Measurement devices**
5	Are you ever in dangerous situations at work, requiring a fast reaction?		■ Never □ Almost never □ Could happen
6	What do you think about the importance (in such situations) of simulations, remote access and control, coordination		□ Not so high ■ High □ Extremely high
7	Is it clear the application concept?	General user feeling	■ yes □ no, specify why?
8	How satisfied are you with the OPEN migration platform?	The user is asked for his overall impression of the usability of the OPEN migration platform.	□ 1 - Very satisfied ■ 2 - Satisfied □ 3 - Average □ 4 - Disappointed □ 5 - Very disappointed
9	How usable did you find the registration of devices to the OPEN migration platform?	This more concrete question aims at subjective feelings of how easy it was to register the video wall.	□ 1 - Very easy □ 2 - Easy ■ 3 - Average □ 4 - Hard □ 5 - Very hard
10	Would you like to migrate user interfaces in our daily applications?	In this question we ask the user whether the OPEN migration platform as a whole package is useful for his/her work.	■ yes**, e.g. topographical measurements** □ no
11	What application elements are missing in order to boost performance in the EOC?		

12	Which RIA platform do you prefer?		□ AJAX □ FLEX □ Silverlight □ Other, specify ■ Indifferent/Don't know
13	Do you like the look and feel of EOC-application?		■ yes, **even if it is very basic** □ no, specify why
14	Are there additional functionalities you would like to add?		■ yes, specify – **Height measures for flood forecasts** □ no
15	Would you like to enlarge the application to other environments?		■ yes, specify – **management of urban building plans** □ no
16	Comments	Here the user can enter free style comments. User comments might give useful hints towards specific usability problems, not foreseen in the design of the evaluation or of the original OPEN migration platform.	

USER G

Age: 40

Question	Description	Rationale	Answers
1	Which job category do you belong to?		**IT Consulting**
2	How many years of work experience did you make?		□ 0-5 □ 5-10 □ 10-20 ■ More than 20

3	How would you define your technical background?		□ Very basic □ Average □ Good ■ Expert
4	Which kind of device do you use at work?		■ Mobile phone ■ PC □ PDA □ Other, specify –
5	Are you ever in dangerous situations at work, requiring a fast reaction?		■ Never □ Almost never □ Could happen
6	What do you think about the importance (in such situations) of simulations, remote access and control, coordination		□ Not so high □ High ■ Extremely high
7	Is it clear the application concept?	General user feeling	■ yes □ no, specify why?
8	How satisfied are you with the OPEN migration platform?	The user is asked for his overall impression of the usability of the OPEN migration platform.	□ 1 - Very satisfied ■ 2 - Satisfied □ 3 - Average □ 4 - Disappointed □ 5 - Very disappointed
9	How usable did you find the registration of devices to the OPEN migration platform?	This more concrete question aims at subjective feelings of how easy it was to register the video wall.	□ 1 - Very easy ■ 2 - Easy □ 3 - Average □ 4 - Hard □ 5 - Very hard
10	Would you prefer migrating application user interfaces to display information locally?	In this question we ask the user whether the OPEN migration platform as a whole package is useful for his/her work.	■ yes □ no
11	What application elements are missing in order to boost performance in the EOC?		**More information about the simulation**

12	Which RIA platform do you prefer?		□ AJAX □ FLEX □ Silverlight ■ Indifferent/Don't know
13	Do you like the look and feel of EOC-application?		■ yes □ no, specify why?
14	Are there additional functionalities you would like to add?		■ yes, specify – **edit simulation data** □ no
15	Would you like to enlarge the application to other environments?		■ yes, specify – **earthquakes** □ no
16	Comments	Here the user can enter free style comments. User comments might give useful hints towards specific usability problems, not foreseen in the design of the evaluation or of the original OPEN migration platform.	

WEB APPLICATION QUESTIONNAIRE

Usability Parameter	very low	low	medium	high	very high
Text readability	□	□	□	□	□
Visibility of titles and headers	□	□	□	□	□
Visibility of links	□	□	□	□	□
Images rendering	□	□	□	□	□
Web forms usability	□	□	□	□	□

Navigability	□	□	□	□	□

WEB MIGRATION QUESTIONNAIRE

Usability Parameter	very low	low	medium	high	very high
OPEN UI user friendly	□	□	□	□	□
Web browser interoperability	□	□	□	□	□
Continuity	□	□	□	□	□

SOCIAL GAME QUESTIONNAIRE

Usability Parameter	very low	low	medium	high	very high
Racing Game controls from PC keyboard (the usability level of the racing game controls)	□	□	□	□	□
Racing Game controls from mobile phone (the usability level of the racing game controls)	□	□	□	□	□
Racing Game Indicators on PC screen (the clearness of the indicators displayed when the user is playing the racing game)	□	□	□	□	□
Racing Game Indicators on mobile phone (the clearness of the indicators displayed when the user is playing the racing game)	□	□	□	□	□
Chat Evaluation (an overall usability	□	□	□	□	□

evaluation about the chat tool)					
Betting Evaluation (an overall usability evaluation about the betting tool)	□	□	□	□	□
IPTV Evaluation (an overall usability evaluation about the IPTV simulator)	□	□	□	□	□
Migration Evaluation (a usability evaluation about the commands used in order to simulate the migration of the game commands from the PC to the mobile phone)	□	□	□	□	□

EMERGENCY QUESTIONNAIRE

Usability Parameter	very low	low	medium	high	very high
Flooding simulation readability	□	□	□	□	□
Traffic simulation readability	□	□	□	□	□
Merged simulation readability	□	□	□	□	□
Migration process usability	□	□	□	□	□

B. APPENDIX: PROGRAMMABILITY ASSESSMENT TABLES

CONTEXT MANAGEMENT FRAMEWORK

Title:	OPEN Programmability Assessment Context Management Node		
ID:	OPEN Programmability_Context_Management_Node_1		
Version	**Issue**	**Date**	**Author**
1	1	08-06-2009	AAL/ Vodafone team
Module name Context Management Node			

General considerations	The context management framework (CMF), consisting of one management node and several agents distributed in the network, is able to collect, distribute and provide easy access to context information. The key points with respect to programmability of the CMF are: • **The collection: it** is done via small software components, called retrievers, interacting with raw sources of data, e.g. device discovery and Device Selection Map (or DiscoveryMap-see D3.1) and the CMF, and by processing units which may produce/infer non-measurable data types. The Trigger Management will utilize the processing capability as to infer the right moment in time, space and context for a potential service migration. • **The distribution: it** is handled by the internal of the CMF as needed, but can be influenced by ***scoping*** from the user, and support ***synchronous*** as well as ***asynchronous access*** to context information. • **The information model:** it is the key to the interaction, and is extensible in terms of attributes or entities that may be produced or provided. • **Configuration of the CMF: it** is done via XML files which allow a flexible setup of the agents in the network, allowing also overlay network types to cross network domains. The configuration of an Agent is required for both the Context Management Node (CMN), and for each of the clients in the network connected to the CMN, but with different settings. • **Installation of the CMF:** It ensures that the required Java packages are also installed, but does require the user to setup an environmental variable "CMF_PATH" to whatever installation path that has been chosen. Currently this is not automatic. The intention at a later stage is to run the CMF in an OSGi environment, simplifying the processing and retriever component setup procedure significantly and dynamically, but for now this is done statically via XML configuration files. By implementing the retrievers and processing units as OSGi service bundles, these can easily be *installed*, *started*, *stopped* and *uninstalled* as needed. By utilising remote-OSGi, those bundles can even be

	found in remote, centralized repositories from where Context Agents can locate relevant bundles as needed, making the Context Agent a full automatized, autoconfigured entity, which provides access to any information needed in a distributed environment.
Reference prototypes	"Trigger Management and context information management prototype" described in D3.2
Synthetic description	User: developer Supported context variables type, Manageable variables: variables described by the XML file Available tools for configuration: XML files
Context variable collection and distribution	Since the CMF is responsible for distribution and access to any general information types, the model used is key important to benefit from the system. The information model is relying on each information element having some or all of the following elements • **EntityIdentifier**: A unique identifier of the information element • **EntityType**: A type element that describes the information type • **AttributeName** and **Value**: A set of attributes and values (in pairs). There may be many attributes per information. Currently simple values, like integers, floats, strings, etc. are supported. • **Metadata**: additional information about the information, e.g. timestamp. So, for example, the battery voltage of a device could be described by <Entity> <EntityIdentifier>someDeviceIdentifier</EntityIdentifer> <EntityType>Device </EntityType> <AttributeName> <name>BatteryVoltage</name> <type>float</type> <value><float>12.5</float></value> <metadata> <name>unit</name> <type>string</type> <value><string>Volt</string></value> </metadata> <metadata> <name>timestamp</name> <type>long</type> <value><long>1242208577546</ long></value> </metadata>

	</Attribute> </entity> The setup, as mentioned, is currently done via XML files, and is too comprehensive to detail in this document. However, the intention is to move the CMF to OSGi framework, from where retrievers and processing units can be handled like separated services, hence leading to a minimum of setup via XML files. A major requirement to the CMF, is its ability to collect, distribute and provide access to general information. With respect to the collection of information, the CMF addresses this by allowing: o Extensible collection method by allowing specifically written retrievers components to be plugged into the framework, which converts raw, measured data into a common data description model o Extensible approach of inferring, deriving new types of context information based on measured information, by processing unit. Similar system to the retrievers, processing units are plugged in, and may provide any relevant information not directly measurable by retrievers. With respect to distribution, the framework o Informs the Context Management Node (CMN, the central entity in a CMF network configuration) about the availability of information at a given Context Agent. Subsequently, the CMN may be inquired about the location of context information and then followed by a direct request to the relevant entity for the value of the information. In this way, only information needed to be exchanged/communicated over the network is exchanged, hereby limiting the network traffic to only the absolute needed. With respect to the access of information o The access of information happens via a dedicated query language (Context Access LAnguage, CALA). This offers several ways of conducting searches for relevant information, mainly by *EntityIdentifier* and/or *EntityType* plus any additional *Attributes* that may be desired. o Furthermore, scoping of context queries, e.g. a query may be scoped via network domain, location or time. The CMF then takes this into account when accessing the rightful device. o Finally, the CMF offers synchronous and asynchronous access via either a request/response model or subscription/notification based approaches (either periodic or event based, with possibility of defining events in the subscription query).
Language/tool available for the module behaviour description	NA

Parametrical evaluation	• Extensibility (capability of accepting and managing new variables): **5/5** • Consistency: **5/5** • Efficiency: **NA** (it was not possible to perform an efficiency measurement) • Robustness: **3/5**
Qualitative evaluation	• Flexibility. The CMF module offers a good level of flexibility. It is possible to define new variables and they are correctly managed by the module. • Simple mechanism for a variable request. It is very simple to get a variable from the CMF module. In particular, only a CALA query or a CALA subscription is needed to get the required variable. • Java retriever needed. In the tested version, a developer is forced to implement the retriever using Java language. A programmability enhancement of the module could be the definition of a mechanism that allows the application developer to choose the language to use (for example using XML-RPC or SOAP).
Synthetic description of the adopted verification and validation strategies	In order to allow the CMF module to manage a new context variable (in the performed test it was the battery level of a device, represented by an integer value) the following steps have been performed: • Development of a **Retriever**. • Modification of the **DSAM** configuration file. • Execution of a **CALA query** and of a **CALA subscription**.

WEB UI ADAPTATION

Title:	OPEN Programmability Assessment – Web UI Adaptation		
ID:	OPEN Programmability_Web_UI_Adaptation		
Version	**Issue**	**Date**	**Author**
1	1	08/06/2009	ISTI-CNR team / Vodafone Team
Module name Web UI Adaptation			
General considerations	This module aims to adapt the user interface of the source device to the characteristics of the target device. In order to do this, this module accepts a CUI (Concrete User Interface Description), specified in XML-based language and describing the user interface of the application rendered on the source device *at a concrete level*: this means for instance to specify the UI elements not referring to a specific final implementation language, but in more abstract terms, just referring to the specific platform considered. Then, the Web UI Adaption module transforms a CUI (designed for the source device) into another CUI adapted to the characteristics of the target device. This transformation is performed by following a cost-based algorithm that calculates the cost of every UI element in a presentation (for instance, the cost of a textual string is the number of pixels occupied by it on the screen) and then, depending on the total cost of the various presentations composing a UI, calculates a new CUI that is more suitable for the characteristics of the target device. In addition, from this new calculated CUI, this module generates the end user interface using a specific implementation language for delivering the UI on the target device. It is worth pointing out that, in order to enable programmability features on this Web UI adaptation module, it is possible for the user of the OPEN platform to e.g. specify/change the costs associated to various UI elements. Therefore, depending on the values specified by the user (e.g. the costs of some UI elements), the adaptation can deliver different results. Regarding the programmability features, this module allows for modifying the adaptation rules both for the *mapping* and the *splitting* transformations, which are defined below: • The **mapping** rules basically allow for transforming a specific UI element into another UI element. As an example of such rules we might consider the transformation of a radio-button (desktop platform) into another UI element,		

	which is deemed more suitable to be rendered onto a mobile platform: for instance, if the cardinality of a radio-button is higher than a certain threshold, the radio-button might be transformed into a pulldown-menu (on a mobile platform), since the latter element occupies less screen space. Therefore, in order to have programmable mapping rules, such transformation rules should be modifiable. • Through the **splitting** rules, this module can change the structure of a presentation. Then, with such rules, a single presentation (e.g.: for a desktop platform) can be translated into multiple, smaller presentations, which will be rendered onto a mobile platform. Then, the splitting rules specify the rules according to which a certain presentation will be split into multiple presentations (since e.g. the original presentation does not fit the capabilities of the target device). Therefore, in order to have programmable splitting rules, such rules should be modifiable.
Reference prototypes	Web migration prototype, described in D2.1. It can handle desktop web applications that are well-designed (e.g. they comply with W3C standards) and can be specified at a concrete level.
Synthetic description	User: service provider, migration platform administrator Supported context variables: the Web UI Adaptation module basically handles variables that model the various aspects managed by the adaptation algorithm. Such aspects basically refer to device-related characteristics like e.g. the 'cost' of a graphical UI element (e.g.: the number of pixels needed for rendering it on the screen), the number of characters that can be contained in a single line visualized on the device screen, the interaction capabilities of a certain device, etc.. Therefore, this module basically manages variables that can be represented by integer values. Available tools for configuration: a graphical tool is available, together with a configuration file. They are both currently subject to further improvements. Workflow patterns supported: NA
Context variable collection and distribution	• User agent information (for identifying the target device) + WURFL repository (for retrieving more detailed information about the various characteristics of a certain device) • Device description file specifying the characteristics of a certain device (this information is supposed to be exchanged between devices during the device discovery phase)
Language/tool available for the module	A graphical tool is available for manipulating the variables that can be handled in a programmable way by the Web UI Adaptation module, through the mapping rules and the splitting rules. Among such variables we cite e.g. variables like the cost of the

behaviour description	various elements of a graphical UI, the tolerance (number of allowed scrollings within a single graphical presentation), the number of characters that can be contained in a single line, etc.. In addition, such variables (together with their current values) are also specified in a configuration file.
Parametrical evaluation	• Conciseness (capability of specifying the module behavior in a synthetic way): ***5/5*** o weight: 1 • Fulfillment (capability of specifying the required workflow patterns): ***2/5*** o weight: 3 • Usability (usability of the provided tool): ***4/5*** o weight: 2 Tot: 3,17
Qualitative evaluation	• Consistency. Every supported feature of the configuration tool offered by the Web UI Adaptation module is consistent with the expected behavior. • Runtime Efficiency. No runtime efficiency measure has been performed on the Web UI Adaptation in order to evaluate the effects of the reconfiguration on the module performances. However, no relevant problem has been noticed during the testing activity. • Robustness. No robustness test has been performed during this testing activity. The configuration tool offered by the Web UI Adaptation module is very direct and easy to use. In the tested version only a restricted set of parameters was available and it was not possible to create a rule (for example, when several devices are using the module, the following rule could be defined: the maximum image height must be half of the device screen height, with the device height that is automatically retrieved from the WURFL repository). However, considering that the application development lifecycle had ot been completed, the Web UI Adaptation module offers a good programmability level.
Synthetic description of the adopted verification and validation strategies	Some test cases have been executed on the configuration tool. A group of meaningful mapping and splitting rules have been tested in order to evaluate the tool consistency (by checking that the adapter behavior is the expected one).

SERVER SIDE APPLICATION LOGIC RECONFIGURATION

Title:	OPEN Programmability Assessment Server side Application Logic Reconfiguration		
ID:	OPEN Programmability_Application_Logic_Reconfiguration_1		
Version	**Issue**	**Date**	**Author**
1	1	08/06/2009	ClU/Vodafone team
Module name Application Logic Reconfiguration			
General considerations	This module is responsible for the adaptation of the application logic during runtime. Application logic is realized by components which interact through interfaces. Thus, the task of this module is to change the wiring of the components and their internal behaviour like introduced in deliverable D4.1. This module is the key module for enabling the OPEN applications programmability (refer to the example after the template).		
Reference prototypes	The PacMan prototype as described in D4.3		
Synthetic description	User: application developer Supported context variables type: variables used for the module configuration are currently hard-coded, so it is possible to use any type of variable and object supported by the programming language. Manageable variables: in the current prototype, the module is not able to handle context information in a generic way. If context information has to be used, it has to be hard-coded into the components. In fact, these variable types have to be defined during development time of the application. In the future version, it will be possible to make use of all kinds of context variables. Available tools for configuration: in the current version, no tool support is provided. In future versions, some kind of configuration files can be used to describe the reconfiguration rules, also considering reconfiguration conditions based on context information, like for example: • use components on those devices where battery>50% The goal is also to provide a tool which shows a graphical representation of the current system configuration in order to ease application administration. Workflow patterns supported: • Sequence • Parallel split		

	• Synchronization
	• Exclusive choice
	• Simple merge
	
	As already mentioned before, the application logic is built out of interacting components, currently implemented based on OSGi and Java. What the application developer does is to implement the components and define their required and provided interfaces within the code of the component. Required interfaces are given by an annotated variable, and provided interfaces by implementing the according interfaces:
	`public class ExampleComponent implements Service {`
	`@RequiredInterface`
	`private Service myService;`
	`public void foo() {`
	`...`
	`}`
	`}`
	Furthermore, the developer can define an integer value representing the quality of service of the interface implementation. The ALR component will automatically inject the required instance into the given variable as soon as an according instance becomes available. Furthermore, it will replace an instance, if another instance with a higher priority becomes available. As soon as all required instances are injected into the according variables, the ALR module will notify and start the component. Every time a new component becomes available, the ALR will check if a rewiring of components or a replacement of a component is necessary. The result is an application logic implementation which changes its behavior during runtime.
	For these reasons, each type of workflow patterns can be realized. However, they have to be implemented by the component developers. The parallel split pattern, for example, can be realized by just calling methods at two different components. The synchronization pattern, on the other hand, can be realized by a component which waits until all execution threads to synchronize have called a method at that component. A component can implement the exclusive choice pattern by deciding which component to call next based on available information.
	It is not intended for the OPEN project to integrate a workflow specification language into the ALR module. Thus, the specification of the workflow will still take place in the code of the components. But for a future version it is intended to have an application specification where rules can be specified defining how the components are wired and adapted based on context information, like already mentioned above.

Context variable	NA

collection and distribution	
Language/tool available for the module behaviour description	NA
Quantitative evaluation	NA
Qualitative evaluation	NA
Synthetic description of the adopted verification and validation strategies	NA

C. APPENDIX: NOT PERFORMED PROGRAMMABILITY TEST CASES

ID	Programmability_WebUIAdaptation_1-NOT POSSIBLE
Module	Web UI Adaptation
Description	The objective of the test case is verifying the effect of modifying a **mapping rule** in the Web UI Adaptation module when passing from a desktop platform to a mobile one. This rule transforms a (desktop) radiobutton into a different UI object (e.g. a pulldownmenu, which occupies less screen space) depending on the cardinality of the possible choices of the considered radiobutton element. The concerned rule takes in input the maximum number of options that radiobuttons can have for being displayed on a mobile device (let's call it **MaxCard**). If the cardinality of the selection items of the considered radiobutton (let's call it **Card(radioButton)**) is higher, the radioButton is transformed into a pull-down menu onto the mobile platform; otherwise the radiobutton is maintained in the mobile platform.
Input	**MaxCard** An integer value representing the maximum cardinality of options in radiobutton elements
Expected output	For each radioButton existing in the desktop UI: If Card(radioButton)>MaxCard the radiobutton is transformed into a pulldownmenu. Then, a pulldownmenu should appear on the target mobile device UI instead of the original radioButton. If Card(radioButton)<=MaxCard the radiobutton is maintained in the mobile platform (no transformation of the UI object takes place)
Actual output	This TC is not supported at this time
General considerations	This test case will be performed during the next test iteration.

D. APPENDIX: NOT PERFORMED TECHNOLOGICAL TEST CASES

FROM D2.1: WEB MIGRATION

ID	OPEN Technological test plan Web migration TC2 – NOT POSSIBLE
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 6 - System should be able to trigger a migration
Input	This TC is not supported at this time
Expected output	
Actual output	
General consideration	

ID	OPEN Technological test plan Web migration TC3 - NOT POSSIBLE
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 82 - Migration should be automatic / system triggered. Based on previous settings by the user
Input	This TC is not supported at this time
Expected output	
Actual output	
General consideration	

ID	OPEN Technological test plan Web migration TC4 – NOT POSSIBLE
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 62 - Users want to use the migration process for triggering application actions, e.g. for joining a game
Input	This TC is not supported for this application
Expected output	
Actual output	
General consideration	

ID	OPEN Technological test plan Web migration TC7 – NOT POSSIBLE
Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 34 - Service content should be provided in a context aware manner
Input	This TC is not supported at this time
Expected output	
Actual output	
General consideration	

ID	OPEN Technological test plan Web migration TC10 – NOT POSSIBLE

Item	Specific requirements
Description	Web migration testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 106 - OPEN should let me know where my data is. After it has migrated several times
Input	Since only the one-way migration is now available, it is not possible to perform several migrations, so this TC is not supported at this time
Expected output	
Actual output	
General consideration	

TRIGGER MANAGEMENT AND CONTEXT INFORMATION MANAGEMENT

ID	OPEN Technological test plan Trigger Management TC2 – NOT POSSIBLE
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 86 - Migration should be triggered by the user
Input	
Expected output	
Actual output	
General consideration	Migration is triggered when user moves the devices B (PDA) into the Bluetooth coverage of device C (PC2), so user and system are always working together to perform the migration.

ID	OPEN Technological test plan Trigger Management TC5 – NOT POSSIBLE

Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 74 - Users must be able to migrate identified parts of the application to other devices e.g. high score list
Input	
Expected output	
Actual output	
General consideration	The application is not separable in different parts

ID	OPEN Technological test plan Trigger Management TC7 – NOT POSSIBLE
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 131 - The offline-online migration must be triggered by network QoS parameters too
Input	
Expected output	
Actual output	
General consideration	The application is running without Internet connection.

ID	OPEN Technological test plan Trigger Management TC8 – NOT POSSIBLE
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since

	they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 80 - Users must be able to accept or deny a migration from a to b
Input	
Expected output	
Actual output	
General consideration	This functionality is not supported at this time.

ID	OPEN Technological test plan Trigger Management TC9 – NOT POSSIBLE
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 66 - The user must be able to specify migration policies, e.g. automatic migration when switched off
Input	
Expected output	
Actual output	
General consideration	This functionality is not supported at this time.

ID	OPEN Technological test plan Trigger Management TC10 – NOT POSSIBLE
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: 91 - OPEN should predict the data and applications needed when going mobile.

	Possible migration also for non-OPEN service providers
Input	
Expected output	
Actual output	
General consideration	The application has not been tested in the mobile environment.

ID	OPEN Technological test plan Trigger Management TC12 – NOT POSSIBLE
Item	Specific requirements
Description	Trigger Management testing will start by verifying the specific requirements, since they are primary to check what the prototype does, and if its functionalities are correctly performed. This test case aims to verify this requirement: A2 - The offline-online migration must be triggered by battery too
Input	
Expected output	
Actual output	
General consideration	The application is running without Internet connection.

E. APPENDIX: ACCESSIBILITY AND ADHERENCE TO THE STANDARDS TEST REPORT

This appendix is the report about the Accessibility and Adherence to the standards evaluation, to which the Web migration prototype was submitted during the first testing iteration (M18).

The evaluation took place on the following five web pages from the application:

Page 1(home.htm):

Figure 37: Page 1

Page 2 (home_2.htm):


Categories

- Air Freshners
- AppleSauce
- Baby Food
- Baby Products
- Baked Snacks
- Baking
- Baking Soda / Powder
- Beans & Vegetables
- Beverages
- Breakfast
- Candy
- Cereals
- Cleaning Supplies
- Condiments
- Cookies & Crackers
- Cooking Oil
- Dessert Toppings
- Dishwashing Detergents
- Fruits
- Gravy
- Health & Beauty
- Herbs & Spices
- Hot Drinks
- Jam & Jelly
- Kitchen Supplies
- Laundry
- Meat
- Medicine
- Mexican Food
- Microwavable Meals
- Milk
- Natural & Organic
- Pancake Mix & Syrup
- Paper Products
- Pasta & Mixes
- Pasta Sauce
- Peanut Butter
- Pet Food
- Pickles
- Pie Filling
- Potatoes
- Rice & Mixes
- Salad Dressing
- Seafood
- Seasoning & Stuffing Mix
- Snacks
- Soups
- Soymilk
- Sugar
- Tomato Products

Back

Figure 38: Page 2

Page 3 (home_3.htm):

Welcome to SuperStore.com
SuperStore.com is the leading online grocery shopping store offering a variety of grocery and consumer products. Find everything from groceries, household cleaning products, health and beauty, baby products, pet food and much more. After more than twenty years in consumer product wholesaling, we are now offering you the most competitive prices directly.

SuperStore Now Carries
Your Favorite Snack & Beverage Items

Back

Figure 39: Page 3

Page 4 (showCategory.htm)

Figure 40: Page 4

Page 5 (showProducts_3.htm)

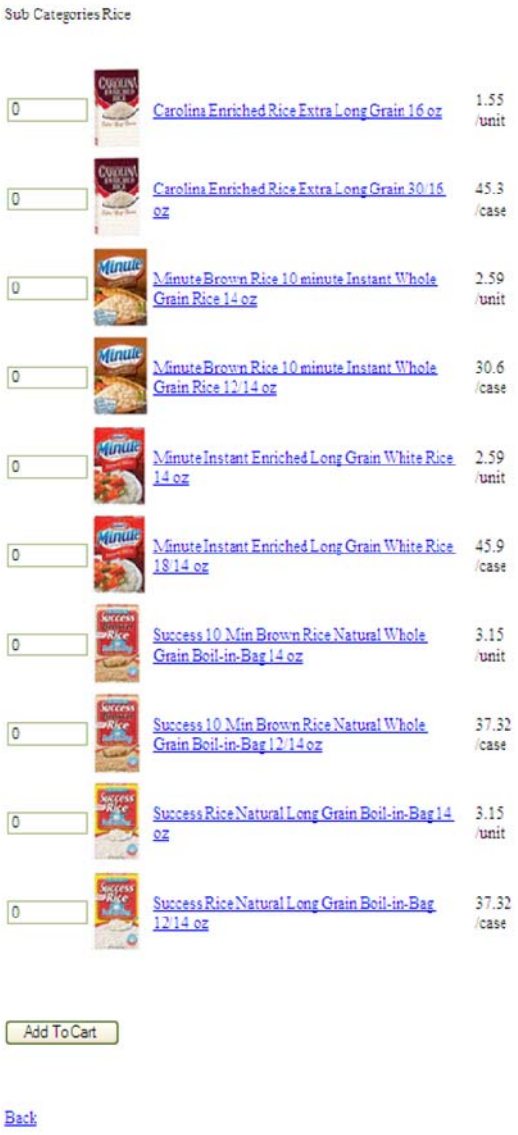


Figure 41: Page 5

Accessibility was evaluated by using Wave tool, while W3C website tool verified the adherence to its standard. The accessibility results follow:

Pg.1 = no errors

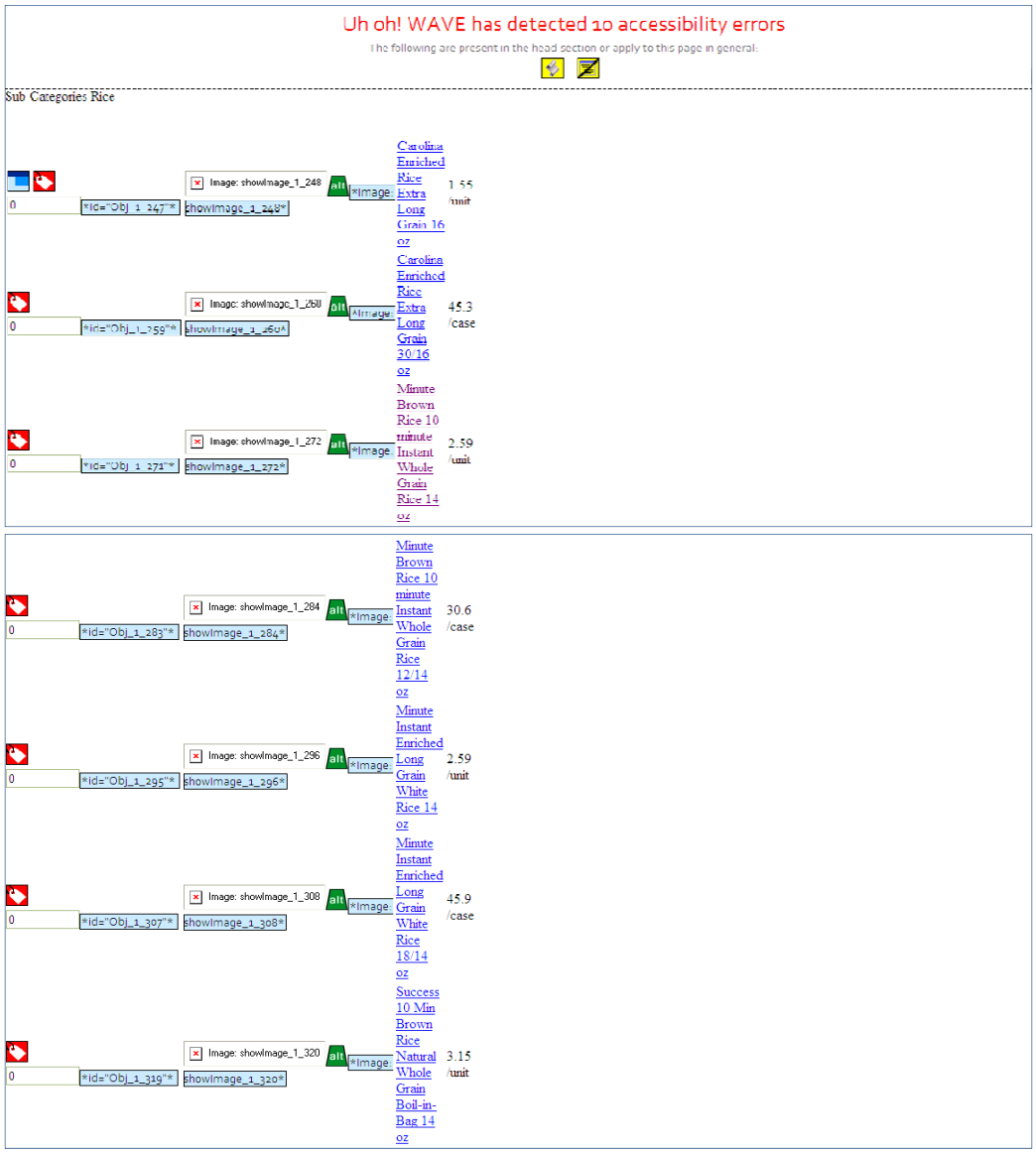
Pg.2 = no errors

Pg.3 = no errors

Pg.4 = no errors

Pg.5 = 1 error x 10 times (Empty form label).

This is the wave report for the page 5 errors:



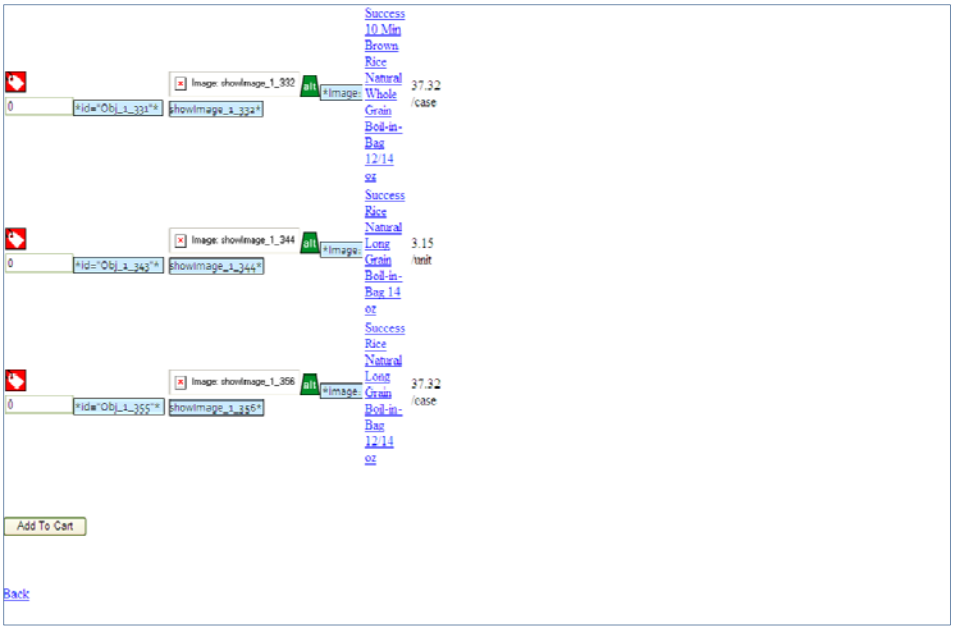


Figure 42: WAVE Output

About the adherence to the standards, W3C website found:

- home.htm
  - Result: 5 Errors, 2 warning(s)
- home_2.htm
  - Result: 15 Errors, 12 warning(s)
- home_3.htm
  - Result: 6 Errors, 4 warning(s)
- showCategory.htm
  - Result: 9 Errors, 4 warning(s)
- showProducts_3.htm
  - Result: 38 Errors, 2 warning(s)

Some of them are repeated many times, this is the complete list, avoiding duplications:

- <meta HTTP-EQUIV="Pragma" content="no-cache"> instead of <meta http-equiv="Pragma" content="no-cache"/>

- & instead of & in the text
- Attribute "height" exists, but cannot be used for this element (<table height="620" width="480" >)
- Line 25, Column 7: element "tbody" undefined. Did you mean "tbody" or "body"? (tbody element in a table)
- Line 228, Column 6: document type does not allow element "br" here; missing one of "h1", "h2", "h3", "h4", "h5", "h6", "p", "div", "pre", "address", "fieldset" start-tag (br element in a form element)
- element "button" undefined. Did you mean "button" or "caption"?
- <input id="Obj_1_247" type="text" name="qty35" size="8"value="0" /> instead of <input id="Obj_1_247" type="text" name="qty35" size="8" value="0" />

These errors can be corrected during the next phase of development within the OPEN project.