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Abstract

This document describes the work that has been done regarding gathering a first set of requirements that will be considered for the OPEN Migration Platform. Such requirements will be taken into account for evaluating the infrastructure for migratory services that will be developed during the Project. Moreover, the document reports how the requirements have been elicited and it also describes the scenarios that have been identified by the Consortium.

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1. Introduction

This document has two purposes. On the one hand, the document intends to share with the consortium the initial set of requirements for the system OPEN. On the other hand, it describes the process how an agreement on this set of requirements we established methodologically. The requirements elicitation, analysis and scenario generation process in OPEN was driven along three methodological influences:

- the VOLERE methodology by Robertson/Robertson: this methodology mainly gave us the necessary templates for describing the initial requirements
- the RESCUE methodology by Maiden et. al. inspired the scenario-driven set-up of a requirements and scenario workshop
- the work of Ben Achour on formally composing, checking and varying scenarios for requirements analysis

The main idea was to first create a (huge) space of possible requirements and then to apply filter criteria on this huge collection.

We combined the ingredients of this three requirement-analytic mentioned above influences in a quite creative way and less strict than actually possible, as the OPEN consortium has the following characteristics:

- it is a mix between industrial and academic researchers
- the number of technically oriented people is high
- a direct contact to customers is not given in the first requirements phase

Consequently, the methodology for the first set of requirements was shaped along the formation of user-centered scenarios. The idea of this process was to hook every requirement, be it of technical or non-technical nature to a story (i.e. scenario), which clearly illustrates, how an end-user of the system OPEN will benefit from an implementation of the requirement. In turn, the scenarios have the purpose of revealing requirements and especially not to forget requirements, what could easily happen discussing on an abstract architectural level. Thus, besides the purely technical analysis of the system properties and alternatives in OPEN, the scenarios aim at grounding and reflecting on architectural sketches in OPEN at an early stage.

The document is structured in the following way. First we explain the structure of a scenario, then we show the as-is and aimed-at structure of the requirements. Then we show the process steps conducted in our scenario-driven requirements analysis and complement it with comments on the workshop we conducted. Finally we document the status of our results regarding the collection of requirements and

scenarios for OPEN - and how fit and filter criteria will be applied on this set. In the appendix, the scenarios that have been identified by the various partners and the various requirements that have been collected are reported.

2. Scenarios and requirements – the setup

This section shows the structural elements we adopted from related work on scenario-driven requirements analysis. We will start with scenarios and then show the subset of VOLERE elements we kept for our requirements shell.

2.1 Structure and guidelines for scenarios

Ben Achour's work raises a spotlight on the linguistically traceable of a scenario, which can be defined as a natural language description of a single course of user actions in/with a system without branching the storyline. Ben Achour's theory regarding a crystallized description of the course of action intervenes even at the level of natural language syntax. For example, it should be clear from the syntactical use, who is an actor and what is data passed by an actor. The estimated effort of teaching this is quite high. Consequently we decided to apply a set of Ben Achour's less formal guidelines for contents of a scenario, as sent out to the consortium. Note that the rules express an ideal shape of a scenario. For the sake of fluidly telling stories, we used these rather as guidelines instead of laws.

(i) "The expected scenario prose is a description of a single course of actions. This course of actions should be an illustration of fulfilment of your goal. Alternative scenarios and exceptions should be described separately." [1]

This means, that any choice, system misbehaviour, unexpected behaviour or would create a new scenario. The strictest possible interpretation of this rule would apply this for the actions expressed by each single sentence in a scenario description. We did not apply this strictness, but rather detected what questions on the course of actions and on the assumptions in the scenario came up in the face-to-face discussions during the workshop. These were transformed to so-called what-if triggers (see process description below).

(ii) "You should describe the course of actions you expect, not the actions which are not expected, impossible, and not relevant with regard to the problem domain. Therefore, avoid modal verbs such as should, could, can, may, etc. In addition, avoid negation like "not." or "never" ".

The rule implies that a scenario should as explicitly as possible state, what actions and interactions actually happen, instead of explaining mere possibilities. Committing to this rule also creates one of the main differences between scenarios and architectures, where the latter ones can be seen as the culmination point of expressing all possibilities as building blocks of a system.

(iii)“A course of actions describes sequentially ordered actions (in other words, a kind of story). Ideally any action should be directed from an agent to another agent, and apply on a parameter.”[1]

Here, an agent is any entity performing an action. The rule implies that the description should be more on exchanging parameters instead of describing internal states of the agents. Of course, describing the internal state (for example) motivation of the human agents participating in a scenario makes some scenarios more vivid, but should not bias blur the course of actions. Describing the internal state of technical systems involved in a scenario means restricting the story to particular solutions, which is not the purpose of scenario engineering.

(iv) “State explicitly the assumptions allowing differentiating your scenario from another. In particular, you should not forget to state the cause of an exception.” [1]

Assumptions should not be hidden, especially as they cause particular courses of actions. This rule also implies, that any shift of assumptions with a consequent set of exceptions is a trigger for a new scenario, i.e. generating a variant.

(v) ”If there are loops, they should be restricted by conditions, in order that the number of occurrences of the repetition is finite.” [1]

(v) means that the course of actions should always be manageable and named. Placeholders and loops generated by a meta-level should be avoided. This is also stated by the next rule:

(vi) ”You should stay at one level of abstraction all along the scenario.” [1]

To free the flow of ideas the application of the rules was not checked in the scenarios which came in, but SAP provided the following example scenario, which was worked out by the WearIT at work project, where SAP was strongly involved in the scenario analysis:

“Introduction

Dr. Eve Adam is a surgeon. When she is in the hospital she is always on the move: sick rooms, nurses’ and doctors’ lounges, acute day ward, endoscope room and OP. Wherever Dr. Eve is working, she needs to communicate with her environment. As far as personal communication is concerned, there is no need to worry – this is something Dr. Eve is very gifted with. Electronically, she is getting help from a

small everyday companion: Felix is a A7- sized, 2 cm thick electronic device, light and easily fitting both into the pocket of her white coat and her stylish purse.

Felix is Eve's communication hub, serving several purposes and functioning in many ways. Sometimes it simply communicates with other devices in his surroundings without being touched at all, sometimes it needs additional input and output device (like headsets, displays, cameras etc.) to become fully operational. In other cases it functions like the plain old smart phones Eve has stopped using years ago, because most of all they lacked "smartness" and delivered little useful functionality for both the cost and the weight.

Situation 1: Arrival and Day Planning

When Dr. Eve arrives at the hospital parking in the morning, Felix opens the booms for her and takes care of authorization and payment. Arriving at the charge office, Felix tells the Hospital system, that Eve has started working and has her workstation booted for her. Knowing what Eve wants to know first, Felix calls up today's schedule and shows what's up for today. A patient who was foreseen for a check-up in 10 days signed in already for this morning, on the other hand an endoscope appointment was postponed to the day after tomorrow. Eve shares her professional and private availabilities with Felix and Felix in turn lets the hospital systems know, what it needs to know during working hours. So any appointments made in her absence are in sync with the schedules Felix keeps track on.

Situation 2: Ward Round

After changing into her white coat, Eve summons her assistant doctors and the principal nurse for the ward round. Luckily they don't have to push the ward cart with them any more. Formerly it was piled with paper sheets and lists, later there was a clumsy laptop, with one assistant fully occupied retrieving and feeding information from and to it. They used to stand in front of the sick room downloading the occupants' data from the host and trying to memorise them for the conversation with the patients. Now, Felix has them ready whenever he anticipates that she might need them.

When they enter the room and approach the first bed, the A3 monitor at the foot of the bed lights up and displays the "fever chart" of the patient. Actually this chart has ceased to be a fever-only chart decades ago (in most of the cases the patient's temperature is the least essential information). Nowadays all the relevant parameters of the patient's condition are listed here – adapted to the actual situation and the case. Dr. Eve can tilt the display into a horizontal position like a drop-flap writing surface. The system (triggered and authorized by Felix) displays the latest diagnostic findings, suggests medication and shows the patient's medical history from various points of view. Eve even has access to data originating from exams done by her patient's practitioner many years ago. Felix cannot really take credit for this important feature (this is rather due to the db-admin's constant

struggle for data-interchange with doctors outside the hospital), but still – it's a good thing to have the feeling that she is well informed.

The display can also be moved so that Dr. Eve can share information with the patient, showing x-rays or an endoscope video of the previous procedure. Later on, the display will be also used by the patient for surfing the web or watching TV. In parallel and Instructed by Felix, the bed-display-system will remind (and monitor) the nurses to administer inoculations and infusions in the foreseen time frame of 30 minutes and – of course – that the drug belongs to the patient of this bed."

Note that this scenario just gave the impression to the consortium of how scenarios can be expressed, passages like "*Felix cannot really take credit for this important feature*" deviate from Ben Achour's recommendation of avoiding explanations of "the impossible". The scenario was chosen for practical and didactic reasons, as feedback from WearIT@Work showed that it was clear enough to communicate features, actions and systems involved from a user's perspective, and that it was near enough to the basic ideas of migratory applications and especially interfaces in OPEN. By passing it around SAP, as the initiator of the requirements and scenario process in OPEN, pointed out that it was not a scenario for OPEN and that there were specific scenarios to follow. Also note that any circumstance changing the passing of parameters in the scenario would have triggered a variant, i.e. a new scenario. Considering situation 2 of the example scenario this might be

- the behaviour of "Felix", for example a delay of displaying results on the patient's display
- the surrounding, for instance a patient, who would prefer another modality than the display.

Communicating the requirements template

VOLERE [2] is a requirements analysis process, which scales to different sizes, run-times and degrees of agility. The relevant subset of the VOLERE shell, i.e. the initial template for requirements applied in the OPEN scenario and requirements workshop and its follow-up activities extending the set of requirements, contained the following elements. Because of the shape of the consortium and because of the orientation along scenarios the terminology was slightly differing from VOLERE.

- *description*: this is a brief text explaining, what is meant by the requirement
- *rationale*: a justification of why a user might want the requirement to enter the requirements specification. An important feature of this element for the fluidity of the requirements process is the fact, that the justification is not due to debate among the people (i.e. the OPEN consortium) bringing in requirements. However, it is a way of explaining and clarifying the requirement.

- *owner*: this field is called “originator” in VOLERE, but as scenarios have owners in the OPEN requirements and scenario process we filled this field with the names of scenarios' creators.
- *initially triggered by scenario*: the scenarios work in two directions. On the one hand they support the discovery and elicitation of requirements, on the other hand pointing back to a scenario makes each single requirement more readable, as it is embedded to a story.
- *number*: a number for uniquely identifying the requirement

The illustrative (on purpose: non-IT-) example for introducing the requirements template and also the distinction between requirements and solutions during the workshop was a thing all participants know, namely a requirement on a Coca Cola bottle. The instantiated template for a requirement would contain:

- *description*: the user must be enabled to open the bottle
- *rationale*: it must be possible to fill and empty the bottle

Note that “filling” and “emptying” actually refer to different types of users. This corresponds to also a formal twist when approaching requirements from scenarios: action of opening does not necessarily have to be part of one particular scenario, nevertheless the actions of opening and the passing of a parameter “amount of liquid” generates the need expressed in the requirement. The generation of requirements over more than one scenario was explicitly agreed upon as suitable for the requirements elicitation. We will explain such interdependencies between the elements of the requirements process and this document in more detail throughout the next section.

3. The process of capturing scenarios and requirements in OPEN

The first phase of working on requirements and scenarios in OPEN was arranged around a two days workshop. We describe the phases of workshop preparation, conduction and debriefing.

The preparation for each partner consisted in writing two scenarios of the kind shown in the last section. SAP as organizers of the workshop sent out the guidelines and the example. As a result of this activity, there was the following collection of scenarios (the organisations contributing denoted in brackets respectively), which are also documented in full length as an appendix to this document.

1- Web multiplayer game (Arcadia)

2– PacMan (Arcadia)

3- Video Telephony (NEC)

4- Navigation System (NEC)

5- Shopping Spree (NEC)

6- Transmodal Web Migration (CNR-ISTI)

7- Migration across platforms supporting different implementation languages (CNR-ISTI)

8- Emergency/Flood Scenario (SAP)

9- Service Worker Scenario (SAP)

10- IPTV Gaming (Vodafone)

11- IPTV Business (Vodafone)

12- Mobility support (+ context awareness) (Aalborg)

13-Context awareness (+mobility) (Aalborg)

14- Racing Game Scenario (Clausthal)

15- Lecture Scenario (Clausthal)

The list of scenarios is one central means of communication for the OPEN requirements analysis. This was also reflected by the agenda and the process of the scenario and requirements workshop. The scenario part of the workshop itself started with a presentation of a selection from the above, essentially each organization chose one scenario to present. The moderation by SAP was concerned about establishing the following rules throughout the workshop. The principles were the first thing developed by the moderator of the workshop:

- *brainstorming and discovery character*: this principle on the income mechanisms states, that basically every idea is allowed. The atmosphere of

the workshop should be creative [3] and allow the free exchange without a censorship on thoughts brought in. An important information and agreement among the technically oriented participants of the workshop was the inequality between a requirement and the necessity to implement it at once. The next basic principle is showing the same principle, just from the point of view on the "outcome/output mechanisms" of the scenarios and requirements process as a whole.

- *filtering*: any filtering a priority mechanisms were declared to be out of scope of the workshop. This deliverable nevertheless contains (non-instantiated) filtering criteria, but the moment of applying them was kept away from the activities of the workshop.
- *ownership*: the idea of having owners for each scenario and requirement is essential for a maximum understanding and clarification
- *groups*: parts of the workshop were dedicated to group work, in order to raise the involvement of the single participants. Groups always consisted of participants, which were selected from different organizations of the consortium, also to leverage the understanding of requirements on the level of oral communication.
- *devices and tools*: all presentations and documentations of the intermediate results were captured in non-electronic form. In that sense distracting devices (notebooks, PDAs, mobile phones) could be reduced, as the amount of individual documentation was kept to a minimum.

The workshop started with a non-slideshow presentation of one scenario per group. The discussion about controversial points in that scenario was transformed into what-if triggers for later discussions and in a narrower sense development of scenario variants and requirements in subgroups. For example, if during the presentation of a scenario a discussion about the network connectivity starts, a potential what-if triggers would be "what if the network connection was not given all the time?" or "what if there was no internet connection at all?.

After the presentation of scenarios and the collection of what-if triggers the participants divided into cross-organizational subgroups. Each what-if trigger was then used to initiate the development of scenario variants, which were presented by the owners of the original scenarios thereafter. Note that for some what-if triggers there might be no change of assumptions and consequently no change of actions in a scenario. In turn, the participants were encouraged to develop other variants of the scenarios. The collection of what-if triggers contained the following elements, the original versions and the resulting variants are documented in the appendix. The triggers:

Scenario 2 (Pac Man): What if another player enters the game? What if a big screen/multiple screens is used?

Scenario 3 (Video Telephony): What if multimodality is involved?

Scenario 5 (Shopping Spree): What if positioning information was available/unavailable? What if browsing for people instead of shops? What if several people share a screen? What if we were at a fare?

Scenario 7 (Migration across platforms supporting different implementation languages): What if more devices are becoming available? What if AJAX was available?

Scenario 8 (Emergency/Flood Scenario): What if not only the data migrates, but also the applications? What if only ad-hoc connections are available?

Scenario 10 (IPTV Gaming): What if there is no network/internet connectivity? What if the feedback from resulting from actions of other cars was available?

Scenario 12 (Mobility Support): What if the application domain was different?

Scenario 14 (Racing Game Scenario): What if the game is not pre-installed on the PDA? What happens if the component repository is not available?

Comments on the what-if triggers and resulting shifts were the last point of the agenda of the first day of the workshop. The work on requirements was the central issue of the second day. After a two minutes repetition of each of the scenarios discussed the day before, the participants were invited to fill the movable walls [3,4] with requirements, where all 14 scenarios along the VOLERE fields description, rationale, owner, initially triggered by scenario (the numbering was a post-workshop documentation activity by SAP). These sessions lasted for more than one hour. After this first generation of requirements, the owners of the scenarios commented on the understandability of the requirements, i.e. posed direct questions to the owners in a plenary session with slots for each scenario. As discussion of the requirements during the production of requirements and the hooking of requirements to scenarios turned out to produce overall clear requirements (and thus only a small amount of questions on understanding), the owners of the scenarios were also invited to comment on the principal clusters of requirements and give an overview. A ratio of two third of the requirements reported in this deliverable originated from this workshop.

3.1 Feedback and comments on the workshop

Finally SAP asked the participants of the workshop for qualitative feedback on the tools and techniques applied and on the moderation of the workshop. The participants' comments were positive in the sense, that

- the techniques from requirements engineering, i.e. creativity workshops, scenarios and requirements elicitation were perceived as working and supportive
- the workshop was perceived as a balance between structure and brainstorming
- the involvement of the participants in each step of the workshop were appreciated

- the discovery of other scenarios from existing ones was rated as beneficial
- the notion of ownership for requirements as well as for scenarios was appreciated and there was the explicit wish to keep this for all follow-up measures in the requirements and scenario process of OPEN

The participants saw room for improvement and expressed their wishes regarding the following issues, which SAP as lead of the deliverable tried to respond on the follow-up steps:

- Issue: electronic documentation of the workshop
- Organizational response: sent out via e-Mail immediately after the workshop

- Issue: vagueness in the ad hoc generation of what-if triggers
- Organizational response: To be determined in the second workshop (second year of OPEN). Possible ways of working with this would be a more consequent application of Neil Maiden's creativity triggers [3] in case of a group running out of ideas for scenario variants.

- Issue: additional feature section in the scenario template
- Organizational response: added for the phase after the scenario workshop (see next section).

- Issue: use of the second scenario, as only one was presented by each partner
- Organizational response: all scenarios, no matter if presented or not, were allowed for creating variants and requirements elicitation.

Note that generating what-if triggers from the day 1 scenario discussion and letting scenario owners present his/her states of understanding the requirements initially triggered by the are novel in comparison to the set-up described in Maiden's work on creativity workshops. We observe two main results applying this.

First, the groups working on what-if triggers on day 1 had a tendency of "running out of topics for discussion". This has a systemic reason. The amount of time discussing a potentially controversial what-if trigger in a larger group shifts to a discussion in a smaller group, thus the chance of having the "drivers" or "polarities" of a controversial discussion in this smaller group decreases and discussions come to the point of results. Nevertheless the moderator should have extra triggers (for example Maiden's generic creativity triggers [3]) at hand to pass them to groups, which resolved the what-ifs from the plenary discussion.

Second, the presentation of requirements from the perspective of understandability by the owner of the scenario turned out to be very effective. The amount of re-asking the owners of the requirements about their meaning by the scenario was low, such that a summative plenary overview of requirements took about eight minutes per scenario. This is positively astonishing, as the requirements were attached in a

very interactive way not only to one's own scenario, but in a really cross-organizational way. Potential explanations for this were communication opportunities the two preparation slots for requirements: the group work on variants and the slot of putting requirements cards to the wall.

3.2 Post-workshop and ongoing work – detailing scenarios and requirements

The partners had three weeks of creating additional requirements with the initial templates above. Moreover, they gave a textual description of the scenario variants found in the workshop. The set of requirements grew from 107 to 164 during this time. For a more complete and readable presentation in this deliverable, the initial templates are extended by a best-practice approach applied in former successful projects of Vodafone.

The template for scenarios contained the following fields to be filled out by the owners of the scenarios for their own scenarios:

- *name and number:* as from the list of scenarios and variants shown above
- *author:* the owner of the scenario
- *story line:* a textual description of the scenario and the variants as developed in the steps described above
- *relevance:* relevance of a scenario is just to inform the participants of the process of the perception, how important a scenario might be, e.g. in terms of business value. Each scenario will be kept as a means of communicating and explaining requirements. Priorities on architectural and implementation issues will be a result of applying the filter criteria on the fine-grained set of requirements. In turn, introducing this field does not mean at all, that a scenario will be implemented or be dropped. In contrast, we envision decisions to be based on or checked against the requirements as the level of granularity for priority decisions.
- *Context of use:* the application domain, the user profiles, devices and environments from a general point of view
- *goals to be achieved:* a description of the goals motivating the actions described under *story line*.
- *involved users:* a list of concrete users (personas) taking part in the *story line*.
- *business roles:* the central actions of the *involved users,* which create business value.
- *elaboration and evaluation*: a first more technically oriented sketch of the migration behaviour, the added values by migration, contextualization, personalization or other relevant principles covered by the scenario as well as first comments on risk and usability
- *analysis*: description of possible issue, constraints, challenges or possible problems. Every argument pointed out by usability / innovation, technical, business, ethical and legal evaluation should be inserted in this field.

Additionally, there are three more fields (list of use cases, use cases diagram, list of services) pointing to the future work on the OPEN architecture. These cover the *use cases*, which can be seen as an abstraction from scenarios and the *services*, which shall be supported by the OPEN platform. Note that use cases will also emerge from sorting and clustering requirements. Thus, this deliverable provides two sources for the architectural deliverable, especially its part on use cases: requirements, which can be prioritized and clustered – and scenarios, which we can draw abstractions from.

The elaborated template for requirements contains the following fields:

- *code:* the number/id identifying the scenario
- *owner:* as in the initially used parts of the VOLERE shell
- *text:* the textual description of the scenario
- *typology:* the technological area involved by potential implementation of the requirement
- *status:* approved or not approved
- *related scenarios*: the scenarios, which initially triggered the requirement. General requirements are also valid.
- *relevance, filter criteria:* to be filled out in the next step of assigning priority to requirements and creating different views for a decision on priority:
    - User satisfaction: if requirement no. x was successfully implemented - how happy would a user be with that? (1 = uninterested, 5= extremely pleased)
    - User dissatisfaction: if requirement no. x was not part of the final OPEN - how unhappy would a user be with that? (1= hardly matters, 5= extremely displeased)
    - Degree of innovation: if requirement no. x was successfully implemented - how would rate the degree of innovation in comparison to the state of the art? (1=just repeats well-known features, 5=groundbreaking& completely surprising innovation)
    - Business impact - can anyone make profit from the outcome of OPEN as a result of meeting a certain requirement (1=none at all, 5=market breaking)
    - Level of ambition - to what extend do we spend all of our effort meeting the requirement (1=hardly any additional effort, 5=the requirement will be the only one met)
    - Partner interest - is the requirement within the interest area of each partner (1=not at all, 5=primary area of interest)
- *interaction with other requirements:* the field is mainly dedicated to similar requirements
- *rationale:* as in the initially used parts of the VOLERE shell

The fields on *status, relevance* resulting from an instantiation of the *filter criteria* will be filled out by averaging over the partners' individual. This assignment of priorities according to different views is an ongoing part of the requirements process. As mentioned above, it is based on requirements, not on scenarios. The *allocation* of a requirement to an architectural solution also points to bridging between the deliverables on architecture and on requirements.

4. Example Requirements

Three exemplary requirements have been picked from the list of 164 requirements to give an impression of these requirements.

The full list is contained in an Excel list allowing to sort and filter the requirements for different purposes. The full list is stored on the internal OPEN web-site.

Req no.	Requirement	Rationale	Owner	Cluster	Originally triggered by scenario no.	Interaction with other reqs	Typology [Network / Application Logic / User Interface / Migration Service Platform / Scenario Specific]
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)	Carmen	Control	5 (Shopping Spree)	Yes: 23, 36, 37, 138, 39	User Interface
36	Users must be able to define privacy policies for application on shared/public displays.	Send applications to shared/public devices.	Ernö	Privacy	5 (Shopping Spree)		
76	It should be possible, that parts of the application migrate and also that the whole application migrates.	Sometimes there are pre-installed parts of the applications on the target device, so you don't need to migrate these.	Holger	Reconfiguration	2 (Pac Man)	128, 129, 74, 10, 85	Application Logic, Migration Service Platform

The elicited requirements have been clustered according the most common concepts of the project. An analysis of the clusters is shown in Figure 1 listing the number of requirements in each cluster.

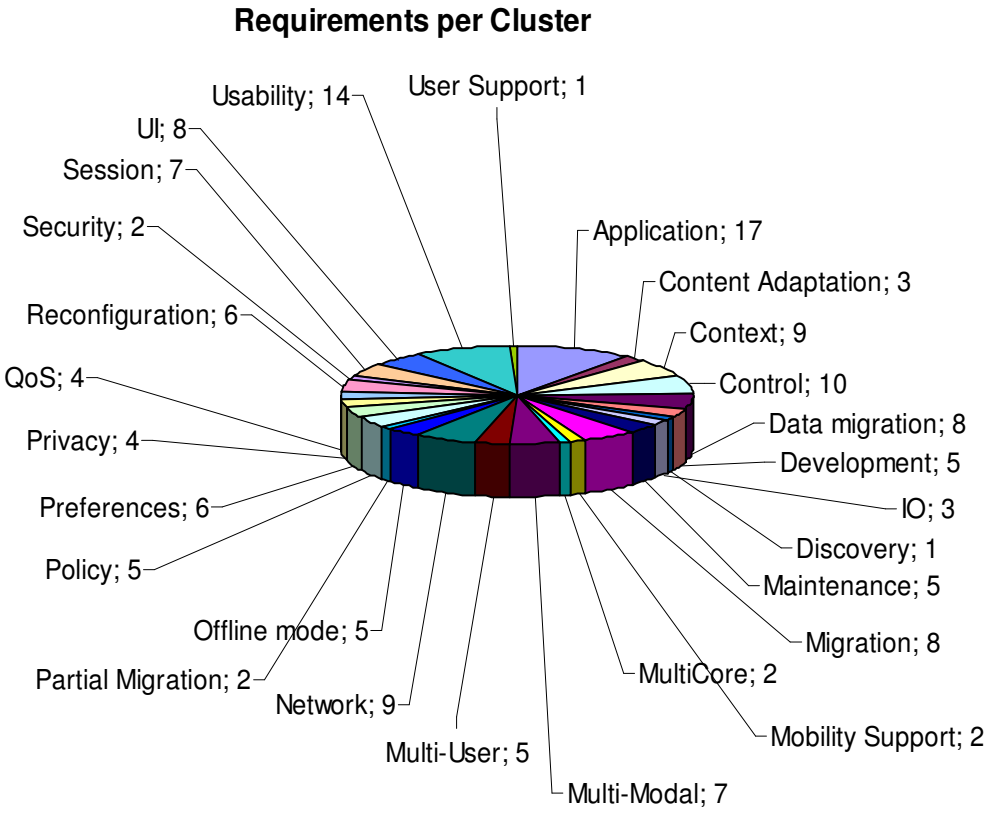

Figure 1 Requirements per Cluster

A number (17) of requirements are centred around the two application that should be build to demonstrate the capabilities of the OPEN approach. The larger amount however is dealing – as indented in this deliverable – the requirements of the platform. The clusters with the most requirements are Usability, different migration types, context, and reconfiguration.

5. Conclusion and next steps

The deliverable generated a set of requirements for OPEN along a methodology, which enables developers and architects throughout the project to use

- the deliverable as a documentation while designing and implementing technical solutions
- get into contact with the persons who raised a requirement and its context (i.e. scenario)

An overview of this activity is given by figure 1. The picture shows, how the requirements are distributed. The different sectors of the diagram are due to a preliminary clustering, where 27 different areas of requirements ranging from "application" to "user support" could be identified. An even more aggregated version of this clustering will be among the next steps to filter and weight the requirements to determine priorities. For example, there are overlaps between requirements in the current clusters "application", "UI" and "migration", which could be used for a lower granularity of the clustering, which will prepare the detection of similar requirements for a condensed version.

The next step after clustering will be dedicated to weighting or priorities. There are two potential approaches to that, namely along the scales of the filter criteria shown above or by just assigning a priority date. Potential filter criteria from the literature and proposed by the consortium are

- User satisfaction: if requirement no. x was successfully implemented - how happy would a user be with that? (1 = uninterested, 5= extremely pleased)
- User dissatisfaction: if requirement no. x was not part of the final OPEN - how unhappy would a user be with that? (1= hardly matters, 5= extremely displeased)
- Degree of innovation: if requirement no. x was successfully implemented - how would rate the degree of innovation in comparison to the state of the art? (1=just repeats well-known features, 5=groundbreaking& completely surprising innovation)
- Business impact - can anyone make profit from the outcome of OPEN as a result of meeting a certain requirement (1=none at all, 5=market breaking)
- Level of ambition - to what extend do we spend all of our effort meeting the requirement (1=hardly any additional effort, 5=the requirement will be the only one met)
- Partner interest - is the requirement within the interest area of each partner (1=not at all, 5=primary area of interest)

Working along these criteria would create the demand for the definition a weighted sum or would create different views on priorities. In contrast to that, priority dates would just roughly sketch the expected delivery date of the implementation of a requirement (essentially: prototype 1, prototype 2 or never for low priority requirements). Nevertheless, the consortium will discuss this alternative carefully, as the overall effort of working with might be more adequate.

Finally, we would like to point to deliverable D5.1 of the OPEN project, which will document application-specific requirements. We plan to continue on the basis of the given scenarios, especially Pac Man and the emergency scenario will be analysed in further detail to create more requirements out of it. Scenario walkthroughs, further input by potential users together with the detection of exceptions will extend the set of application-specific requirements already given and documented.

6. References

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7. Appendix

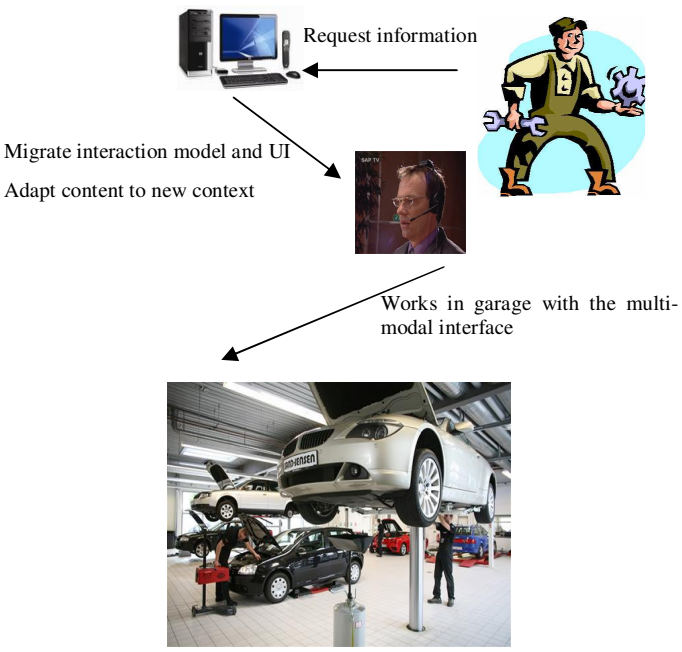
7.1 Scenarios

7.1.1 SAP Research Scenario (Car Repair)

1.1	NAME	Car Service and Maintenance
1.2	AUTHOR	Tobias Klug, Manuel Goertz – SAP AG
1.3	STORY LINE	**Introduction** Mr. Brandt is 31 years old and working in a garage as a car mechanic. There he is maintaining and repairing modern high-tech luxury cars. Since he completed his apprenticeship 11 years ago, he attended several seminars on diagnosis techniques and equipment required to complete the complex maintenance procedures on the cars he has to deal with. **Situation: Car Service and Maintenance** Service means inspection and maintenance. An inspection requires Mr. Brandt to follow a checklist of items that might need to be maintained. If he discovers a problem during the inspection or if the car was already brought in because of problems, he follows the car's maintenance manual to repair the problem. In the morning when he arrives, Mr. Brandt looks up today's schedule of service orders in his PC. Then he takes his multi-modal headset from the cupboard and steps outside. The system displays him the drivers-license of the car which is next. The finds the first car on the parking space outside and drives it into the workshop. Now he looks at the car's maintenance and inspection history on the service terminal using a gesture interaction to determine the required inspection checklist for this specific car model and starts with the inspection. He looks at a few items of the inspection list at a time and performs the checks, for example checking the car's fluid levels. To check these levels, he first has to get into the car, to release the hood. Then he opens the hood and finds the fluid containers. In case of the oil levels, he needs to get a cloth where he can wipe the dipstick. If the fluid levels are ok, the result is documented. Otherwise he refills the fluids and documents all billable activities. Other items like checking the breaks require the car to be lifted from the ground with a car hoist. Mr. Brandt then takes a flashlight to check items on the underside of the car. For all these task Mr. Brandt uses the mobile headset and the voice recognition system. If he detects any problems during the inspection or if the car was initially brought in with problems, he starts the appropriate maintenance procedure. The required procedure is specific for each model and it is virtually impossible to know all of them. Therefore, he looks up the procedure and follows its steps. For example, if the engine has a problem, he needs to start with connecting to the onboard diagnostic unit. The car's documentation tells him the location of the unit's

		connector where he can attach the diagnostics laptop. The diagnostics software now performs a series of internal tests. If these tests indicate a possible source for the problem, he continues with disassembling the engine to take a look at this specific part. He needs to follow the maintenance procedures to open the engine, as there are too many variations for him to know them all. The documentation lists the location of relevant screws and the order in which they have to be removed. Sometimes the documentation even lists maximum forces for unscrewing or tightening specific screws. Therefore, Mr. Brandt is frequently switching between looking at the documentation and performing manual work on the engine. As the engine contains oil, his hands get dirty very quickly. Therefore, the user access and interacts with the system using modals such as gesture or voice recognition. Once the part indicated by the diagnosis software is exposed, Mr. Brandt fetches an external testing device that he uses to check the part. The device's results of course need to be documented for future reference. Depending on the results, he repeats the process of checking parts, documenting results and consulting the documentation for instructions until the problem is solved. Once Mr. Brandt has completed all items from the checklist and all required maintenance procedures, he completes the inspection and issues an invoice for all billable activities. Then he drives the car out of the workshop and onto the parking space. Then he starts with the next service order.
1.4	**RELEVANCE**	Technology: 3 Business: 4
1.5	**CONTEXT OF USE**	Application domain: Service Maintenance User profile: Maintenance worker Device: • PC • Multi-modal headset • Mobile service device Environment: • Garages • Server

1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Reduce work context switches • Use hands free or keyboard/mouse-free interaction modalities • Have same information on multiple devices • Take information and application with you The scenario goals from the business perspective are: • Reduce maintenance time per car • Provide correct billable information/actions.
1.7	**INVOLVED USERS**	• Car maintainer (Mr. Brandt)
1.8	**BUSINESS ROLES**	• Car maintainer • Content creator • The Network provider offers the network infrastructure. • The OPEN Platform provider manages the migration.
1.9	**SYSTEM CAPABILITIES**	• The system should allow to migrate the interaction component • The system should migrate the UI • The system should be able to adapt the content to the "new" UI and interaction modality

1.10	**ELABORATION - EVALUATION**	 **Figure 2: Car Service and Maintenance** The migration happens from the PC to the multi-modal head-set: 1. The user requests information about the next repair on the PC. The information is displayed in a PC-application. 2. The user wants to work in the garage. The application logic components will stay in the PC. However, the interaction model and the UI will migrate and change their modality to the multi-modal headset. The user uses this device to interact with the application. 3. The content will be adapted to fit the working environment (context) of the service maintainer. Related technology: • Different access network technology (UMTS, xDSL, …) or Personal Area Network (PAN) technology (Bluetooth, infrared, …) • Personal device • Server Risks • Interaction modal is no suitable Usability goals

1.11	ANALYSIS	Possible issues are: • Multi-modal interaction does not work properly • Network availability (in the garage)
1.12	LIST OF USE CASES	*tbd*
1.13	USE CASES DIAGRAM	*tbd*
1.14	LIST OF SERVICES	• Maintenance • Billing Service

7.1.2 SAP Research Scenario (Emergency)

1.1	NAME	Emergency Scenario, Scenario No. 8, 8b
1.2	AUTHOR	Andreas Faatz, Manuel Goertz – SAP AG, SAP Research CEC Darmstadt
1.3	STORY LINE	**Introduction** A depression area moving from the Mediterranean Sea over Austria to Eastern Germany causes heavy rain in most of Germany and causes flooding in the areas adjacent to the Elbe river, the Rhine and the Danube. A following period of adverse weather leads to high tides, especially along the Rhine and the Elbe river. In consequence, Saxony declares a catastrophe alert. Necessary actions include the protection of the chemical plant "Iridium" against the continually rising tide. The fire brigade secures the causeways around the plant with sandbags. First analysis however shows that the available contingents of sandbags leave them with a narrow margin. For reasons of effectivity, projections of the current situation will be done, covering the worst case scenario as well as the scenario most probable (based on past experience). Two experts (Ex 1, Ex 2) from the state institute for high tides have been called and the later tasks assigned to them. **Situation: Emergency** Based on the available sensor data Ex 1 gains an overview of the current situation at his OPEN-enhanced terminal and enters simulation parameters for a worst case scenario that includes continuing heavy rain and a shortage of freely available manpower for further causeway securing at both the fire brigade and the German Federal Agency for Technical Relief (GFATR, German: THW).

In this simulation the chemical plant eventually cannot be protected from being flooded and poisonous chemicals will probably leak out. Furthermore the power supply must be shut down for safety reasons and a nearby hospital has to be evacuated.

Meanwhile Ex 2 accesses the recorded data from past floodings and simulates an analogous scenario where the weather clears off slowly. Furthermore he assumes that the number of available forces at the fire brigade and the GFATR is theoretically sufficient.

In the course of his simulation Ex 2 notices that the calculation of manpower is very tight and the risk of a flooding serious. He therefore looks for available capacities of sand at building yards in the surrounding area and for empty sandbags at the Federal Armed Forces.

Both experts now discuss their forecast with the responsible member of the staff (called S4). Consecutively the experts transfer their simulations an OPEN-enhanced wall screen and annotate them with personal remarks during the discussion. The wall screen is capable of a very high resolution and reacts to touches (smart wall).

Subsequently the experts present the modified forecasts to the staff director on the huge wall screen. For the high risks to the population he decides that contingents for sandbags will be calculated according to the worst case scenario. Also a call for support will be issued to the Federal Armed Forces.

Scenario Variants - *what if not only the data migrates, but also the applications? What if only ad-hoc connections are available?*

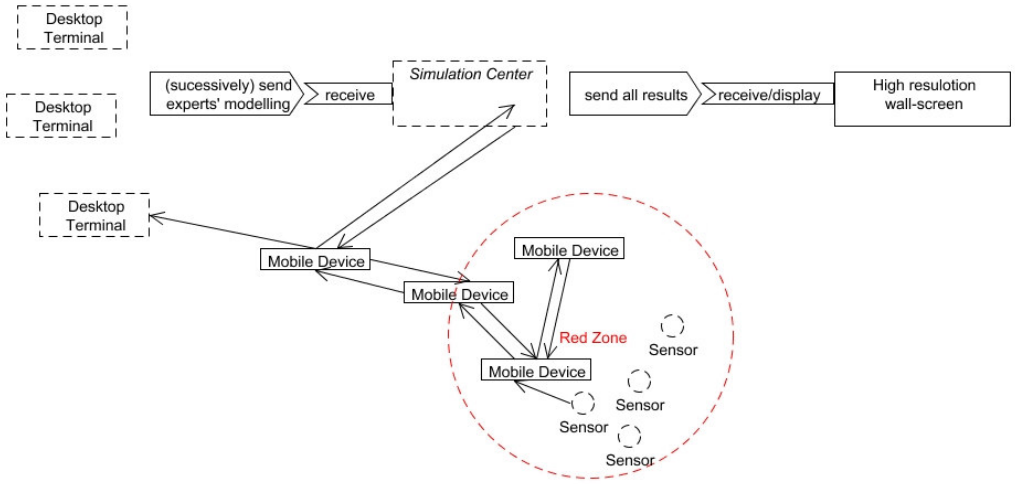
In case of huge and very dangerous emergencies (for instance the explosion of a chemical manufacturer combined with severe continuous rain falls in the same region) there exist geographic spots called “red zones”, for which the simulations done by the emergency control center are incomplete. “Red zone” means, that there are severe damages to the telecommunication infrastructure, i.e. also to the network infrastructure and the available local sensor data.

Different work groups (technical support unit and fire brigade) enter a “red zone” emergency area from different directions and entry points. The technicians’ mission is to re-equip the area. The fire brigades have the mission to assure general safety against chemicals and in particular to help their colleagues from the technical support unit.

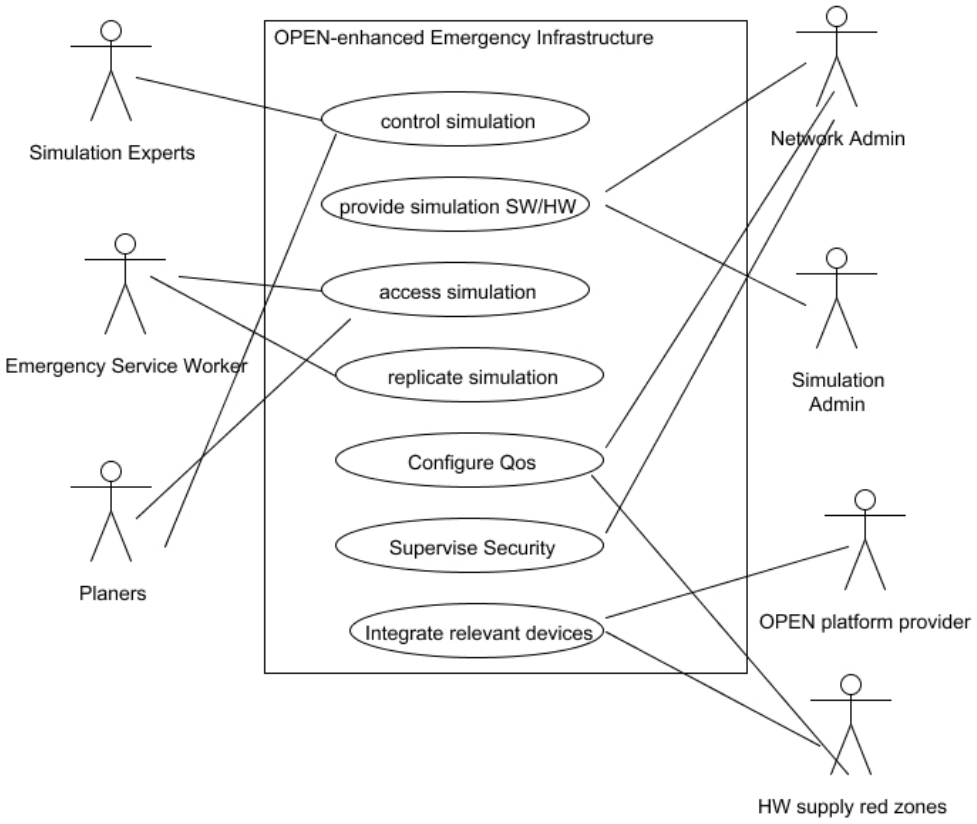
Because of the damages to the infrastructure, only locally available information via ad hoc connections can be assumed to be reliable. The technical support unit and the fire brigade carry initial simulation data (given out by the emergency control center) as well as sensor equipment with them, the latter one to find new measurements (such as smoke, humidity of the soil, particular chemicals in the air etc.) in the “red zone”. Although they come from different organizations and use different modalities (the fire brigade prefers spoken input and output of simulation tools, the technical support unit prefers visual expressions of the simulation data) migrate the simulation data and application in the following way:

		Each worker per default uses the offline mode, because data already on the device could be processed. The initial data of several technical and fire brigade people is synchronized via the ad-hoc connections in the "red zone" and further processed by human and sensor input: • enhanced by new measurements (smoke, humidity of the soil, particular chemicals in the air etc.) by the equipment brought into the "red zone" as well as • annotated by spoken input (description of the situation) by the fire brigade to fill-in missing information The results from the workers of the two groups will be used by the central for an update of the overall simulation by the central. People entering and leaving the "red zone" contribute by updates, which are computed by the high-end simulations machines of the emergency control central. The other way around, people entering the "red zone" spread these updates by means of the ad hoc network. ○
1.4	**RELEVANCE**	Technology: 5 Business: 5
1.5	**CONTEXT OF USE**	Application domain: Business / Public Services User profile: emergency service planning staff, emergency service workers, control units Device: • Control screen: a smart wall screen with over-photorealistic resolution, reacts to touches • Desktop or note book screens • Mobile phones and/or PDA-like mobile devices with spoken input channels Environment: • Computationally strong simulation server or simulation cluster • Intranet • Ad hoc network • Sensor environment • Positioning system

1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Making maximal use out of individual simulation results by unifying simulations (data as well as control) to a very large control overview ("scaling up") • Spreading relevant parts of simulation results to mobile devices even in maximally critical areas ("scaling down"). This also refers to display and control of the data, as emergency service workers push data back from the emergency area. • Merging relevant data and applications • "always online" functionality, even if hands are busy or internet is not available • Keeping the simulations up to date for as many participants as possible regardless of the underlying network technology. The scenario goals from the business perspective are: • Reduce frictions between several units of public services. • Reduce costs for introducing and training new special devices and enhance existing ones by OPEN instead.
1.7	**INVOLVED USERS**	• Simulation experts • Control staff • Emergency workers from different organization: fire brigade, technical support, armed forces, police • Network administration • OPEN platform provider • Device supply and software maintenance for emergency areas
1.8	**BUSINESS ROLES**	Simulation experts receive data individually and provide parts of the simulation. The control staff decides on the next steps, actions and peopled scheduled to a particular area. Emergency service staff provides fresh data and The Network provider offers the network infrastructure. The OPEN Platform provider manages the migration. Device supply and software maintenance support re-equipment of emergency areas.

1.10	**ELABORATION - EVALUATION**	 The first migration is the result of successively applying simulations to a huge planning and simulation task: 4. Application logic components migration: before the migration, simulations are controlled by single experts for simulation. After the migration, parts of the data input and output inform simulations, which were separated before. 5. User interface migration: before the migration, the simulation images, graphs and diagrams are displayed in the mobile phone screen. After the migration, these visual elements are re-interpreted and embedded into a highly detailed card (two dimensional) or even photorealistic presentation on a(n extremely) high resolution screen. The second migration is a migration from the visually highly detailed environment to a far more courser one or to even another modality: 1. Network migration applies, as internet is not available in some regions, but nevertheless data updates must be transferred to the central simulation server or cluster. 2. Application logic components migration: possibly yes, if people want to base or check local decision against an updated simulation or have a "mobilised simulation expert" with them. 3. User interface migration: if the situation in a "red zone" gets critical for the acting individuals, the simulation capabilities might reduce and the simulation results only guide emergency workers. 4. Content adaptation: simulation graphics, topographic and positioning information readable on simple small displays. Topographics, positioning and simulation results also "hearable" and "speakable".

		Values added by migrations are: • Continuous use and update of simulations when changing devices Values added by personalization: • The cognitive overload of emergency workers can be reduced to support quick decisions. Related technology: • Different access network technology (UMTS, xDSL…) or Personal Area Network (PAN) technology (Bluetooth, infrared…) • Personal device • Server, Server Cluster • Real time communication Risks • Low data rate when real time communication is needed. • Slow migration Usability goals • Performing migration in a totally seamless and transparent way, with as less cumbersome inputs settings as possible • Triggering the migration if needed • Being notified of the possible migration which could enhance user experience • In critical situations: being *forced* of the possible migration which could enhance user experience • Being unaware of the underlying network technology
1.11	**ANALYSIS**	Possible issues are: • Security • Throughput of data • Integration of legacy software and hardware • Network availability (both UMTS and xDSL) • Latency times
1.12	**LIST OF USE CASES**	• Public emergency – planning and local service work

1.13	USE CASES DIAGRAM	 **Figure 2: Public emergency – planning and local service work use cases diagram.**
1.14	LIST OF SERVICES	

7.1.3 CNR-ISTI Scenario (Shopping List)

1.1	NAME	Shopping List
1.2	AUTHOR	Fabio Paternò, Carmen Santoro, Antonio Scorcia
1.3	STORY LINE	**Introduction** Paolo is a commuter, who works at a school as a teacher. Today has been a very long day at school, due to a long meeting with other teachers. When he finally was able to go out the school and go home by train, he realises that he has completely forgotten to have promised Giulia, his wife, to buy the typical food it is needed for the dinner that they are going to prepare for their friends for in the next days. Giulia strongly recommended him to manage the shopping list because she already knew that she would not have been able to arrange this, since she could come back home

only in the evening because she had to collect the children who were at a birthday party.

Situation

When Paolo is on his way back home on the train, he suddenly realises that he has to manage the shopping list. He starts to prepare the shopping list by connecting through his mobile device to the web site of typical dishes for buying typical (Sardinian) food and start to buy what he is pretty sure it is currently missing at home. Thus, using the PDA, Paolo can access the page dedicated to the products and specify the category he is interested in (for example, after having selected fish, Paolo adds "bottarga" to the shopping list, and after having selected wines he adds "Vermentino"). For each item, also the cost is visualised on the shopping list on the PDA.

When Paolo enters home, the smart environment suggests him the possibility to migrate the user interface to other devices which have been recognised as available in the new environment (interacting with the digital TV through the TV controller), since the agent-based architecture has recognised a situation where more comfortable interactions might take place.

Indeed, after having seen what is actually missing at home and also checked inside the fridge, Paolo decides to migrate the user interface towards the digital TV and to complete the list by interacting with the digital TV with large screen while sitting on the couch and without having to save his previous selection from the PDA and login again the application from the new device.

After the interface migration, Paolo can find on the digital TV's screen the items that were specified before, through the PDA (e.g. the request for the wine and the bottarga, which was specified using the handheld device) and edit them and/or add new ones until he lastly send the request. The text can be entered by selecting a specific button on the TV controller, which activates a virtual keyboard on the screen.

Variant

When Paolo enters home, as soon as he comes nearby the fridge with his PDA, he can see the screen on the fridge displaying what is currently within the fridge. By pointing the PDA to the fridge and clicking on a button, a comparison is carried out between the two lists and modifications are done to the list on the PDA. Such modifications are also vocally rendered and inform Paolo that the 'bottarga' is already available in the fridge, so it is not needed to buy this item and therefore this item is cancelled by the list displayed on Paolo's PDA.

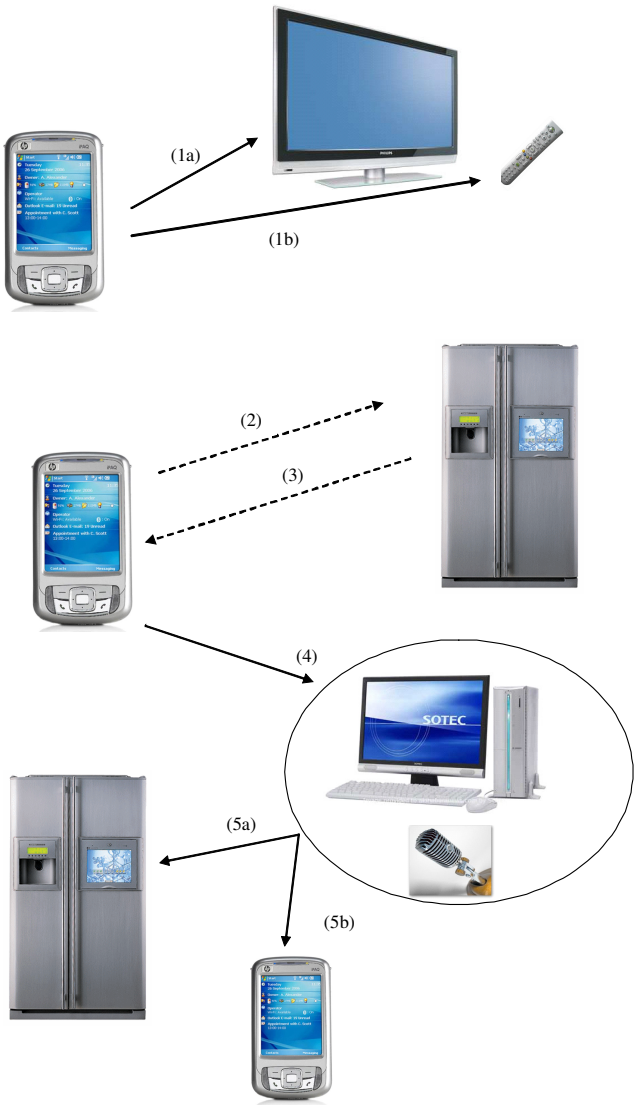
Paolo then goes in the living room. The smart environment suggests him the possibility to migrate the user interface to other devices which have been recognised as available in the new environment, depending on his current position. Then, the environment automatically suggests him that there is the possibility to migrate the user interface to a PC and to complete the new list by vocally interacting with the PC with a large screen, while sitting on the couch. Paolo continues to add other things to the list: he says e.g. "pane carasau", a typical bread from Sardinia island. While he is further editing the list by vocally interacting with the PC, his wife and the children come back home. Paolo then decides to migrate the input control from

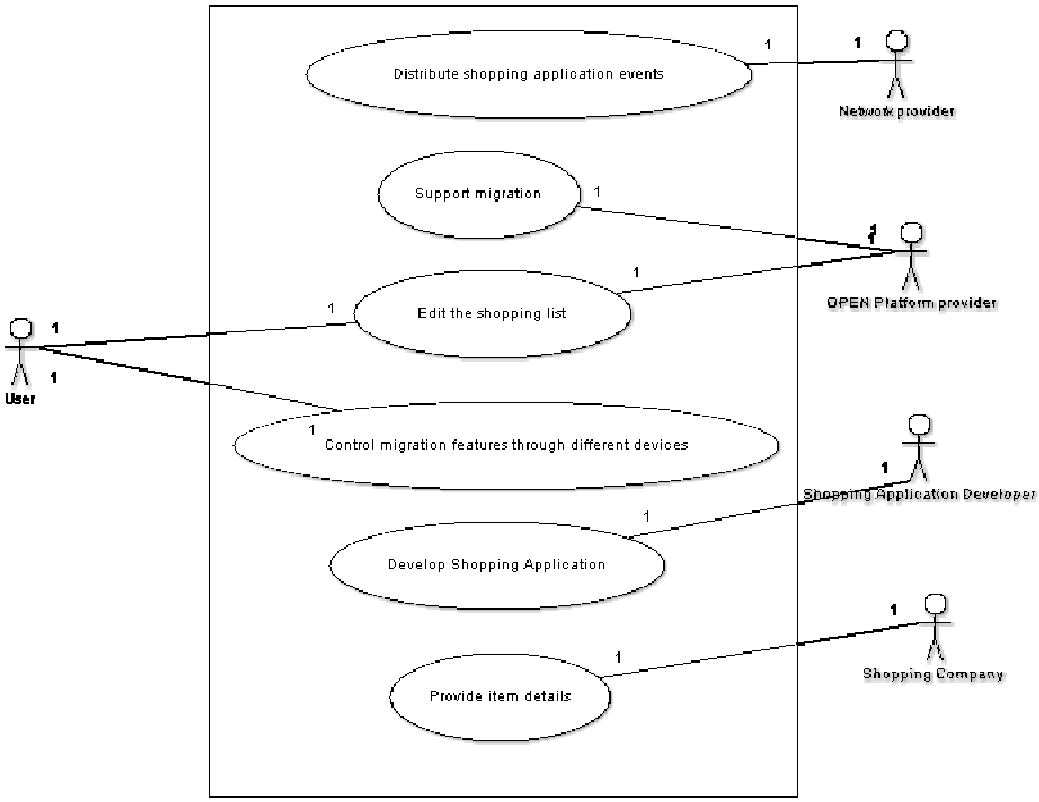
		vocal command again to pen-based interaction through his PDA, in order to prevent unauthorised access from the children and also because the environment has become too noisy for vocally interacting with the PC. Afterwards, Paolo decides to migrate the shopping list both to his PDA and also to the fridge screen so that Paolo and Giulia can collaboratively continue to complete the shopping list while they are in the kitchen.
1.4	**RELEVANCE**	Technology: 5 Business: 3
1.5	**CONTEXT OF USE**	Application domain: Shopping User profile: no tech-savy users, but familiar with using personal and home devices Device: • PDA • Digital TV • Interface of the fridge • PC with large screen • Vocal device Environment: • On the train • At home (smart environment) : living room and kitchen

1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Save time (eg: reduce the need of restarting the activity from the beginning, have automatic features for comparing virtual world objects (objects in the current shopping cart) with real world objects (objects which are already in the fridge) and update the shopping cart accordingly,.. • Have more comfortable interactions depending on the current context of use • Prevent possible issues/misuses of the current UI configuration due to changing context conditions (e.g.: children back home) • Have support and control on the migration target device • Have the possibility to exploiting various available devices, in particular those that are dynamically nearby The scenario goals from the technological perspective are: • Provide suitable adaptation depending on the device • Support different tasks depending on the context of use • Preserve the state of the user interface across various devices The scenario goals from the business perspective are: • For a shopping application developer: provide a usable Web desktop application for shopping • For a shopping company: provide flexible access to their services from any context of use • For OPEN platform provider: provide the possibility of dynamically generating application versions adapted to different types of devices without further effort from the application developer, and the possibility to migrate across them.
1.7	**INVOLVED USERS**	○ Users (Paolo, Giulia) ○ Shopping Application developer ○ Shopping Company ○ Network providers ○ OPEN Platform provider

1.8	**BUSINESS ROLES**	• Paolo and Giulia prepare the shopping list, and can trigger the migration and set the migration parameters. • The shopping application developer provides the Web desktop version of the application • The Network providers offers the network infrastructure. • The OPEN Platform provider provides a software infrastructure able to support migration, including the dynamically generated versions of the user interfaces for various types of devices.
1.9	**SYSTEM CAPABILITIES**	• The system should be able to migrate the UI partially on a device and partially on another device • The system should be able to adapt the UI according to the interaction capabilities and modalities of target devices • The system should be able to manage migration between devices supporting different implementation languages • Context-awareness: the system should be able to recognise the environment conditions for suggesting suitable migration

1.10	**ELABORATION - EVALUATION**	• Kind of migration
		  ○ Partial/Total Migration of UI
		  ○
		• Values added by migration, context awareness, personalization. etc.
		  ○ Time saved
		• Related technology
		  ○ Smart environment at home
		• Risks
		  ○
		• Usability goals
		  ○ Support task continuity
		  ○ Improve the user experience (e.g.: by suggesting the best conditions of migration)



1.11	**ANALYSIS**	Possible issues are: • Low battery of the PDA (on the train) • Information losses during migration if problems occurs during migration • Risks in cooperative editing of the shopping list
1.12	**LIST OF USE CASES**	• Distribute shopping list application events • Support migration • Edit the shopping list • Control migration features through different devices • Develop Shopping Application • Provide item details
1.13	**USE CASES DIAGRAM**	
1.14	**LIST OF SERVICES**	

7.1.4 CNR-ISTI Scenario (Auction)

1.1	NAME	Auction
1.2	AUTHOR	Fabio Paternò, Carmen Santoro, Antonio Scorcia
1.3	STORY LINE	**Introduction** John is planning to go on vacation and would like to buy a new camera. He decides to search for a bargain on an online auction website and accesses the "e-Bet" website through his desktop PC. He checks the information about the available cameras by looking at item descriptions and prices. He finds an interesting offer and accesses the page containing information about the selected camera. He then decides to bid on this item, but discovers that he has to register first, and thus starts filling out the long registration form required by the website. Suddenly, the alarm on the desktop reminds him about a meeting which is going to take place this afternoon at his office, therefore he has to leave. Since the registration form is too long to be completed in time, thus he quickly migrates the application to his PDA and goes out walking towards his car, while he continues filling in the form. As a result of this process, the long desktop form is split into two pages or presentations for the PDA. Additional connections are inserted for allowing the user to navigate from/to the two pages. Since the last input in the desktop interface was the email address, then the mobile page supporting (re-)entering this piece of information is the one activated first in the mobile device. After completing the registration, John, with his PDA, places a bid on the camera before the auction ends in a matter of a few minutes, and then he is redirected to the page containing the camera description, where he can monitor the status of his bid. Therefore, in this scenario two migrations occur: in the first migration (from desktop to PDA), the user partially completes the form, by providing only some information (the last information provided when the first migration is requested is the email address). As soon as the migration is activated, the migration server finds where the form filling was interrupted and then shows to the user the PDA presentation with the form partially filled. Afterwards, John continues interacting with the application: it means that he re-enters the email address, as requested, and moves on the next PDA presentation (see PDA presentation on the bottom), by providing further information (e-Bet User ID). Still interacting with the PDA, John provides the user id (e.g. 'Johnbet'), and then a migration is requested towards a vocal device. Indeed, while John is keeping an eye on the bidding, he enters his car and the application automatically migrates from the PDA to his mobile phone and it can now be accessed through the vocal interface thanks to the wireless connection to the car voice system. Thus, the environment carries out a redesign of the application for the new platform (vocal) and therefore identifies how the user interface design should be adapted for the new platform. Moreover, after having updated the new user interface with the data gathered from the user so far, the environment identifies the point where the user was before the migration was activated, and it allows for continuing the interaction

		from the point where it was left off. Indeed, the speaker says "You have entered your e-Bet User ID Johnbet. If you want to check the availability of your e-Bet USER ID say *availability*; if you want to enter the password say *password*, or say *reset* if you want to reset the application. The user replies saying "availability' and then the application make aware the user of the fact that the user id is not available. Then the user is asked to provide a new ID. This time the ID is available and then John can continue his interaction with the auction system while driving towards his office.
1.4	**RELEVANCE**	Technology: 4 Business: 4
1.5	**CONTEXT OF USE**	Application domain: Private Life (and Business) User profile: business man Device: • Desktop PC • PDA • Mobile Device • Vocal device Environment: • Home • Outdoor • Car
1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Save time (eg: reduce the need of restarting the activity from the beginning) • Be able to meet auction deadlines and buy the wanted item • Have more comfortable interactions depending on the current context of use (eg: in the car, the vocal platform provides more comfortable interactions) The scenario goals from the technological perspective are: • Provide suitable adaptation depending on the device • Preserve the state of the user interface across various devices
1.7	**INVOLVED USERS**	• Businessman (John)
1.8	**BUSINESS ROLES**	• John interacts with the auction application, he (partially) fills in the registration form for receiving a user id and password, and he activates the migration for completing the purchase while he is on the move.
1.9	**SYSTEM CAPABILITIES**	• The system manages the migration of the UI

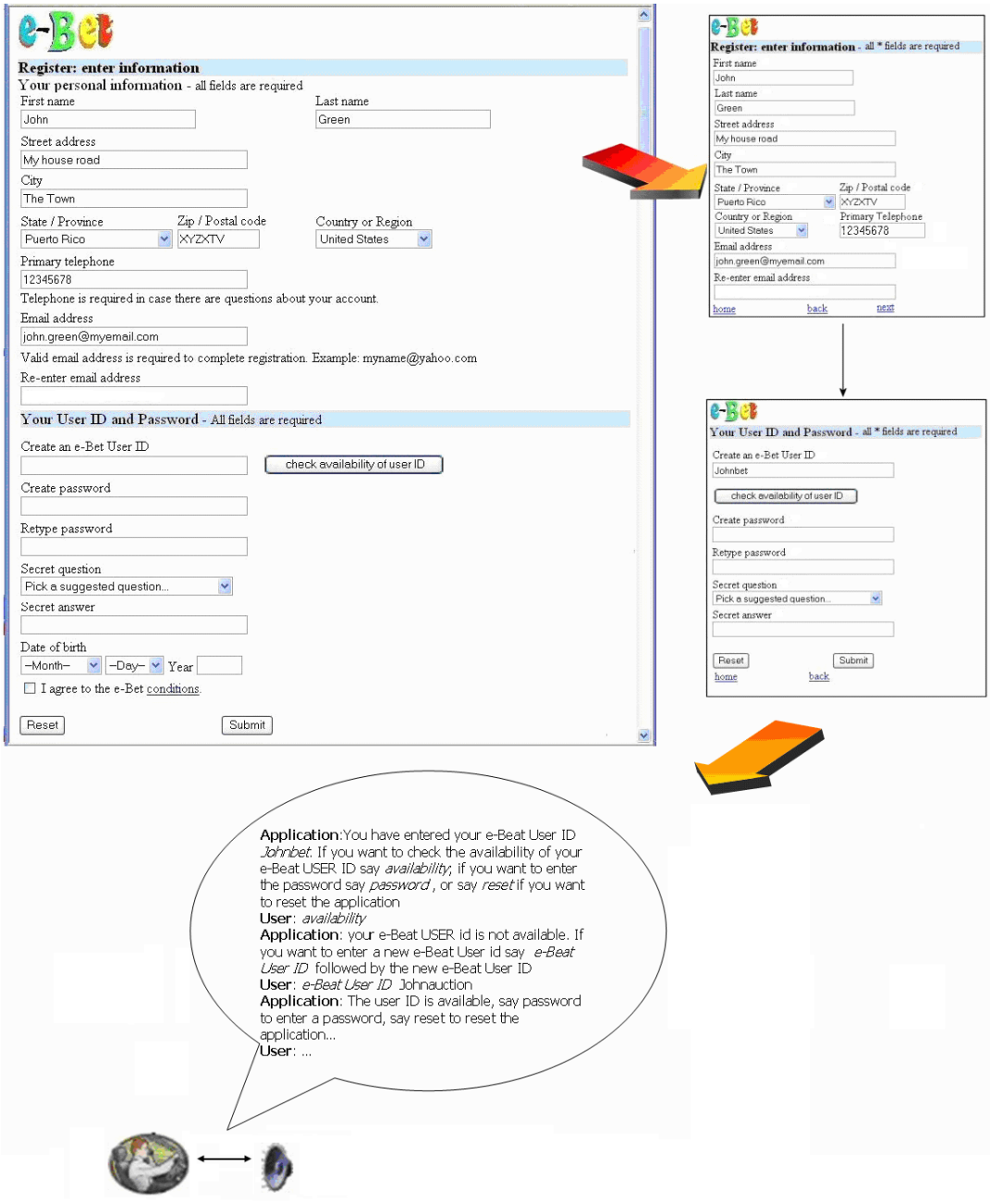
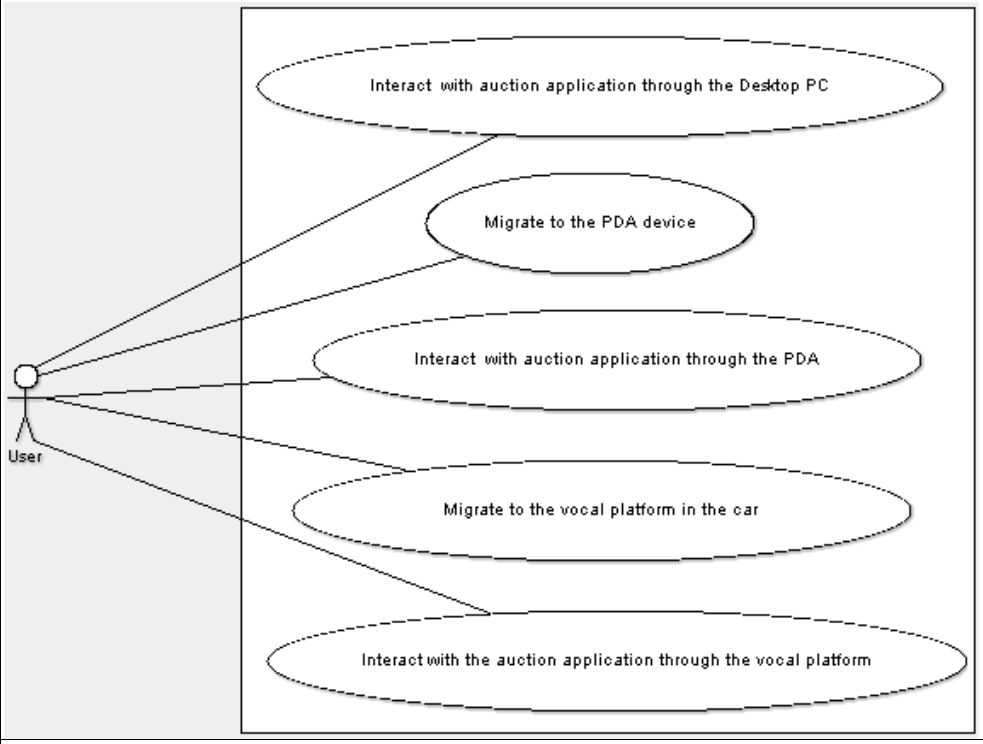
		• The system adapts the content to the new device capabilities and interaction modalities
1.10	**ELABORATION - EVALUATION**	

Fig. 4 The desktop form partially filled in and how it is transformed for the PDA (1st migration) and then for the vocal platform (2nd migration)

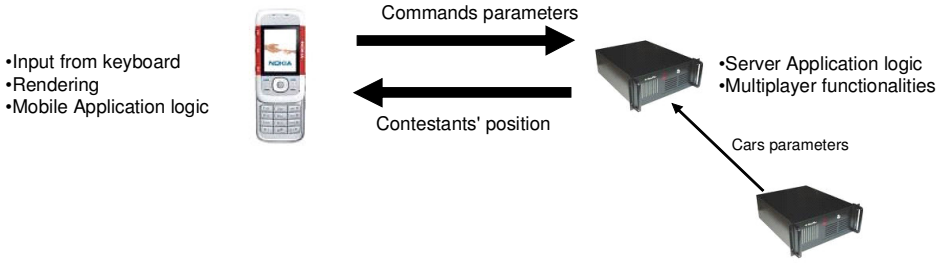
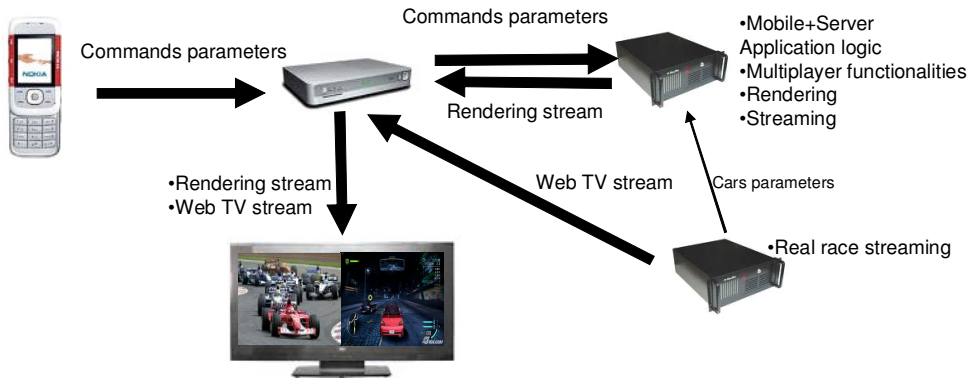
1.11	**ANALYSIS**	Possible issues are: • Noise does not allow for good interaction with the vocal platform while the user is in the car
1.12	**LIST OF USE CASES**	• Interact with the auction application (registration form) with the desktop PC • Triggering of migration from the desktop PC to the PDA • Continuing the interaction with the auction application through the PDA • Migration from the PDA to the vocal platform • Continuing the interaction with the auction application through the vocal platform in the car
1.13	**USE CASES DIAGRAM**	
1.14	**LIST OF SERVICES**	

7.1.5 Vodafone Scenario (IPTV Gaming)

1.1	NAME	IPTV Gaming
1.2	AUTHOR	Stefano Marzorati, Agnese Grasselli, Giulio Caperdoni –Vodafone Omnitel NV
1.3	STORY LINE	**Introduction** Thomas is a 19 years old college student. He loves Formula 1 and is a big fan of Lewis Hamilton. Moreover, he spends 4/5 hours a day playing video games. So he is used to watching, with LiveF1 software, all F1 Grand Prix races on his laptop. He usually places it on the couch and watches the race while playing video games on his Sony PlayStation3 connected to the Plasma TV. ACME Corporation has just announced the release of the Connected Entertainment package that merges its IPTV services with the PS3 gaming system. Thomas purchases the Connected Entertainment package, as the F1 new season is only two weeks away, and he upgrades his Formula 1 Championship Edition game license with all the new season official drivers, cars, circuits, rules and teams. **Situation: IPTV Gaming** Thomas has left the study room of his college library just a few minutes before the start of the first Grand Prix of the season. He starts playing with the mobile phone while waiting for the bus on his way home: he adds a new team - his own "Thomas Racing Team", adds two drivers to the team – Thomas himself and his buddy Brad, and sets up his car. As he gets home, the context is switched to the IPTV-enabled gaming console [STB]. After that he switches to the STB, the STB receives game commands from the phone/remote control, sends the commands to a server in the network and receives the images from a streaming server on the network. The Grand Prix is going to start, so Thomas opens a second HD window on the Plasma TV. Everything is ready! Thomas loves it. With his IPTV-enabled gaming console, he can watch high-definition F1 Grand Prix on one side of the screen, and on the other side, he can virtually race his own car against the real contestants (Raikkonen, Massa, Alonso, but above all Hamilton). He invites Brad, who is still at the library. The Grand Prix starts. Brad plays the game on his mobile phone without watching the Grand Prix, Thomas plays while watching it. Suddenly his grandfather enters the sitting room, asking for help: Thomas should hold the ladder while his grandfather tries to fix a broken ceiling lamp in the kitchen. Thomas has to make an unscheduled pit stop, because he cannot go on playing while holding the ladder; then he switches the live Grand Prix race to the wall screen in the kitchen: a widget at the right lower corner of the kitchen screen keeps Thomas informed of his car's state (lap, position, etc). As the lamp fixing is lasting longer than expected, Thomas decides to give up playing and quits the game from his mobile while still holding the ladder. In the meanwhile Brad, who is still playing on his mobile device after having left the college library, gets off the bus and, instead of going home, rings Thomas' door bell: Thomas' grandmother opens the door and Brad, entering the living room, switches from his mobile to the STB. After twenty

		minutes Thomas gets back, just in time to see Hamilton winning the Grand Prix on one side of the screen and Brad coming in second on the other side of the screen. **Scenario Variants** If there is no IP connectivity:: • With a hybrid STB (IP plus DTT or Satellite etc) live TV could migrate from IP to broadcast, when necessary. Furthermore, while watching broadcast TV, Thomas could go on playing: the STB still receives game commands from the phone/remote control while getting live metadata (both real contestants and Brad) from the mobile network. That is, to summarize, live TV is backed up by a broadcast technology and gaming by the mobile network. (application logic modules) In addition: • events in the virtual world do not influence the real world • virtual players could influence each other • events in the real world could influence the virtual world o if it starts/stops raining o if the safety car comes out o unexpected obstacles o etc
1.4	**RELEVANCE**	Technology: 5 Business: 4
1.5	**CONTEXT OF USE**	Application domain: Gaming User profile: video game players, Formula 1 fans. Device: • IPTV-enabled game console (STB) • Plasma TV (connected to the STB) • Wall screen (without STB connection: no gaming capabilities) • Mobile phone Environment: • IPTV streaming server • Game server

1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Achieving a game user experience enriched with real race information. • Performing migration in a totally seamless and transparent way, with as less cumbersome input settings as possible (during the first migration process, avoiding to: save the session, close the application in the mobile phone, start the same application in the STB, load the previous saved session, set the mobile phone as the game controller, set the connectivity between the mobile and the STB and then restart playing. The goal is to: set the game migration from mobile phone to STB, setting the option "input from current device" and straightaway continue playing). • Triggering the migration if needed (the user, entering home, clicks the migration icon in the mobile phone and starts the migration). • Being notified of the possible migration which could enhance user experience (the OPEN platform recognizes the STB and opens a popup in the mobile phone, presenting the migration option). • Enjoying the race regardless of the underlying network technology. The scenario goals from the technological perspective are: • Device discovery • Device capability knowledge • Content adaptation (at application level, i.e. image size adaptation, transforming flash into another format supported by the target device, …) • Logic reconfiguration (to maintain the original business logic irrespective of the device capabilities and irrespective of the kind and number of device involved) • Streaming capabilities (for streaming rich media content to device with limited CPU power) • Migration trigger management • Session management (user single sign on) • Application data storage (during migration) • Connection setup and maintenance The scenario goals from the business perspective are: • Provide gaming experience for a wider customer base, as gaming is possible on multiple devices. • For a network provider to evolve into a Service Provider.

1.7	INVOLVED USERS	• Players (Thomas, Brad) • Content distributor who provides the game and the telemetric data (the other actors of the value chain are not considered because not directly involved with the end user) • Network provider • OPEN Platform provider (it can be one of the previous two or a third one)
1.8	BUSINESS ROLES	Thomas and Brad play the game, trigger the migration and set the migration parameters (e.g.: which parts of application migrate and where). The Content distributor hosts in its servers the game application, collecting and distributing also real race information (weather conditions, telemetric …). The Network provider offers the network infrastructure. The OPEN Platform provider manages the migration.
1.9	SYSTEM CAPABILITIES	*Note: as we shared Francesca's suggestion to add technical and business perspective in the "goals to be achieved" section, we believe this "system capabilities" section has already been covered there.*
1.10	ELABORATION - EVALUATION	 **Figure 5: scenario before the first migration.**  **Figure 6: scenario after the first migration.** The first migration is the result of different kinds of migrations: 6. Network migration: before the migration the user is playing with the mobile phone, using the UMTS network. After the migration, the player uses the STB, with xDSL access network, to communicate with the game server. Moreover, the migration needs a connection between the mobile phone, which is used to control the game, and the STB, which sends the commands to the streaming server. This connection is inside the player's (W)PAN.

7. Application logic components migration: before the migration, the mobile phone sends to the game server the player's commands parameters and the game server sends back contestants' position to the mobile phone, which renders the game images. After the migration, because of poor STB CPU capabilities, the rendering is done by the game server: the STB sends to the game server the player's commands parameters, and the game server streams to the STB the game images. The application part managing player's input remains in the mobile phone.
8. User interface migration: before the migration, the game images are displayed in the mobile phone screen. After the migration, the game is displayed on the Plasma TV screen.
9. Content adaptation: game graphics enhancement.

The second migration is a migration from the IPTV-enabled gaming console and Plasma TV to the wall screen:

5. Network migration: do not apply
6. Application logic components migration: do not apply
7. User interface migration: The game is migrated to a wall screen without any gaming capability; the migration forces a pit stop (game state change) of the player's car.
8. Content adaptation: game graphics shrunk to an info widget

Values added by migrations are:

- Continuous game experience, when changing devices

Values added by context awareness:

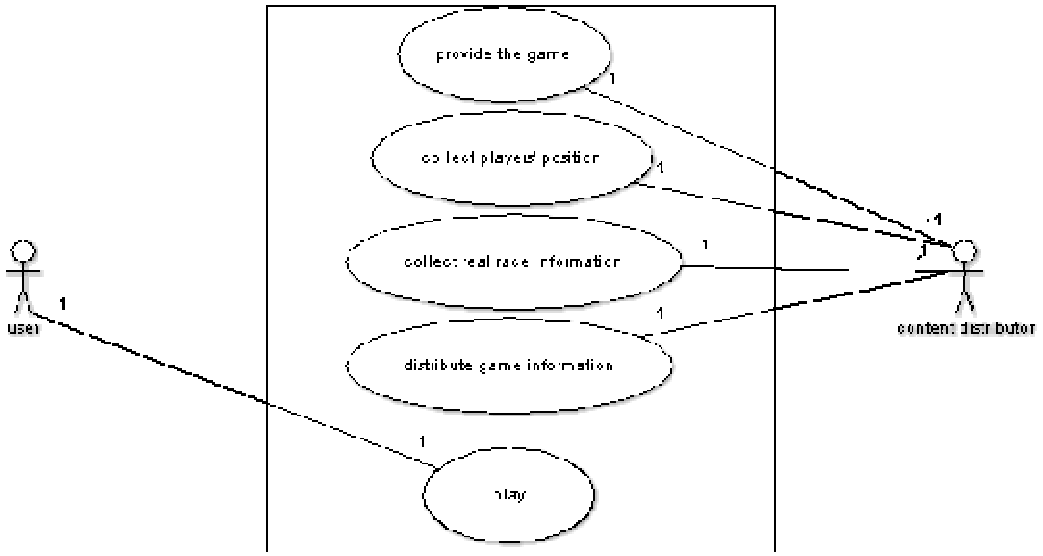
- Trigger the migration from lower capacity device to higher capacity device to enhance user experience

Values added by personalization:

- The user profiling can speed up migration process (e.g.: mobile phone and STB can be recognized as user personal devices, during the migration the authentication/authorization phase can be skipped)
- The user profiling can avoid some input setting during the migration (e.g.: the user can set some migration preferences as default)

Related technology:

- Different access network technology (UMTS, xDSL…) or Personal Area Network (PAN) technology (Bluetooth, infrared…)
- Personal device
- Server
- Real time communication

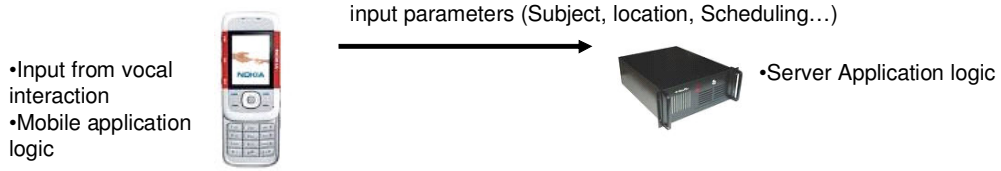
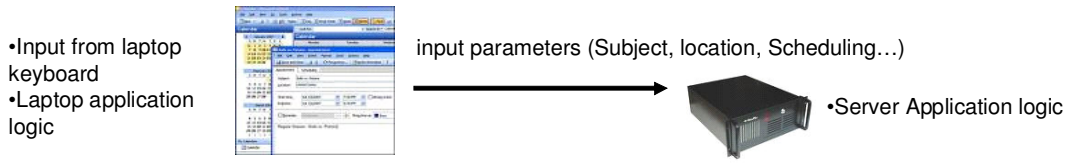
		Risks • Low data rate when real time communication is needed. • Slow migration Usability goals • Performing migration in a totally seamless and transparent way, with as less cumbersome inputs settings as possible • Triggering the migration if needed • Being notified of the possible migration which could enhance user experience • Being unaware of the underlying network technology but being aware of the eventual change of fees
1.11	**ANALYSIS**	Possible issues are: • Low phone battery when on the bus • Network availability (both UMTS and xDSL) • Latency time while migrating from mobile phone to STB
1.12	**LIST OF USE CASES**	• IPTV gaming
1.13	**USE CASES DIAGRAM**	 **Figure 7: IPTV Gaming Use Case Diagram.**
1.14	**LIST OF SERVICES**	• IPTV • Gaming

7.1.6 Vodafone Scenario (IPTV Business)

1.1	NAME	IPTV Business
1.2	AUTHOR	Stefano Marzorati, Agnese Grasselli, Giulio Caperdoni –Vodafone Omnitel NV
1.3	STORY LINE	**Introduction** Nigel is a sales agent working for ACME Corporation, whose fiscal year is about to end. He is negotiating with a prospect for a big deal: if he closes the deal, he will beat his fiscal year sales target. While going back to his office he tries to organize an urgent meeting with Kurt, a pre-sales engineer, by accessing his calendar through voice interaction on the phone; once in the office he finds a pre-filled appointment on his Outlook calendar, adds an attachment and sends it to Kurt. After he finds out that Kurt is taking part in a pre-sales engineer training course, Nigel enters the room where all the pre-sales engineers are and takes a seat next to Kurt; Nigel starts writing and every so often Kurt looks at it. In the meanwhile the training course ends; Nigel only migrates to the large screen in the room a few of the pages of the commercial offer to ask for help from all the engineers in the room. **Situation: IPTV Business** Nigel completes the commercial offer late in the evening: he should send the offer to his prospect the morning after and, as the stakes are high, even though it is late he would like to revise the offer with his boss, Gordon. He checks for his presence and finds out he is off duty, so he tries to get in touch with him via IM but the message is sent to Gordon's living room 60-inch IPTV screen; Gordon is watching the world figure skating championship with his wife. Gordon answers and asks Nigel to send the commercial offer, so they can review it together. Gordon gets the file and looks it over: he has the offer and the IM client on one side of the screen and the championship on the other. Gordon realizes that essential changes are needed, so he pauses live TV and drafts the changes in the offer. Gordon migrates his word processor to Nigel's laptop, asking him via IM to complete the offer so that he and his wife can resume watching the figure skating; Nigel completes the offer and switches the word processor to Gordon's screen. Gordon's wife loses her patience so he decides not to pause live TV again: he keeps the commercial offer on a quarter of the screen and migrates the IM session onto his smartphone to continue the discussion with Nigel. Ten minutes only and he is done! **Scenario Variants** Gordon, instead of being available, decides to sign out of IM when he is at home, writing the status message "Please, leave a message; it will be dealt with later". Nigel asks for help sending a message: "Gordon, please review ASAP the attached offer. I have to send it tomorrow morning". When the world figure skating championship is over, Gordon finds Nigel's message, starts reviewing it on TV but, because essential changes are needed and a keyboard would be very helpful, he migrates the offer to his laptop. The next morning Nigel finds the completed offer in his inbox.

1.4	**RELEVANCE**	Technology: 5 Business: 4
1.5	**CONTEXT OF USE**	Application domain: Business User profile: business man. Device: • Laptop • STB • 60-inch screen (at home) • Screen (in the meeting room) • Mobile phone • Smartphone Environment: • IPTV streaming server • Office applications (IM…)

1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Improve efficiency trough a more flexible and seamless access to enterprise applications: a more effective documents sharing, a more simple communication (presence), etc. • Performing migration in a totally seamless and transparent way, with as less cumbersome input settings as possible. • Triggering the migration if needed (the user, entering the training room, clicks the migration icon in the laptop and starts the migration). • Being notified of the possible migration which could enhance user experience (the OPEN platform recognizes the screen and opens a popup in the laptop, presenting the migration option). • Keep control of which information will be migrated (only few of the pages of the commercial offer will be migrated in the public screen while the window of the IM client running in the laptop, the mail notifications, and other personal applications/data, will not be displayed) • Enjoying the world figure skating championship with trick mode (fast forward, fast reverse) support and regardless of the underlying network technology. *The scenario goals from the technological perspective are:* • *Device discovery* • *Device capability knowledge* • *Content adaptation (at application level, i.e. image size adaptation, transforming flash into another format supported by the target device, …)* • *Logic reconfiguration (to maintain the original business logic irrespective of the device capabilities and irrespective of the kind and number of device involved)* • *Streaming capabilities* • *Migration trigger management* • *Session management (user single sign on)* • *Application data storage (during migration)* • *Connection setup and maintenance* The scenario goals from the business perspective are: • Provide an office applications suite extremely efficient, able to support: migration, multi-user application, unified communication. • For a network provider to evolve into a Service Provider.

1.7	INVOLVED USERS	• Employees (Nigel, Kurt, Gordon), Gordon's wife • Content distributor(s) who provides the world figure skating championship • Network provider(s) • Office application suite/services provider • OPEN Platform provider (it can be one of the previous three or a fourth one)
1.8	BUSINESS ROLES	Nigel, Kurt and Gordon interact with the office suite applications, trigger the migration and set the migration parameters (e.g.: which parts of application migrate and where). The Content distributor streams the world figure skating championship. A second content distributor or the same one hosts in its servers the world figure skating championship. The Network provider(s) offers the network infrastructure(s). The OPEN Platform provider manages the migration.
1.9	SYSTEM CAPABILITIES	*Note: as we shared Francesca's suggestion to add technical and business perspective in the "goals to be achieved" section, we believe this "system capabilities" section has already been covered there.*
1.10	ELABORATION - EVALUATION	 **Figure 8: scenario before the calendar migration.**  **Figure 9: scenario after the calendar migration.** The first migration is the result of different kinds of migrations: 1. Network migration: before the migration the user is interacting with the mobile phone, using the GSM/UMTS network. After the migration, the user interacts with the laptop keyboard, with xDSL/WiFi access network. 2. Application logic components migration: before the migration, the mobile phone sends to the application server the user's input parameters. The inputs should be wrapped by an application component in order to let the inputs understandable by the server (speech to text conversion, association with the proper appointment field…). After the migration, the wrapping is done by the laptop (no more speech to text needed…). Function such as file attaching is not available for vocal interaction. 3. User interface migration: before the migration, there is a vocal interaction between the user and the server. After the migration, the pre-filled

appointment is displayed on the laptop screen.

4. Content adaptation: function of different interaction modalities.

The second migration is the migration from the laptop screen and the meeting room screen:

1. Network migration: do not apply
2. Application logic components migration: do not apply
3. User interface migration: The user interface is first displayed in the laptop screen and then in the meeting room screen.
4. Content adaptation: function of a different screen size.

The third migration is between Gordon's word processor running in his STB and Nigel's laptop:

1. Network migration: do not apply
2. Application logic components migration: from Gordon's STB and Nigel's laptop.
3. User interface migration: from Gordon's screen and Nigel's laptop, different interaction modalities.
4. Content adaptation: function of a different screen size and different interaction modalities.

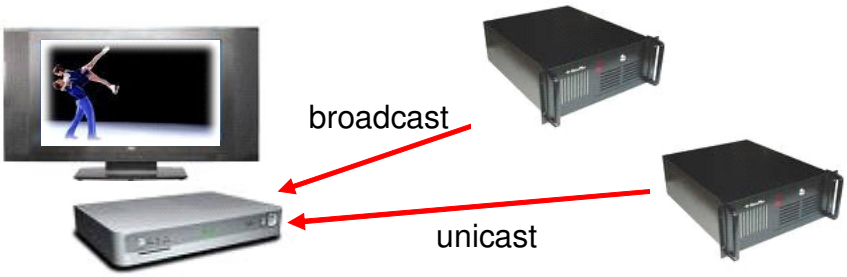


Figure 10: fourth migration.

The fourth migration is between DTT broadcast end IPTV unicast:

1. Network migration: before the migration, Gordon and his wife are watching the live world figure skating championship through a DTT channel. Gordon pauses live TV, in order to draft changes in the offer. When he press play, he can not continue watching the live program from the point he stops it using the DTT channel, because in the meantime the championship do not stop. The STB, using its xDSL interface, establishes a unicast connection with a streaming server, in which the championship is recorded. The championship is streamed to the STB, from the point Gordon stops it.
2. Application logic components migration: different application logic components are needed, in order to manage DTT and IPTV.
3. User interface migration: do not apply.
4. Content adaptation: do not apply.

The sixth migration is between Nigel's laptop and Gordon's word processor running in his STB:

1. Network migration: do not apply
2. Application logic components migration: from Nigel's laptop and Gordon's STB.
3. User interface migration: from Gordon's screen and Nigel's laptop, different interaction modalities.
4. Content adaptation: function of a different screen size and different interaction modalities.

The seventh migration is the IM client migration, between Gordon's STB and TV screen and Gordon's smart phone. This migration can be realized in two ways:

a) Only the IM interaction component (the component which receives the inputs) is migrated from the STB to the smart phone:
   1. Network migration: a new connection in the Gordon's (W) PAN should be established between the STB and the smart phone.
   2. Application logic components migration: interaction component migrate from Gordon's STB and Gordon's smart phone, with different interaction modalities.
   3. User interface migration: from Gordon's screen and Gordon's smart phone, different interaction modalities.
   4. Content adaptation: function of a different screen size and different interaction modalities.

b) The IM is totally migrated from the STB to the smart phone:
   5. Network migration: switching between different access networks (from xDSL and UMTS).
   6. Application logic components migration: application migration from Gordon's STB and Gordon's smart phone.
   7. User interface migration: from Gordon's screen and Gordon's smart phone, different interaction modalities.
   8. Content adaptation: function of a different screen size and different interaction modalities.

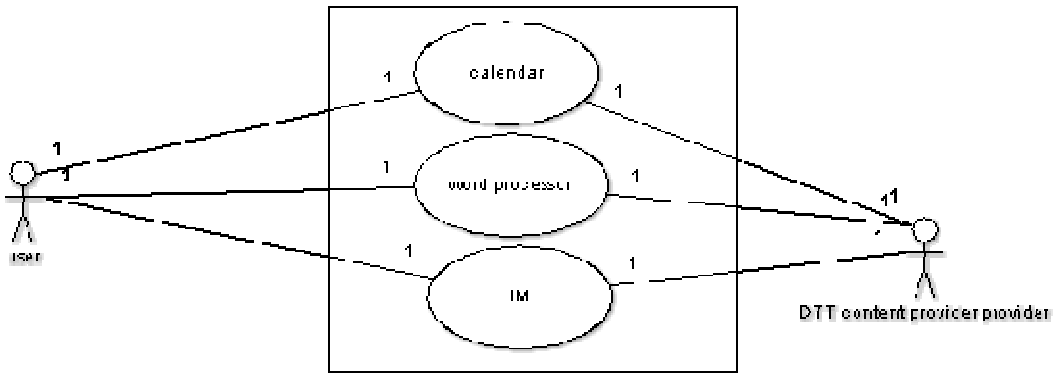
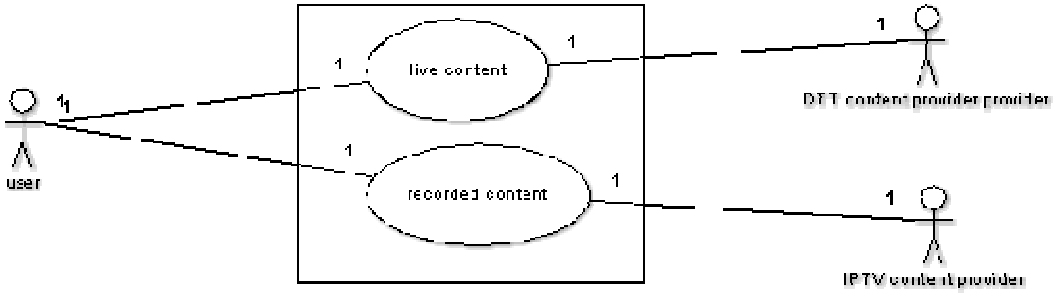
Values added by migrations are:

- Improve efficiency trough a more flexible and seamless access to enterprise applications, a more effective documents sharing, a more simple communication (presence).
- Enjoy (live) TV content regardless of the underlying network technology.

Values added by context awareness:

- Trigger the migration from lower capacity device to higher capacity device to enhance user experience

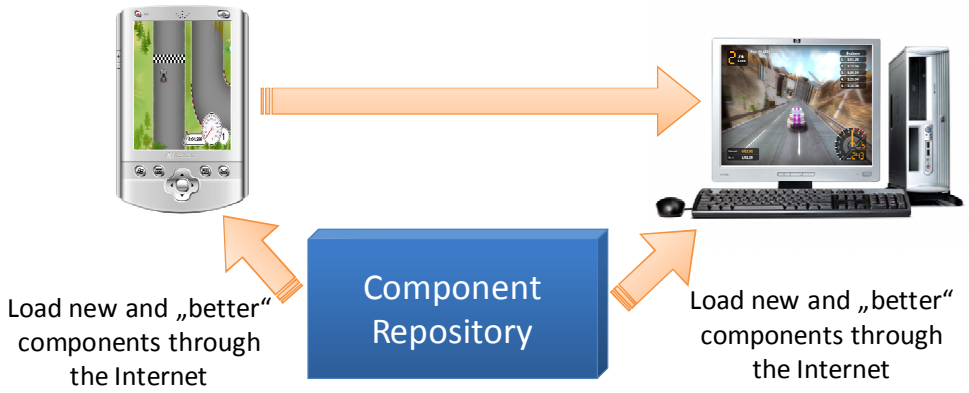
		Values added by personalization: • The user profiling can speed up migration process (e.g.: mobile phone and STB can be recognized as user personal devices, during the migration the authentication/authorization phase can be skipped) • The user profiling can avoid some input setting during the migration (e.g.: the user can set some migration preferences as default) Related technology: • Different access network technology (UMTS, xDSL…) or Personal Area Network (PAN) technology (Bluetooth, infrared…) • Personal device • Server • Office application suite Risks • Slow migration • Privacy Usability goals • Performing migration in a totally seamless and transparent way, with as less cumbersome inputs settings as possible • Triggering the migration if needed • Being notified of the possible migration which could enhance user experience • Being unaware of the underlying network technology but being aware of the eventual change of fees • Maintain usability level while changing interaction modalities.
1.11	**ANALYSIS**	Possible issues are: • Low phone battery before arriving at the office • Network availability (UMTS, xDSL, DTT) • Latency time while migrating • Information losses during migration if some problems occurs
1.12	**LIST OF USE CASES**	• Calendar • Partial migration of a word document • IM migration • Network migration

1.13	USE CASES DIAGRAM	 **Figure 11: calendar, word processor and IM use case diagram.**  **Figure 12: network migration use case diagram.**
1.14	LIST OF SERVICES	• IPTV • Office applications

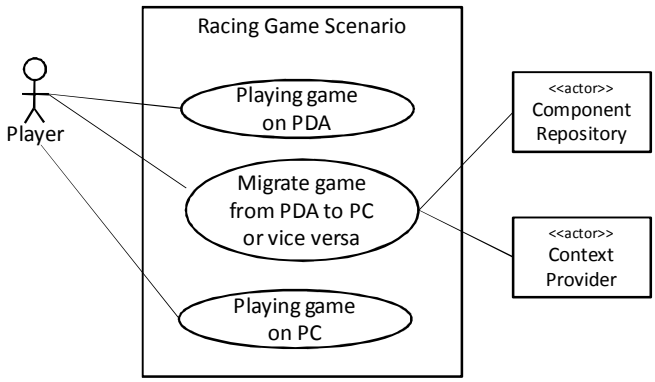
7.1.7 Clausthal University Scenario (Racing Game Scenario)

1.1	NAME	Racing Game Scenario
1.2	AUTHOR	Holger Klus, Andreas Rausch, TU Clausthal
1.3	STORY LINE	**Introduction** Today, the world of computer games is going from strength to strength. There are games available for all kind of operating systems and all kind of devices like PDAs or PCs. Moreover, we are playing games everywhere, at home, at work, on journeys etc. This scenario deals with a single racing game which is migrated from one device to another and thereby adapts to the device's capabilities. **Situation: Racing Game** Tim is sitting in a train home. He is playing a car racing game on his PDA. The train arrives at the station just in that moment when he is going to overtake an opposing car. But he has to switch off the PDA in order to leave the train. After a short walk home, he wants to continue the game on his PC. He switches the PC on and afterwards he switch on his PDA while aiming the PDA towards the PC. The game is then automatically transferred to the PC. Because there is a high performance 3D engine available on the PC together with a fast CPU, the game is transformed to high resolution and will also use a better physic engine than on the PDA. **Scenario Variants** What happens if Tim first plays the racing game on his PC at home and then wants the application to migrate to the PDA where the racing game is not installed? • If the complete application on the PC is able to adapt to the available resources on a PDA then the application will migrate from the PC to the PDA. In this case no internet connection is necessary. • If the application running on the PC is not able to adapt to the available resources on a PDA then all missing components will be loaded from a repository which can be accessed via internet. If there is no internet connection available the migration will fail. In addition: • The user should be able to decide explicitly when to migrate the application and also if the system should load missing components from the repository. • The system should try to get the newest and best version of the components from the repository considering the usage context.
1.4	RELEVANCE	Technology: 4 Business: 4

1.5	**CONTEXT OF USE**	Application domain: Gaming User profile: Video game players, racing game fans. Device: • PDA • High-performance desktop PC Environment: • Component repository for downloading missing components. • Context Provider
1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Triggering the migration if needed (the user, entering home, clicks the migration icon in the PDA and starts the migration). • Being notified of the possible migration which could enhance user experience. • Getting the newest components available for the game without installing these components manually. • The user can be certain that they play the game using the most appropriate configuration including graphics, physic engine, etc. *The scenario goals from the technological perspective are:* • *Different kind of devices with different resource constraints* • *Migration triggering by aiming the source device to the target device* • *Application logic reconfiguration by using different components on application layer for PDA and PC (e.g. 3D engine, physic engine)* • *GUI reconfiguration by using the full capacity of the particular device* The scenario goals from the business perspective are: • Provide gaming experience everywhere in best quality possible on the current device. • Game providers can address people who like playing high-performance games at home as well as people who like playing simple games on their PDAs or mobile phones.
1.7	**INVOLVED USERS**	• Player (Tim) • Network provider (for connection to the component repository) • OPEN Platform provider
1.8	**BUSINESS ROLES**	Tim plays the game and triggers the migration from PC to PDA and vice verse. The Network provider offers the network infrastructure. The OPEN Platform provider manages the migration.

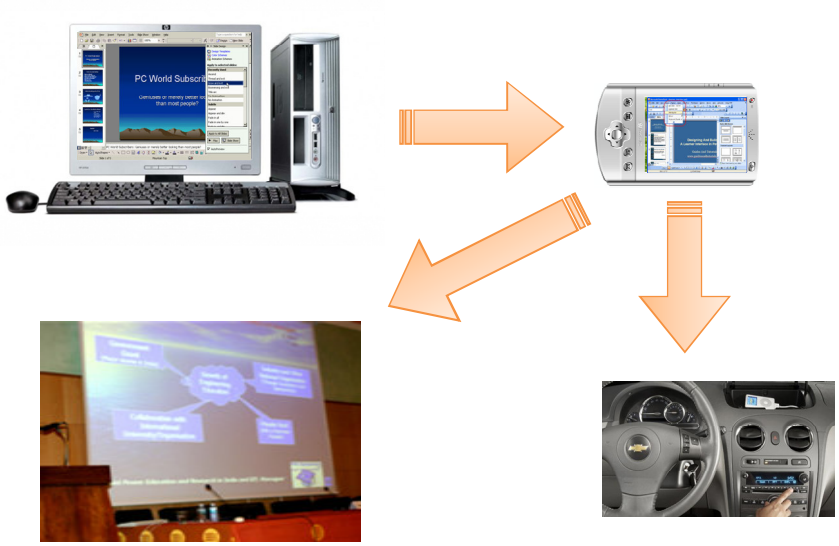
1.9	SYSTEM CAPABILITIES	*Note: as we shared Francesca's suggestion to add technical and business perspective in the "goals to be achieved" section, we believe this "system capabilities" section has already been covered there.*
1.10	ELABORATION - EVALUATION	 **Figure 33: The racing game before and after migration from the PDA to the desktop PC. Missing or better components are provided by the Component Repository if an Internet connection is available.** The following issues are affected by this migration: 10. Application logic reconfiguration Before the migration, the application on the mobile phone uses only a small subset of possible gaming features like a very simple 2D graphics engine. After migration the application reconfigures its behaviour in a way that it now takes into account among others an enhanced physic engine, audio output and force feedback if an appropriate joystick is available. If some required components are not available on the target device, the OPEN middleware will try to connect the Component Repository or the source device to load and install these missing components on the target device. If the missing component is not available on the source device and if there is no internet connection available, the migration will fail. 11. Replacing installed components by "better" ones Sometimes there is a better/new version of a single component available in the Component Repository than installed on the target device. The OPEN middleware recognizes this and replace the old component by the new one. 12. User interface migration Before the migration, the game images are displayed in the mobile phone screen. After the migration, the game is displayed on the flat screen at the desktop PC. 13. State migration Before the migration the state information can be very simple like position on track for example. After migration other types of state information come into play like damage of the car for example.

		Values added by migration are: • Continuous game experience when changing devices including keeping the state of the race but using the best system configuration possible on the target device. Values added by context awareness: • Triggers the migration from lower capacity device to higher capacity device to enhance user experience. • Assures that the best application configuration is used in the current usage context. Values added by personalization: • The user profiling can avoid some input setting during the migration (e.g.: the user can set some migration preferences as default) • The user profile can define in which situation a migration should be performed automatically without user interaction. • The user profile can define specific game settings like name of the player for example. Related technology: • Code migration and reloading • Update mechanisms for outdated components Usability goals • Triggering the migration automatically or triggered explicitly by the user. • Being notified of the possible migration which could enhance user experience • Being unaware of the underlying network technology and the component repository. • Having always the best configuration possible for the current device.
1.11	**ANALYSIS**	One possible issue is the network availability, because no migration would be possible if no appropriate components are available on target or source device. Another possible application configuration would be that one component remains running on the source device and is used by the application running on the target device (distributed application).
1.12	**LIST OF USE CASES**	• Playing game on PDA • Playing game on PC • Migrate game from PDA to PC or vice versa

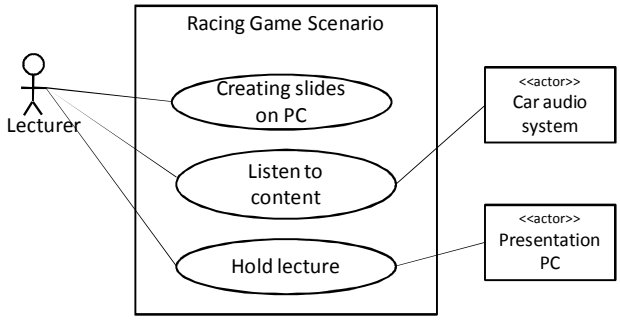
1.13	USE CASES DIAGRAM	 **Figure 14: Racing Game Use Case Diagram.**
1.14	LIST OF SERVICES	• Gaming on various kinds of devices with different resource constraints.

7.1.8 Clausthal University Scenario (Lecture Scenario)

2.1	NAME	Lecture Scenario
2.2	AUTHOR	Holger Klus, Andreas Rausch, TU Clausthal
2.3	STORY LINE	**Introduction** Lecturers hold their lectures often using PowerPoint slides. In addition they are often on business trips and therefore infrequently in their office. Thus, they have to prepare their slides at home, at the train, during meetings and so on. And it happens that slides get completed just before the lecture starts. So it should be as easy as possible to provide a changeover of the current status of the slides from one device to another, and as a last step to the presentation PC. **Situation: Lecture** The lecturer prepares the slides for the next lecture at home on his PC. On the next day he drives to the university by car where he has to hold his lecture. In order to practice holding the lecture he let the audio system of the car read the slides. To do this, he simply transfers the slides to his PDA which he then plugs into the car by using a Bluetooth connection. Arriving at the lecture hall, he simply aims at the presentation PC and all slides will be shown on the beamer who is connected to that PC. Furthermore, he can switch through the slides by pressing a key on his PDA, thus he is using his PDA as a remote control.
2.4	RELEVANCE	Technology: 3 Business: 3
2.5	CONTEXT OF USE	Application domain: Business User profile: Lecturer

		Device: • Desktop PC at home • PDA • Presentation PC Environment: • Car audio system
2.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Seamless transmission and use of adapted content. The scenario goals from the business perspective are: • Using adapted content everywhere you like without paying attention of technical details. • Multi-modal user interface
2.7	**INVOLVED USERS**	• Lecturer
2.8	**BUSINESS ROLES**	The lecturer creates the slides, wants to transfer them to currently available devices and finally holds the lectures.
2.9	**SYSTEM CAPABILITIES**	*Note: as we shared Francesca's suggestion to add technical and business perspective in the "goals to be achieved" section, we believe this "system capabilities" section has already been covered there.*
2.10	**ELABORATION - EVALUATION**	 **Figure 15: Different stages of migration from the desktop PC to the presentation PC and the car audio system.** The steps of migration in this scenario are as follows: 1. From desktop PC to the PDA The lecturer creates his slides on his PC at home. For his trip to the presentation location he transfers the slides to the PDA via Bluetooth. He

		initiates this by targeting the PDA to the PC and then pressing a button on the PDA. The content will be adapted to the capabilities of the PDA. 2. From PDA to car audio system While driving the car the lecturer wants to listen to the content of his slides. The content will be read by software on the PDA by using the audio system of the car as output device. 3. From PDA to car audio system Arriving at the presentation location he can use the presentation PC to show his slides. By pointing the PDA to the presentation PC which is connected to a beamer the slides will be shown on the screen. Furthermore he can use his PDA to switch from one slide to the next. The slides still are stored only at the PDA and the presentation PC is only used for showing the slides on the screen using the beamer. Values added by migration are: • Seamless transmission and use of adapted content. Values added by context awareness: • Content and modality of communication is adapted using context information. Related technology: • Multi-modal user interfaces • Content adaptation Usability goals • Triggering the migration automatically or triggered explicitly by the user. • Being notified of the possible migration which could enhance user experience • Being unaware of the underlying network technology.
2.11	**ANALYSIS**	
2.12	**LIST OF USE CASES**	• Creating slides on PC • Listen to the content • Hold lecture

2.13	USE CASES DIAGRAM	 **Figure 16: Lecture Use Case Diagram.**
2.14	LIST OF SERVICES	• Context management system

7.1.9 Aalborg University Scenario (Email)

1.1	NAME	*Mobility support + context awareness*
1.2	AUTHOR	*Anders Nickelsen, Rasmus Olsen, Hans Peter Schwefel*
1.3	STORY LINE	**Introduction** A man uses his cell-phone on the way to work. He is in a phone conference with business colleagues. As he reaches his office, the call is transferred to his workstation, enabling him to see the other parties of the phone meeting as well as interact with them in a collaborative fashion. He hears and talks to the others using the microphone and speakers of the workstation. Service migration preparation is triggered by the detection of new devices (workstation in range, display in range,) and prepared for automatically by the OPEN migration platform. The actual migration is dependent on the input of the user – either directly by interaction or indirectly by settings in a user profile. **Story** At the end of the day, the messages and documents that the man has marked as reading material are transferred to his mobile device automatically as he has time for reading them in the train heading home. As he was in a hurry to get to the train, he did not finish reading the mail on the screen of his workstation. However, the migration platform had inferred that he was heading home soon and prepared for such a situation. As he picks up his mobile device in the train, the mail is presented to him so he can finish reading it. In this situation, the migration preparation was triggered by the user context. As the mail requires a response, he vocally instructs the system to remind him tomorrow morning when he is back in the office. Having finished

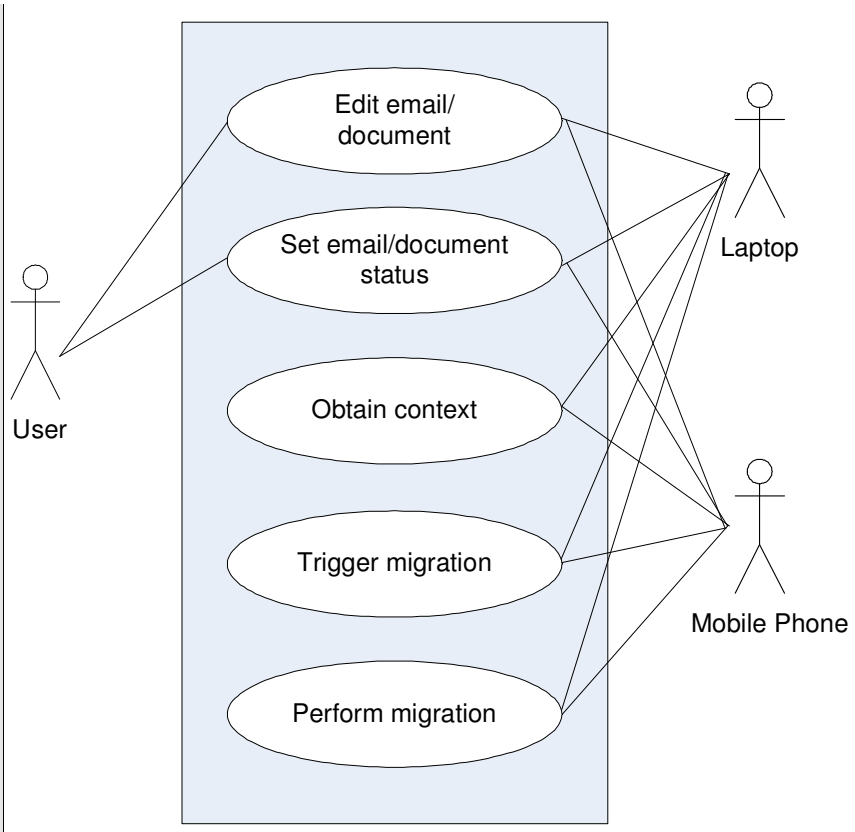
		processing the mail, the man is able to finish reading the previous marked documents on the way home. **Variants** Changes applied from discussion: • Changed application from mail reading to text-processing • Mail application data storage is dependent on internet connection, text-processing is not (necessarily), so internet connection does not help migration, as with IMAP. • Previous focus was data migration, now also state migration of the application itself, not necessarily the data (i.e. the specific mail) At the end of the day, the messages and documents that the man has marked as reading material are transferred to his mobile device automatically as he has time for reading them in the train heading home. As he was in a hurry to get to the train, he did not finish writing the Word-document on his workstation. However, the migration platform had inferred that he was heading home soon and prepared for such a situation. In this situation, the migration preparation was triggered by the user context. As he picks up his mobile device in the train, the draft document is presented to him so he can finish writing it. Everything concerning the state of the word-processor, such as language, change tracking, etc. is already set up, making the transition from the workstation seamless to the user.
1.4	**RELEVANCE**	Application domain: Business domain (and Private life)
1.5	**CONTEXT OF USE**	Settings of the scenario • Mobile telephone • Desktop computer • Email client (on both the mobile phone and desktop computer) • Word processor • A calendar •

1.6	**GOALS TO BE ACHIVED**	End user goals and needs • Easy and efficient work means • Avoidance of disruptions due mobility
1.7	**INVOLVED USERS**	• User
1.8	**BUSINESS ROLES**	• User: Interacting with the email client • Application developers: content of email/document being written is migrated to other email client on mobile phone • OPEN Migration Platform: Handles the data and/or service state migration

1.9	**SYSTEM CAPABILITIES**	• Mobility support
		  o As the user changes location for the duration of the scenario, the network needs to support consistent data connection between laptop and mobile phone while migration is in progress
		• The following context shall automatically be gathered, inferred and used actively:
		  o User focus is on writing email
		  o User will soon need to shift location
		  o Presence of email client on mobile phone
		• Insurance of context privacy: It is vital that the gathered/observed/inferred context information is disclosure to the users terminals only
		• Security: the content of the email being written may need to be encrypted while being transferred to the mobile phone

1.10	**ELABORATION - EVALUATION**	• *Kind of migration*
		  ○ Migration of email/document writing session
		  ○ Migration of application content
		• Value added
		  ○ Easy and efficient work means
		  ○ Avoidance of disruptions due mobility
		• *Related technologies*
		  ○ Email clients/servers(IMAP, POP, ...)
		  ○ Text processing
		• *Risks*
		  ○ Privacy of used context information; user activity is leaked to outsiders
		  ○ Protection of the content of the email; competing company may want to know what the user is exchanging of information
		• *Usability goals*
		  ○ Migration happens fluently and without annoying delay
		  ○ Migration happens without errors (content is not changed)

1.11	**ANALYSIS**	• Privacy and security may need to be considered • Email clients must agree on data formats used for exchanging content
1.12	**LIST OF USE CASES**	• Email migration

1.13	USE CASES DIAGRAM	
1.14	LIST OF SERVICES	• Context Management system

7.1.10 Aalborg University Scenario (Meeting Call)

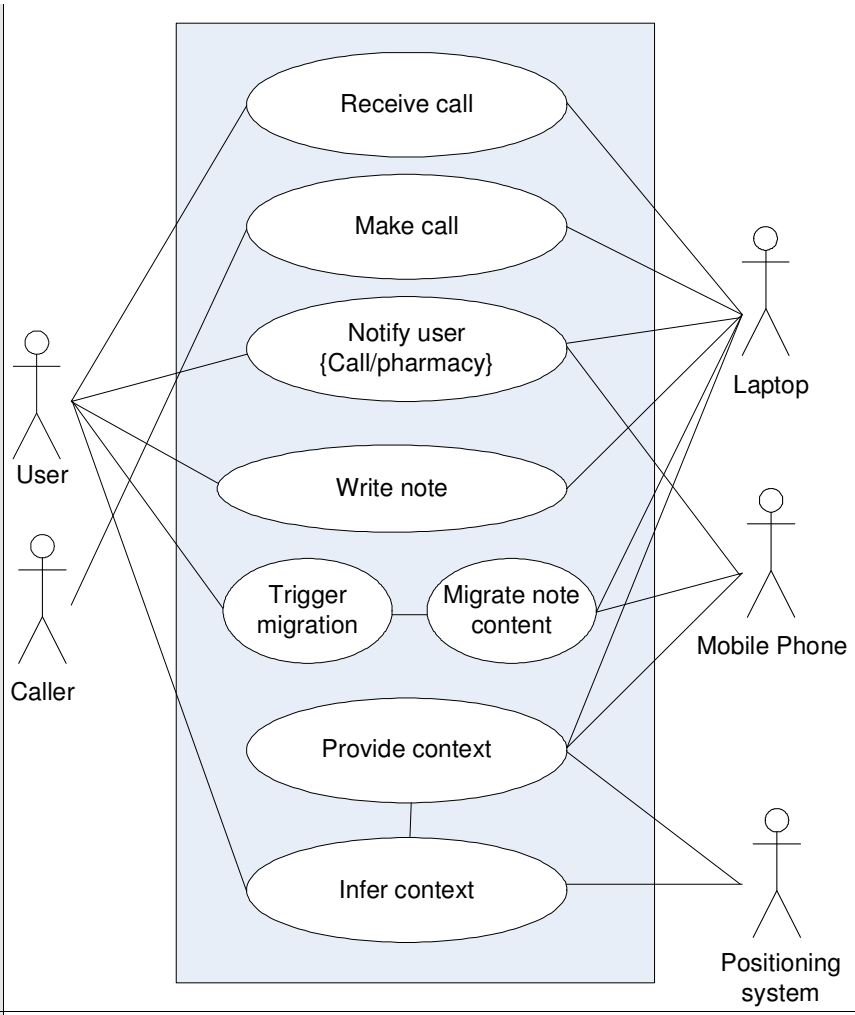
1.1	NAME	Context Awareness + mobility
1.2	AUTHOR	Anders Nickelsen, Rasmus Olsen, Hans Peter Schwefel

1.3	STORY LINE	**Introduction** A man is in a meeting at work. A call arrives, but is not sounded on the cell-phone. Instead the laptop, to which his focus is currently directed, shows a silent notification pop-up that a called was missed and that a message has been left. The man marks the message as important, but cannot attend to it immediately. As a break in the meeting is scheduled, the system prepares to present the message to the man, and as the break arrives, he puts on his headset, turns it on, and the message is played back to him. Still situated in front of his laptop, he is able to make a few notes regarding the call. He makes a note that he has to go by the pharmacy on the way home to pick up a list of items. Riding the bus home, a notification reminds him to go the pharmacy. When he gets off the bus as instructed by the system, the directions to the pharmacy are displayed on the phone, and as he enters the pharmacy, the list of items to pick up is shown in the display.
1.4	RELEVANCE	Application domain: Business domain (and Private life)
1.5	CONTEXT OF USE	Settings of the scenario • Laptop • Headset • Mobile phone • Positioning system
1.6	GOALS TO BE ACHIVED	• User guidance • User notification
1.7	INVOLVED USERS	• The user • The caller
1.8	BUSINESS ROLES	• The user • Positioning system • Notification and guidance application • OPEN migration platform

1.9	**SYSTEM CAPABILITIES**	• Positioning of the user
		• Extraction of user context
		  o Attending a meeting (busy/occupied)
		  o On the bus (vacant/mobile)
		  o Within vicinity of pharmacy
		• Insurance of context privacy

1.10	**ELABORATION - EVALUATION**	• *Kind of migration*
		  o Notification is migrated to various devices
		  1. the incoming call is notified at the laptop
		  2. the notification that he is nearby a pharmacy is provided on his mobile device
		• *Value added*
		  o Efficient notification (notifying where user has focus and not elsewhere)
		  o Guidance of user to the needed products
		• *Related technologies*
		  o Electronic location dependent tourist guidance
		  o Generally any notification functionality, e.g. Skype's incoming call notification or email-notifications
		• *Risks*
		  o Privacy of used context information; user activity is leaked to outsiders
		• *Usability goals*
		  o User notification happens on the relevant device(s) at the right time and place, e.g. the user has focus on the device...
		  o User guidance happens error free, i.e. the user is correctly guided to the correct pharmacy within opening times etc.

1.11	**ANALYSIS**	• Requires interaction with positioning system • Context management system should support event notifications to trigger notifications at the right time and place
1.12	**LIST OF USE CASES**	Notification of call and pharmacy note

1.13	USE CASES DIAGRAM	
1.14	LIST OF SERVICES	• Positioning system • Context Management system • Note tool

7.1.11 Arcadia Design Scenario (Multi-Player Pacman)

1.1	NAME	Multiplayer Pac-Man
1.2	AUTHOR	Francesca Mureddu, Stefano Bigi, Dario Deledda
1.3	STORY LINE	**Introduction** Annie is a young student that likes old fashion games especially because they are easy to learn and quick to play, but also challenging and funny. Annie likes playing everywhere, at home, waiting for the bus, during school breaks and on different

devices like PC, her low-end mobile phone, her father's PDA, what is important for her is to keep that feeling of enjoying her match for the longest time.

One of her favourite game is Pac-Man, a very popular arcade game from 80s. The Pac-Man is three dimensional smile that eats dots, the player controls its movements in a two dimensional maze. When all dots are eaten, Pac-Man is taken to the next stage. Four ghosts roam the maze, trying to catch Pac-Man. If a ghost touches Pac-Man, one life of the Pac-Man is lost. The game finishes when all lives are over.

While Annie is playing, she does not want to be interrupted, because she knows that it is very hard to reach high difficulty levels and Pac-Man does not allow to save the current status of the game. In order to keep playing without loosing the reached level, the Pac-Man is built on the OPEN4GAMES migration platform that allows her to continue playing the same game through different devices. OPEN4GAMES is a software layer that simplifies and manages the migration of the interface and the current status of the game. All the communication between the devices involved in the migration is automatically managed by the OPEN4GAMES platform.

Situation: achieving the best score ever

Annie has just finished her homework and she feels like she needs a relaxing break. What is better than a quick match to Pac-Man? She switches the PC on, starts the game and specifies in the options panel that she wants to be able to migrate the game. She starts playing with the keyboard, but she cannot go over the third level. Those ghosts are just too fast for her! She needs to try something else to interact with the game, so she switches the game to the pause mode, from the option menus selects, between the possible input types, the mobile phone and, after a quick pairing, she controls the game through the keyboard of her mobile phone, while the graphic and audio outputs stay on the PC. Her mobile phone has a useful joypad that helps her to be faster escaping from ghosts. Now she is really enjoying the game and she feels confident in reaching more and more difficult levels. But suddenly her father calls her from the living room, she has a piano lesson in half an hour and he will give her a lift by car. She has to leave, then she switches the PC off and automatically the OPEN4GAMES platform recognizes the closest device as her mobile phone and switches the whole game to it. The game becomes more and more difficult, the mazes are always trickier and the ghosts so fast that she can barely see them on that small screen. When she gets on the car, she realizes that her mobile phone is running out of battery and that the game has started searching for another enabled device. Annie begs her father to give her his PDA to keep playing, since she is reaching her best score ever. Her father tells her that it is the last time he gives her his PDA for such silly games, but Annie has just won an extra life, so she grabs the PDA and keeps playing. When she arrives to the piano lesson, she is very proud of herself because has reached her best score ever. .

Scenario Variants

- What if another player enters the game?
- What if a big screen/multiple screens is used?

		O-Pac-Man is a game built OPEN platform, as a variation of the well known game from 80's. The main differences between Pac-Man and O-Pac-Man are that O-Pac-Man is a multiplayer game and it can be played in different devices. When a player enters the game, he/she can select one of the two roles available, the Pacman or the ghost. The aim of the Pacman role is the same as in the original version, eating all the dots in a maze to reach the next level, while the aim of the ghost role is to catch the Pacman in the shortest time possible. Players can also play in a collaborative mode, both impersonating a Pacman, in order to complete levels in an easier way. While Annie is playing to O-Pac-Man as a Pacman with her PC, a message that asks for permission from her little sister Susan to join the game appears on the screen. Annie remembers that his father went to pick up her sister from school and that Susan must have asked her father to play with his PDA. When Annie accepts Susan's request, one of the ghosts changes colour, that means that Susan decided to be that ghost. Annie notices that her sister is much better than her, and she knows why: her father's PDA has an embedded accelerometer, and it is much easier to control the game with that. She needs to try something else to interact with the game, so she switches the game to the pause mode and selects as input device her mobile phone and, after a quick pairing, she controls the game through the joypad of the mobile phone, while the graphic and audio outputs stay on the PC. Now Annie is faster than her sister and she is able to reach higher levels. Suddenly Susan appears in the room, complaining that Annie is advantaged because she is playing with a bigger screen. Annie pauses the game and move towards the living room, where there is a big TV screen, STB with xDSL. She migrates the audio and video outputs to the big screen while keeping the control on her mobile phone. On the Susan screen appears a request for migration and, after she has accepted, both sisters sit on the sofa in front of the TV and continue having fun together.
1.4	**RELEVANCE**	Technology: 4 Business: 5
1.5	**CONTEXT OF USE**	Application domain: Gaming User profile: video game players Device: • PC • PDA • LCD TV screen, STB with xDSL • Mobile phone Environment: • Home • Outdoor

1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Playing the same game wherever the user is and with a wide range of devices. • Performing migration in a totally seamless and transparent way, with as less cumbersome input settings as possible. • Triggering the migration if needed • Being notified of the possible migration which could enhance user experience • Several users playing the same multiplayer game session using different devices. • Seamless change of game controls for better game experience • Democratic attitude towards the player who migrates (no disadvantage during the migration and on the migrated device in terms of score and playability) The scenario goals from the technological perspective are: • Device discovery • Device capability knowledge • Content adaptation (at application level, i.e. image size adaptation, world adaptation, …) • Logic reconfiguration (to keep the original logic with respect to the device capabilities in terms of CPU, GPU and network performances) • Migration trigger management • Session management (user single sign on) The scenario goals from the business perspective are: • For a game developer: provide gaming experience for a wider customer base, as gaming is possible on multiple devices.
1.7	**INVOLVED USERS**	• Players (Annie, Susan) • Game developer • Network providers • OPEN Platform provider

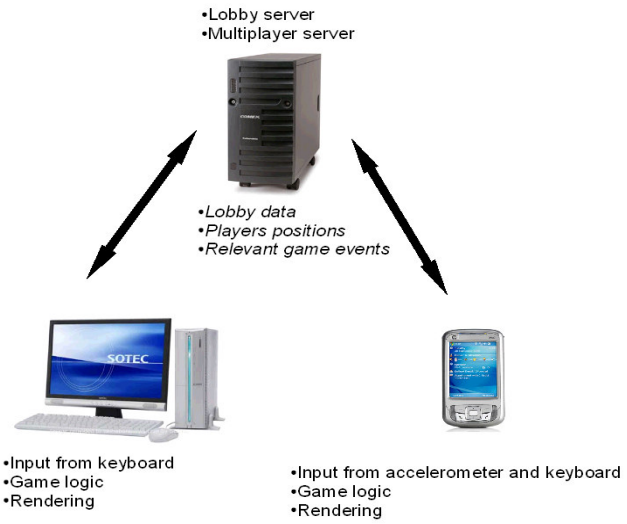
1.8	BUSINESS ROLES	Annie and Susan play the game, trigger the migration and set the migration parameters. The game developer provides the game enabled for migration for all the involved platforms. The Network providers offer the network infrastructure. The OPEN Platform provider manages the migration and provides migration API to the game developer.
1.9	SYSTEM CAPABILITIES	Already included in the 1.6 Goals to be achieved.
1.10	ELABORATION - EVALUATION	 **Figure 47: scenario before the first migration.**

Figure 18: scenario after the first migration.

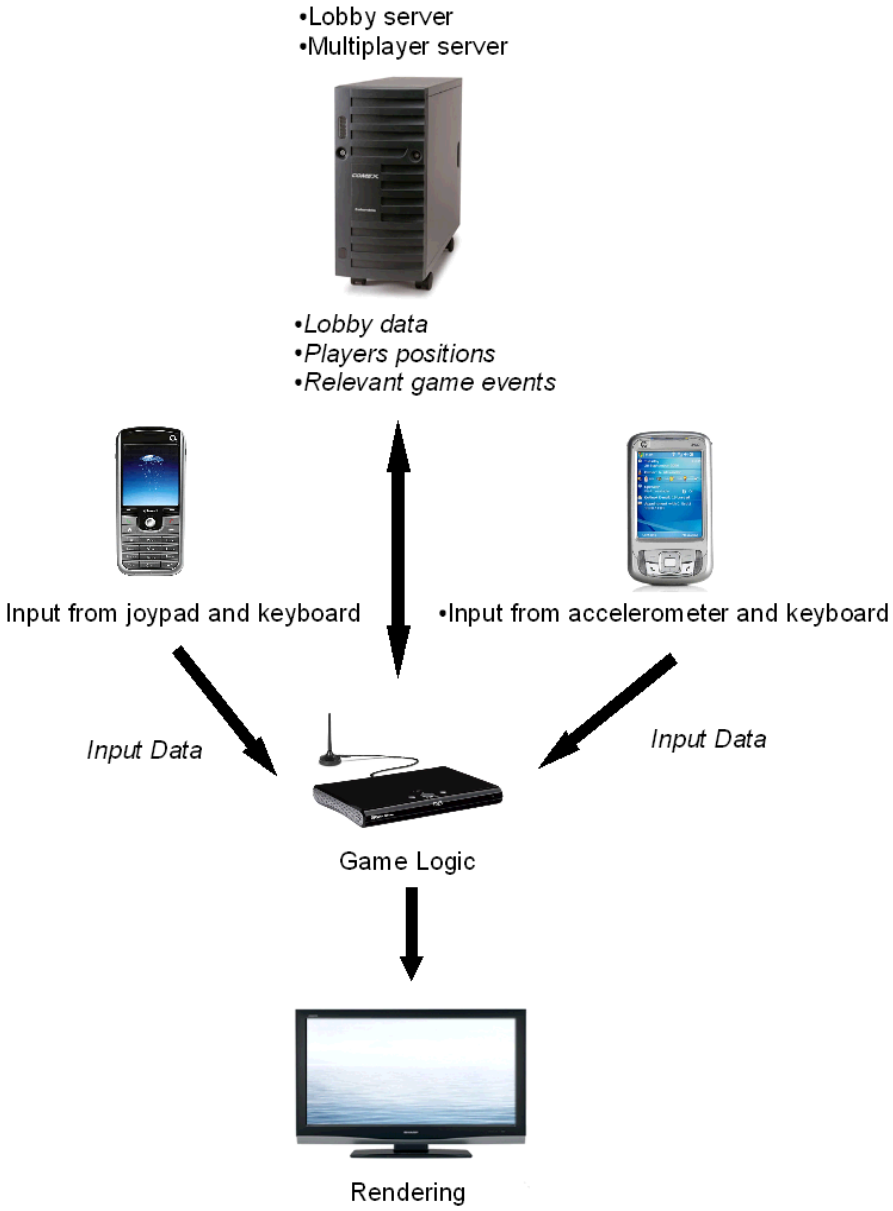


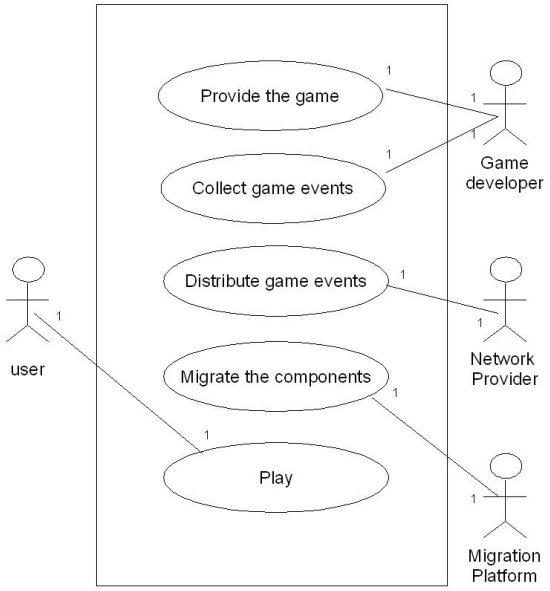
Figure 19: scenario after the second migration.

Kind of migration:

Before the migration (figure 17), two players are engaged in a multiplayer match using different devices and network, the first one uses a PC, the second one uses a PDA.

The first migration (figure 18) is an input control migration, from the PC keyboard to the mobile phone joypad, while the game logic, the multiplayer network

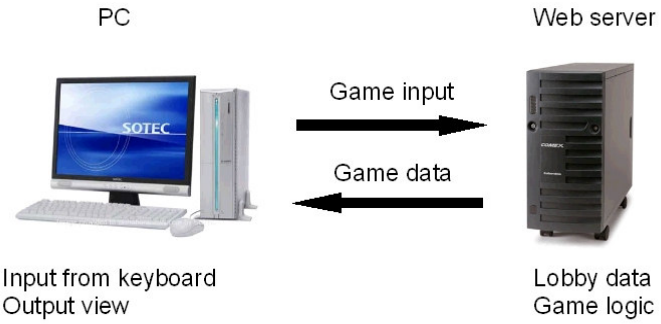
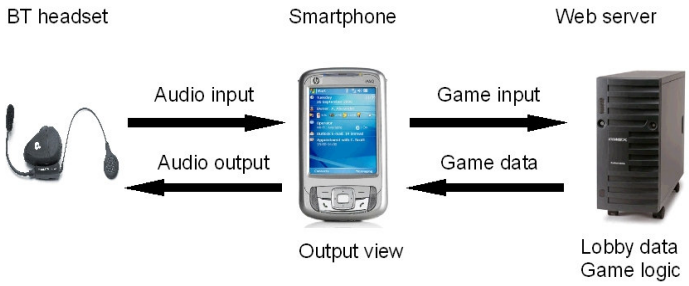
		connection and the output, remain in the source device. The second migration (figure 19) moves the game logic, the output and the multiplayer network connection to a big screen equipped with STB for both players while the input remains in the source devices. Values added by migrations are: • Continuous game experience, when changing devices Values added by context awareness: • Trigger the migration from devices with different type of input (accelerometers) Values added by personalization: • The user profiling can speed up migration process (e.g.: mobile phone and STB can be recognized as user personal devices, during the migration the authentication/authorization phase can be skipped) • The user profiling can avoid some input setting during the migration (e.g.: the user can set some migration preferences as default) Related technology: • Different access network technology (UMTS, xDSL…) or Personal Area Network (PAN) technology (Bluetooth, infrared…) • Multiplayer games • Real time communication Risks • Low data rate when real time communication is needed. • Slow migration Usability goals • Avoid game disadvantages among players because of migration and because of devices with different performances. • Performing migration in a totally seamless and transparent way, with as less cumbersome inputs settings as possible • Triggering the migration if asked by the players • Being notified of the possible migration which could enhance user experience. • Being unaware of the underlying network technology but being aware of the eventual change of fees.

1.11	**ANALYSIS**	• Homogenous behavior among different used inputs in shared screen • Bandwidth and performances aspect to be considered • Network availability (both UMTS and xDSL) • Latency time while migrating.
1.12	**LIST OF USE CASES**	• Multiplayer game
1.13	**USE CASES DIAGRAM**	
1.14	**LIST OF SERVICES**	• Multiplayer game

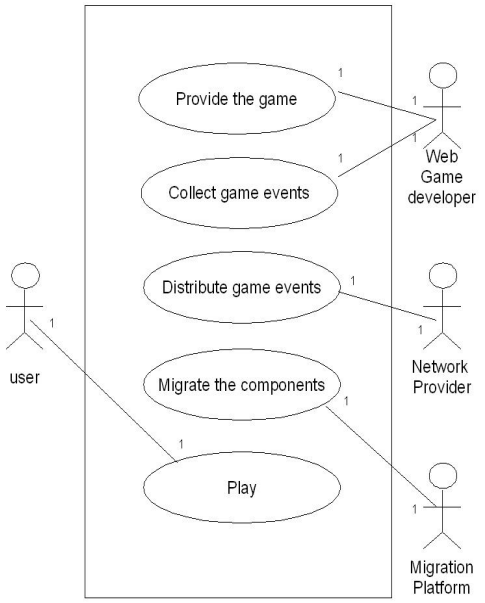
7.1.12 Arcadia Design Scenario (Web Multi-Player)

1.1	NAME	Web multiplayer game
1.2	AUTHOR	Francesca Mureddu, Stefano Bigi, Dario Deledda
1.3	STORY LINE	**Introduction** John is a business man, fan of web strategic turn based games, he plays tournaments at national and international level. His favourite game is Risk, a turn-based game for two to six players, played on a board depicting a stylised Napoleonic-era political map of the Earth, divided into forty-two territories, which are grouped into six continents. Players control armies, with which they attempt to capture territories from other players. The goal of the game is to control all the territories—or "conquer the world"—through the elimination of the other players. John is taking part to the national Risk tournament and he is close to the victory. He had already participated to this tournament last year, but he had been eliminated because he had to leave a match before the end, since he had an unexpected meeting at work. Luckily this year the organizers of the tournament provided the participants with a new tool, OPEN4GAMES, that allows the migration of the game through different platforms, keeping the match alive. **Situation: from home to work** John is playing his last match in front of his PC and he is close to reach his objective, that is the conquest of Asia and South America. Suddenly he receives a call from work that tell him that there is a urgent need of him. During the call he has been attacked by another player: his last defending army got defeated and he has lost the territory. Since he has to go, he will think later about countermeasures. On the PC John activates the migration procedure and a list of close devices to which John can access with his credentials appears. He selects his smartphone: the browser opens automatically in the new device and the adapted interface of the game appears. On the smartphone he sees the current situation of the game and while going to the car he thinks about the next move. When he arrives to the car he activates vocal commands and vocal feedback on the smartphone. While driving to work he plays his turn: first he adds troops close to the territory that he has just lost, then he tries to conquer again that territory. He gives very simple vocal commands: the number of troops he wants to add and the territory that he wants to attack, and receives vocal confirmation of his actions. When finally he arrives to work, he has played three turns and has won the match.
1.4	RELEVANCE	Technology: 4 Business: 4

1.5	**CONTEXT OF USE**	Application domain: Multiplayer Web Game User profile: strategic games player. Device: • PC • Smartphone • Bluetooth Headset Environment: • Home • Outdoor • Car
1.6	**GOALS TO BE ACHIEVED**	The scenario goals from the user perspective are: • Playing the same game wherever the user is and with a wide range of devices. • Performing migration in a totally seamless and transparent way, with as less cumbersome input settings as possible. • Triggering the migration if needed • Several users playing the same multiplayer game session using different devices. • Democratic attitude towards the player who migrates (no disadvantage during the migration and on the migrated device in terms of score and playability) • Keep the same game session while change device The scenario goals from the technological perspective are: • Device discovery • Device capability knowledge • Content adaptation (image size adaptation, GUI, …) • Migration trigger management • Session management (user single sign on) The scenario goals from the business perspective are: • For a game developer: provide gaming experience for a wider customer base, as gaming is possible on multiple devices.

1.7	INVOLVED USERS	• John • Tournament organizers • Network provider(s) • Web game developer • OPEN Platform provider
1.8	BUSINESS ROLES	John plays the game and triggers the migration. The tournament organizers provide rules for the participants. The web game developer provides the game. The Network provider(s) offers the network infrastructure(s). The OPEN Platform provider manages the migration.
1.9	SYSTEM CAPABILITIES	Already included in the 1.6 Goals to be achieved
1.10	ELABORATION EVALUATION	 **Figure 20. Scenario before the migration**  **Figure 21. Scenario after the migration**

		The migration happens from the PC to the Smartphone. The UI of the webgame is migrated and the input changes from the keyboard to the bluetooth headset, part of the visual output migrates to audio output. Related technology: • Different access network technology (UMTS, xDSL…) or Personal Area Network (PAN) technology (Bluetooth, ...) • Web Multiplayer games • Speech recognition Risks • Slow migration • Network availability Usability goals • Avoid game disadvantages among players due to migration and different devices • Performing migration in a totally seamless and transparent way, with as less cumbersome inputs settings as possible
1.11	**ANALYSIS**	Possible issues are: • Low phone battery • Network availability in the car (reliability of the UMTS signal while moving) • Misbehavior of speech recognition
1.12	**LIST OF USE CASE**	• Multiplayer web game

1.13	**USE CASES DIAGRAM**	
1.14	**LIST OF SERVICES**	• Web server • Web games service provider

7.1.13 NEC Scenario (VideoTelephony)

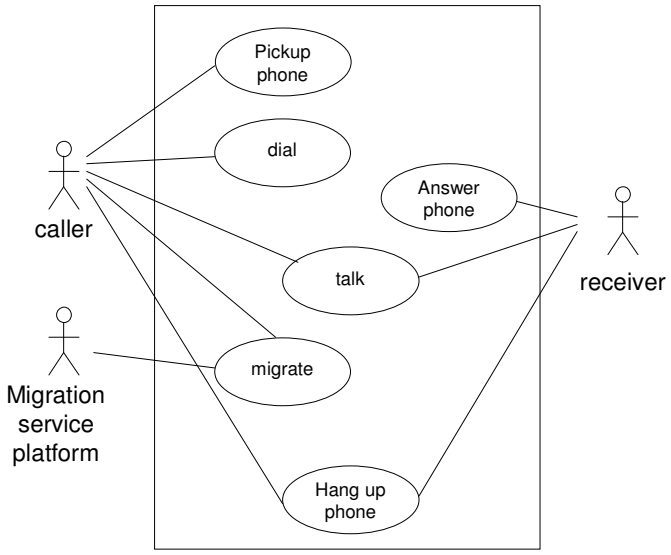
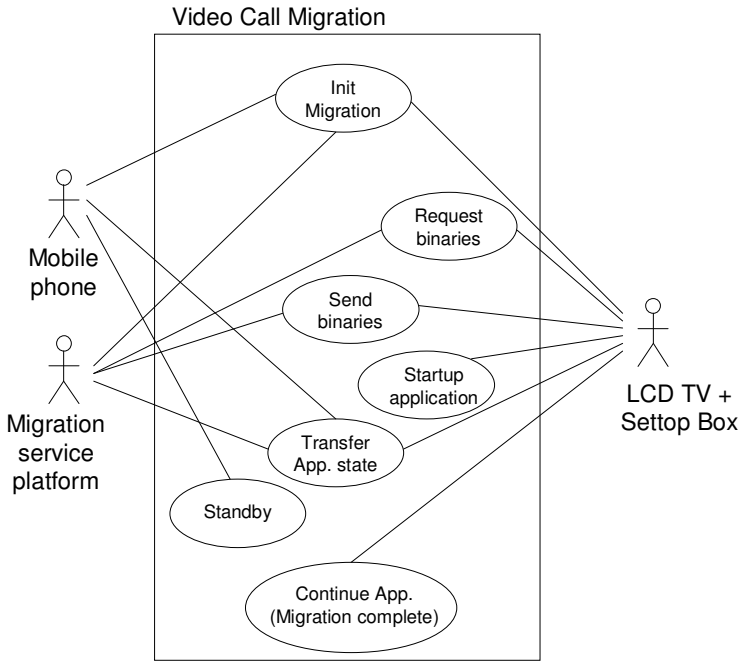
1.1	NAME	Video Telephony scenario
1.2	AUTHOR	Clemens Kujawski, Armin Jahanpanah (NLE-IT)
1.3	STORY LINE	**Introduction** Jessica is a tele-worker. During the day she always has to attend several video conferences with her co-workers and business clients. After work she enjoys hooking up with her friends. She often uses the video phone to fix the time and place for the get togethers or simply to exchange the newest gossip. Using a video phone all this gets very close to meeting face-to-face. **Situation: Video call** Jessica is sitting outside in the garden and reading a book. Her video call enabled mobile phone rings. It's Sarah, her best friend. As it begins to rain, Jessica goes into the living room and with a sweep of her hand she can continue the video call on the large LCD screen which is attached to a set-top box. As the set-top box has more performance, better video codecs and a broadband network connection, Jessica is able to now enjoy the conversation in smooth high definition quality, even the photo of Sarah's daughter is visible in high quality over the video stream. Time is flying and Jessica realizes that she has an appointment in 15 minutes: She continues the call on her mobile phone while getting ready and walking to her car. Once in the car, she points the phone to the car navigation system and continues the call via the hands-free kit… **Variants** What if multimodality comes into the scenario? Multimodal interaction provides the user with multiple modes of interfacing beyond the traditional keyboard and mouse input. In this scenario, a combination of a visual modality (i.e. display) with a voice modality (speech recognition for input, speech synthesis and recorded audio for output) is very useful: • The user could instruct the set-top box via voice input to route incoming calls to the mobile phone • The mobile phone could announce the name of the caller via voice output • *A pen gesture could be used on a smartphone to trigger migration to a different device*

1.4	**RELEVANCE**	Technology: 5 Business: 4
1.5	**CONTEXT OF USE**	Application domain: Business and Private Life Possible devices: • Laptop • STB, media center, streaming clients • 60-inch screen (at home) • Screen (in the meeting room) • Mobile phone / Smartphone
1.6	**GOALS TO BE ACHIVED**	User goals and needs: • Better communication (in office and at home) • Ease of use •
1.7	**INVOLVED USERS**	• Caller • Communication partner / Receiver • Network services • OPEN Migration Platform
1.8	**BUSINESS ROLES**	• Caller: initiates call, can migrate to different devices • Communication partner / Receiver: answers incoming call, can migrate to different devices • Network Services: Provide streaming of audio/video data and routing • OPEN Migration Platform: Handles application component (UI, codecs, etc.) distribution

1.9	**SYSTEM CAPABILITIES**	Required system capabilities:
		• Network: Streaming of Audio/Video data, Connection handling
		• Security, privacy:
		  o Conversation and network traffic should be secure
		  o Context Awareness: E.g. no video transmission if privacy needed
		• Personalization/Adaptation:
		  o Personalized UI/AV settings
		  o Partial migration of audio or video on different devices
		• Device-related capabilities:
		  o Streaming, media processing (bandwidth concerns)

1.10	**ELABORATION - EVALUATION**	• Kind of migration
		  o Migration of application software components (UI, codecs)
		  o AV stream re-routing
		• Values added by migration, context awareness, personalization. etc.
		  o Better communication (face-to-face, more variety)
		  o Increased quality of life
		• Related technology
		  o Voice-over-IP
		  o Media Center Streaming technology
		  o IPTV, Video-on-Demand
		• Risks
		  o May have privacy issues
		• Usability goals
		  o Instant migration / No delays
		  o Leveraging of devices capabilities & performance

1.11	**ANALYSIS**	• May have privacy issues • Bandwidth and performance aspects to be considered
1.12	**LIST OF USE CASES**	• Video Call Migration

1.13	**USE CASES DIAGRAM**	 
1.14	**LIST OF SERVICES**	(Mobile) Video Telephony (IP,UMTS)

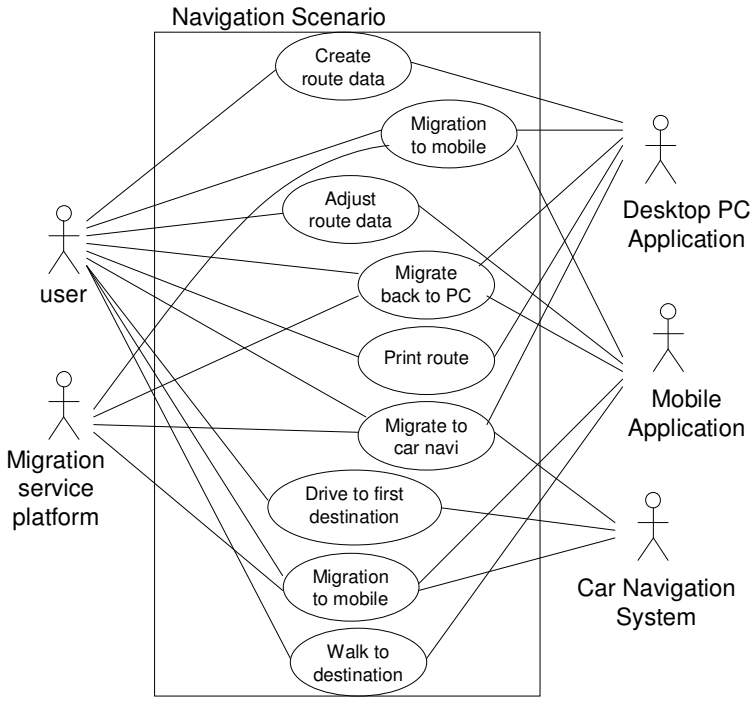
7.1.14 NEC Scenario (Navigation system scenario)

1.1	NAME	Navigation system scenario
1.2	AUTHOR	Clemens Kujawski, Armin Jahanpanah (NLE-IT)
1.3	STORY LINE	**Introduction** Chris is preparing his business trip to another company. He has decided to go by car and already booked a comfortable hotel via the internet. **Situation: Finding the way to the destination** In the office, Chris is planning and calculating the optimal route to his hotel using his PC, taking into account time constraints and usage of gas/fuel. As he is pleased with the result, he takes his mobile phone and with a gesture instructs the routing application to continue on the mobile phone. He goes to the secretariat and discusses the plan. Right there he is able to adjust the route according to small changes requested by his supervisor. After approval by his supervisor Chris goes back to his PC in order to print out the final route and city map by migrating the application back from the mobile device. In the meantime, the selected company car has already contacted Chris's PC via WLAN and now displays the application on the navigation system's TFT screen. When Chris enters the car he can drive straight away as everything is prepared. The trip went without problems and when he arrives near the company building he is looking for a parking lot. Unfortunately, he is forced to park his car some hundred meters away from the destination. Chris takes his mobile phone and is able to walk to the destination thanks to the help of the updated mobile application.
1.4	RELEVANCE	Technology: 4 Business: 4
1.5	CONTEXT OF USE	Application domain: Business and Private Life Possible devices: • Laptop, Desktop PC • Car navigation systems • Screen (in the meeting room) • Mobile phone, PDA / Smartphone

1.6	**GOALS TO BE ACHIVED**	• Finding the way to the destination easily and quickly • Ease of use
1.7	**INVOLVED USERS**	• Business traveler (Chris) • Map and routing service provider • Network services • OPEN Migration Platform
1.8	**BUSINESS ROLES**	• Business traveler (Chris): Device usage, Triggering of migration • Map and routing service: Provides map data and routing functions • Network services: Device communication • OPEN Migration Platform: Device discovery, application and data/state migration

1.9	**SYSTEM CAPABILITIES**	Required system capabilities:
		• Management, configuration, deployment capabilities
		  o Device discovery
		• Network capabilities
		  o Mixed usage of different technologies (Ethernet, GPS, WLAN, Bluetooth, etc.)
		  o Centralized storage
		• Personalization/Adaptation capabilities
		  o UI / Layout preferences
		• Device-related capabilities
		  o Clear display of maps/routes

1.10	**ELABORATION - EVALUATION**	• Kind of migration
		  o Maybe could focus mainly on UI?
		• Values added by migration, context awareness, personalization. etc.
		  o Flexibility, information at your fingertips
		• Related technology
		  o GPS
		• Risks
		  o Potentially many different networking technologies involved (Ethernet, GPS, WLAN, Bluetooth, etc.)
		  o Mobile devices have memory constraints
		• Usability goals
		  o Responsive routing applications
		  o Good readability of maps on small screens (mobile devices)
		  o Instant Migration

1.11	**ANALYSIS**	• Potentially many different networking technologies involved (Ethernet, GPS, WLAN, Bluetooth, etc.) • Mobile devices have memory and performance constraints
1.12	**LIST OF USE CASES**	Map and route planning
1.13	**USE CASES DIAGRAM**	
1.14	**LIST OF SERVICES**	• Map and routing service provider

7.2 Requirements

Reqno.	Requirement	Rationale	Owner	Cluster	Originally triggered by scenario no.	Interaction with other requirements	Typology [Network / Application Logic / User Interface / Migration Service Platform / Scenario Specific]
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.	Anders	Context	2 (Pac Man)	34,95,98,118	MSP, UI
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.	Agnese	Application	10 (IPTV gaming)	127,3	network

5	The user must be enabled to use must be enabled to use the set top box to display a game in a screen.	It must be possible for a user to play a game and use the set top box to display it in a screen in which he can better enjoy the game.	Agnese	Application	10 (IPTV gaming)	145	MSP
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.	Agnese	Application	10 (IPTV Gaming)		MSP
8	The user must be enabled to use the set top box to display different information on a screen (e.g. a widget taking the update of game information but also instant messenger, documents, images)	It must be possible for a user to use the set top box to display different information on a screen and to use different parts of the screen for different information	Agnese	Application	10 (IPTV Gaming)	145	MSP

13	The user must be enabled to play multiplayer games. The players can also play using information coming from the real world, as for example the real position of the competitors in a race.	It must be possible to enrich a game experience with real information.	Agnese	Application	10 (IPTV Gaming)	144	MSP, scenario specific
110	OPEN enables the user (in this case: the emergency control center) to visualise 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 he	Andreas F.	Application	8, 8b (emergency/flood)	many, especially 26	UI

111	OPEN enables users from different organisations to view the status in the emergency area / of the simulation on their preferred device and modality.	The support/help staff as well as the control center in huge emergencies will be heterogeneous, thus the simulation and overview should migrate among them, but also integrate in their preferred application. Parts of the data, which are confidential for an organisation, should not migrate to other organisations.	Andreas F.	Application	8, 8b (emergency/flood)	73, 57, 26, 91, 40	UI, MSP, network
22	Users want to get location- and direction- specific services, e.g. navigation signs.	Simplified Use Experience	Ernö	Application	5 (Shopping Spree)		
78	Gaming anywhere, anytime, anyhow.	People like to spend time ion games.	Fabio	Application	2 (Pac Man)	69, 154, 71	User Interface, MSP
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.	Francesca	Application	10 (IPTV gaming)	8,9	MSP, UI
154	A remote lobby system must handle users' connection in multiplayer game.	The user must be able to enter the game wherever he is.	Francesca and Stefano	Application	2 (Pac-Man)		App. Logic

155	The game must support the pause feature.	The user needs time to change device and UI	Francesca and Stefano	Application	2 (Pac-Man)	45, 54, 64, 102	App. Logic
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).	Manuel	Application	8, 8b (emergency/flood)	100, 91 , 46	UI, MSP
117	OPEN enables the 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.	Manuel	Application	8, 8b (emergency/flood)	70, 87, 90	UI

12	I want to interact with the TV program	Watching TV is boring.	Stefano (at) AD	Application	10 (IPTV Gaming)		Scenario Specific
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.	Stefano (at) AD	Application	5 (Shopping Spree)	28	Scenario Specific
29	I use the shopping spree because I get information faster than in other ways.	I want to save time.	Stefano (at) AD	Application	5 (Shopping Spree)	29	Scenario Specific
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.	Andreas F.	Content Adaptation	8, 8b (emergency/flood)	162, 164, 65, 51	UI
90	The user must be able to select which content he wants to migrate to the low-end device.	The limited resources of low-end devices must be taken into account.	Francesca	Content Adaptation	12 (Mobility support)	74, 91	MSP

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.	Manuel	Content Adaptation	8, 8b (emergency/flood)	108, 109	UI, MSP
135	my new context should mean a change in other participants capabilities (files accessibility, GPS positioning, WiFi localization, …)	If the user migrate from a PDA to a mobile phone with GPS capability, other participants can obtain user position	Agnese, Giulio	Context	general		MSP
136	The platform must collect environmental information, using all possible kinds of sources (sensors, interaction panel, network parameters…)	The content adaptation should take into consideration environmental information	Agnese, Giulio	Context	general		MSP
25	A notification service should use the best (of the context) method	Notifications are automatically triggered in a changing context (devices, modalities, etc.	Anders	Context	5 (Shopping Spree)	59,89	MSP

	for notifying automatically.	…)					
42	My new context should mean a context-change in other participants' context.	Two endpoints can benefit from each others capabilities.	Anders	Context	3 (Video Telephony)	59,135	MSP
34	Service content should be provided in a context aware manner.	The user should only be presented with information relevant to his current situation.	Fabio	Context	5 (Shopping Spree)	35, 59	User Interface, Application Logic
6	System should be able to trigger a migration.	Sometimes the user explicitly wants to trigger the migration, sometimes he wants to define rules when to migrate automatically.	Holger	Context	10 (IPTV gaming), 3 (Video Telephony), 2 (Pac Man), 14 (Racing Game)	130, 131, 133, 134, 137, 65, 82, 86, 94, 37, 80, 66, 148	Migration Service Platform
59	Application should be able to adapt its behaviour to the context / user's needs.	Not only the change of an interface-implementation is relevant, but also the change of behaviour of single components during runtime without replacing them.	Holger	Context	2 (Pac Man)	34, 35	Application Logic, Migration Service Platform
89	A rich context access to guarantee accurate predictions on when the user is	The scenario requires predictions. The only tools to generate them are context sources.	Miquel	Context	12 (Mobility support)		

	going to leave and a migration will be required.						
38	My private information should be kept safe.	I will not use an insecure service.	Anders	Control	5 (Shopping Spree)	23,36,37,39,49,138	MSP, UI
86	Migration should be triggered by the user.	The user is in control of the game meaning that s/he has the decision.	Anders	Control	14 (Racing Game)	98,127,133	MSP, UI
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)	Carmen	Control	5 (Shopping Spree)	Yes: 23, 36, 37, 138, 39	User Interface
30	Users need to get priority over others when needing a device. That might force a migration of the several users.	Controlling the device	Ernö	Control	5 (Shopping Spree)		
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.	Ernö	Control	7 (Migration over platforms)		

51	Users need to find and manage the pieces of applications on different devices.	Being in control, control shopping list.	Ernö	Control	7 (Migration over platforms)		
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.	Ernö	Control	2 (Pac Man)		
80	Users must be able to accept or deny a migration from a to b.	Users should be in control.	Manuel	Control	14 (Racing Game)	82, 14, 37,98	MSP, App. Logic
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	It must be possible to explore causalities and to keep interaction paths from a user's perspective, the latter one to minimize learning efforts.	Manuel	Control	8, 8b (emergency/flood)	113, 109, 120	UI, MSP

	information.						
53	Web applications must be able to control the middleware installed in the device via the browser. Alternatively the browser must be OPEN-aware.	The applications must interact with the OPEN work just like any other one.	Miquel	Control	7 (Migration over platforms)		
139	If output data could be partially displayed on a public screen because of privacy settings, each data should be associated with a privacy metadata (are you sure?)	The user privacy must be preserved	Agnese, Giulio	Data migration	5(Shopping Spree)	138	MSP
126	Streaming and copying of large data volumes must be supported (simulation data, video, etc.), this is also essential	Different devices involved in migration may need to share data	Armin, Clemens	Data migration	3,8,10,14	Yes: 125	Migration Service Platform, Network

	when doing partial migration (audio on mobile phone, video on set-top box)						
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	Carmen and Fabio	Data migration	5(Shopping Spree)	163	User Interface, MSP
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	Carmen and Fabio	Data migration	5(Shopping Spree)	162	User Interface, MSP
9	Migration of applications with real and virtual data.	To increase the interactivity and the user involvement.	Fabio	Data migration	10 (IPTV Gaming)	13	User Interface, MSP, Application Logic

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.	Manuel	Data migration	general	73, 66, 9, 19, 36, 39, 52	MSP, UI, App. Logic
122	OPEN enables the users to synchronise the information after (each) status report, no matter from which work group, device or modality the status report comes from. OPEN gives notification to the user, if information is synchronised or not and this information remains stable over migration of data and applications).	Compare simulation and reality, step-wise correction and update of simulation.	Manuel	Data migration	8, 8b (emergency/flood)	61, 33, 6, 78	UI, MSP, network, application logic
19	Application data (the model in a model view controller pattern) must be stored in a	All the devices read the same emergency information.	Miquel	Data migration	8 (Emergency/Flood)		

	central location a reachable from multiple concurrent heterogeneous devices.						
161	The Open platform should be able to support migration amongst different implementation languages	The Open platform should be able to offer the user new interaction possibilities amongst different environments	Carmen and Fabio	Development	5(Shopping Spree)	81, 46	MSP, User Interface
46	Access an application that can be dynamically implemented in different implementation languages (e.g. Web and Java)	Obtain a migration that is not limited to the implementation language.	Fabio, Carmen	Development	7 (Migration over platforms)	81	User Interface, MSP, Application Logic
100	OPEN should provide mechanisms for developers to easily write code for multiple platforms.	It must be easy to address the heterogeneous mobile market.	Manuel	Development	general		MSP, UI

96	We must ask as little as possible from the application developers and put all that we can on the middleware.	Allow easy portability of applications. Promote adoption. Avoid replicating functionality.	Miquel	Development	general		
104	The underlying network connection (TCP layer and below) must be abstracted, so the application does not realise, that there was a change. Or the application must get a callback mechanism to be notified on changes. Or the application must get a transparent reconnect mechanism.	Which of the three might depend on the legacy mechanisms of the application server.	Miquel	Development	general		
20	Users need to discover devices in the vicinity.	Better experience.	Ernö	Discovery	5 (Shopping Spree)		
70	The user must be able to select different input	Some input can be more effective for game control.	Francesca	IO	2 (Pac Man)	40, 41, 73	MSP, UI

	types.						
156	The input devices must be able support the same actions	If the game need a 4 directions input, all the devices must support it	Francesca and Stefano	IO	2 (Pac-Man)	151, 159	UI
73	Applications must allow multiple concurrent heterogeneous input sources.	The multi-player variant requires cell-phone and PC keyboard at the same time.	Miquel	IO	2 (Pac Man)		
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	Agnese, Giulio	Maintenance	10,10b(IPTV gaming), 2 (Pac-Man), 14 (Racing game)	128,129,132,133,137,138	Application logic, MSP
85	(Pre-)caching of components on the device, background download of components.	Avoid download times for often used or common components.	Armin	Maintenance	14 (Racing Game), all	Yes: 11, 32, 63, 69, 81, 83, 92, 99	Migration Service Platform
84	OPEN should allow automatic updates of components.	User does not want to search for updates.	Manuel	Maintenance	14 (Racing Game)	83	MSP, App. Logic

81	Binary implementations of the services must be downloadable into the target device. An uplink to the internet is required.	The source device cannot possible have all the implementations for all the possible target devices. Therefore, access to a repository is needed.	Miquel	Maintenance	14 (Racing Game)		
83	Applications with compile time versions require an internet connection to download the binaries specific to each device.	There are potentially many applications times many versions. A repository is needed, that is publically available.	Miquel	Maintenance	14 (Racing Game)		
133	The trigger is the event starting the migration. After the trigger, the migration can be: • Automatically managed by the system/platform • Managed by the user(s). In both cases, triggering the migration could not lead to an effective	The user want to manage the migration only if necessary, he doesn't want to lose time in settings	Agnese, Giulio	Migration	10,10b(IPTV gaming), 11,11b(IPTV business)	134,136,137	MSP

	migration.						
134	Migration can be implicitly or explicitly triggered by the user: a particular event generated by the user triggers the migration. The user can be migration unaware (e.g.: referring to scenario 11: the action of pausing the live program he is watching, implicitly triggers the network migration. For this application, an interaction panel notifying the migration can be useless).	The user want to manage the migration only if necessary, he doesn't want to lose time in settings	Agnese, Giulio	Migration	11(IPTV business)	133,136,137	MSP
33	Devices in geographical range (but not network range) should be	Pre-established connectivity should not be a pre-requisite for migration.	Anders	Migration	5 (Shopping Spree)	20,61,104	network

	usable to migrate to						
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.	Anders	Migration	14 (Racing Game)	2,6,41,66,89,93,98,127,133	MSP, UI
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	Carmen and Fabio	Migration	5(Shopping Spree)	93	MSP, User Interface
60	The user wants to migrate the game to the devices.	Continuous gaming, better experiences	Ernö	Migration	2 (Pac Man)		
62	Users want to use the migration process for triggering application actions, e.g. for joining a game.	Use the migration platform in a useful way, simplify user experiences, example: pushgame to a big screen, start multiplayer on a second push.	Ernö	Migration	2 (Pac Man)		

157	The OPEN platform should be installed and listening for any device requesting migration.	If the user wants to migrate the application from a device to another one, the other device must be ready to accept the migration	Francesca and Stefano	Migration	General	46, 53, 54, 69, 84, 85	MSP
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.	Fabio	Mobility Support	5 (Shopping Spree)	34	User Interface, MSP, Network
91	OPEN should predict the data and applications needed when going mobile.	Users cannot expect to have connectivity always.	Manuel	Mobility Support	12 (Mobility support)	2, 101, 65, 18, 63	network, MSP
105	Applications should be able to utilise multiple cores in devices for optimising user experience and performance	More power allows more actions.	Anders	MultiCore	general	74,124	App. Logic, MSP
124	It should be possible to leverage additional cores on multi-core CPUs to provide full	The user wants the best quality of service possible on his device	Armin, Clemens	MultiCore	3,8,10,14	Yes: 105, 125	Migration Service Platform, Application Logic, User Interface

	performance to the user						
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.	Anders	Multi-Modal	2 (Pac Man)	40,41,70	UI
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.	Andreas F.	Multi-Modal	8, 8b (emergency/flood)	40	UI
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...	Andreas F.	Multi-Modal	8, 8b (emergency/flood)	119	UI
121	OPEN enables the user to highlight in different modalities/devices.	E.g. to highlight parts of a map.	Andreas F.	Multi-Modal	8, 8b (emergency/flood)	118	UI
40	Multi-modal input and output.	Keyboard or PDA as input device, graphical or audio output.	Holger	Multi-Modal	3 (Video Telephony)	70, 41	User Interface

109	OPEN enables the user to see/hear/feel, which objects are located in an area defined (in different modalities) by the user.	The user wants to get information about the area of emergency, and this may be directly in the endangered area or in the control center. Some of the users' actions in the endangered area create the need for "hands and eyes free", i.e. this information must be reliably available in different modalities.	Manuel	Multi-Modal	8, 8b (emergency/flood)	119, 164, 70 , 113, 40	UI
113	OPEN enables the user to see/hear/feel on different aggregation levels (individuals and groups) who is where.	Spreading positioning information must be possible under ad hoc and non-ad-hoc conditions, in many cases aggregated information (e.g. of the type "how many people from Darmstadt's fire brigade entered the "red zone"?) is even more valuable than individual positioning.	Manuel	Multi-Modal	8, 8b (emergency/flood)	109, 111, 40	UI, MSP
144	The OPEN platform should be able to handle, e.g. co-ordinate and synchronize,	The platform must handle multiuser applications	Agnese, Giulio	Multi-User	11(IPTV business)	145	MSP

	inputs from multiple-users (not only in gaming scenarios, but for others application too).						
145	The OPEN platform should be able to manage devices shared by multiple users, e.g.: co-ordinating and synchronizing device usage in accordance with priority.	The platform must handle device sharing	Agnese, Giulio	Multi-User	5(Shopping Spree)	144	MSP
58	The open environment should be able to handle, e.g. co-ordinate and synchronise input from different users (multiplayer games).	We want that users can play together in the same game.	Carmen	Multi-User	2 (Pac Man)	27, 52, 145, 142	User Interface, (Application Logic), Network, MSP,
26	Users (plural!) must be enabled to share a device.	Utilizing large video walls.	Ernö	Multi-User	5 (Shopping Spree)		

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.	Francesca and Stefano	Multi-User	2 (Pac-Man)	151	UI, MSP
3	The user must be enabled to watch a program using all possible sources: if he starts watching an IPTV program but after some minutes the network is not available or the quality requirements are not reached and if the set top box has also the possibility to obtain the signal from another network (e.g. satellite), the set top box will switch the signal source.	It must be possible to for a user to watch a program.	Agnese	Network	10 (IPTV gaming)	127,1	network

127	The platform must auto-configure network settings but before the migration from a network to another, it must alert the user and wait for his authorization	Changing network could mean different fee, delay, …	Agnese, Giulio	Network	10,10b, 11	No	Network
132	For migration occurring involving devices in a (W)PAN and network servers, OPEN platform must manage new communication among: • devices • devices and servers • servers (Besides communication already existing before the migration)	The user does not want to set up connection, download files, install modules,...he want to go on playing	Agnese, Giulio	Network	10b(IPTV gaming)	128,129,130,133	network
14	The network should be reachable through	Many providers provide networks restrictions as well.	Anders	Network	8 (Emergency/Flood)	61,83,127	network

	gateways, network address translation…						
67	Devices must have short-range communication means.	Devices in range should be able to see each other.	Anders	Network	2 (Pac Man)	20,61,158	network
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…	Ernö	Network	2 (Pac Man)		
55	The house must be equipped with pervasive network infrastructure.	The user needs to easily change input and output devices while moving inside.	Francesca	Network	7 (Migration over platforms)	14, 33, 54, 67, 89, 134	Network
158	The devices should support wireless connection	The connection procedure should be as smooth as possible, without worrying about physical plug	Francesca and Stefano	Network	General	61, 63, 67, 71, 78, 82	Network
2	OPEN should auto-configure to changing network settings.	User does not want to care about configuring.	Manuel	Network	10 (IPTV gaming)	16, 6, 91, 92, 67, 3	network

131	The offline-online migration must be triggered by network QoS parameters too.	The user want to use an online application if particular parameters (delay, jitter,..) satisfy predefined constraint	Agnese, Giulio	Offline mode	10b(IPTV gaming)	No	network
92	The services should be usable offline.	Requiring an always existing internet connection is restricting.	Anders	Offline mode	12 (Mobility support)	16,61,63,99	network, MSP
63	OPEN should work with and without internet connection.	Moving the control from PC to mobile phone should work without internet connection, if all components are available on the PC.	Holger	Offline mode	2 (Pac Man)	92, 16, 99	Network
16	OPEN should be able to migrate in an offline modus.	Cannot expect to be always on. Infrastructure might be not available	Manuel	Offline mode	8 (Emergency/Flood)	2, 18, 59, 77, 92	App. Logic, MSP, network
99	I'm most of the time offline and I want to keep using my application.	I can't rely on connectivity.	Stefano (at) AD	Offline mode	general	4, 16, 63	MSP, App. Logic
23	Privacy regarding personal information: location, name, address, preferences, habits	Spam degrades user experience, private life has to be protected.	Armin	P	5 (Shopping Spree)	Yes: 15, 36-39, 49, 52, 138-143	All

87	I should be able to migrate more than the user interface, i.e. codecs, computation tasks…	If I have a nice way of interfacing but no power or bandwidth, processing should be moved.	Anders	Partial Migration	14 (Racing Game)	2,3,10,74,76,90	MSP, App. Logic
142	the migration could modify users permission settings	The users permission settings could be influenced by the device	Agnese, Giulio	Policy	7 (Migration over platforms)	143	MSP
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	Ernö	Policy	2 (Pac Man)		
49	The interaction with the shopping list has to be handled with permission policy.	E.g. the parents can delete child's requests, but the children cannot delete parents' requests.	Francesca	Policy	7 (Migration over platforms)	7, 52, 142, 143	MSP, App. Logic
52	OPEN should provide a policy setting for deciding, who can edit data in a multi-user scenario	User wants to explicitly give rights to others	Manuel	Policy	7 (Migration over platforms)	19, 30, 49, 92, 27	MSP
98	Migrations must involve explicit user consent or predefined policies or they won't	I don't want my banking service migrated out of my device by passers-by.	Miquel	Policy	general		

	happen.						
137	The platform should be able to collect preferences explicitly set by the user and/or learned from observing user behaviour. The preferences are related both to device(s) and to migration process.	The user profiling is important to speed migration process	Agnese, Giulio	Preferences	general		MSP
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.	Anders	Preferences	general	2,41,56,93,127	UI, MSP
56	User profiles and preferences: font size, colours, audio volume, brightness…	Don't want to set up parameters every time.	Armin	Preferences	7 (Migration over platforms)	Yes: 41, 50, 59, 94, 95, 137	User Interface (Migration Service Platform, Application Logic)
93	The system should remember previous migration settings, when it recognises that the conditions are the	We want to enable the user to make shortcuts for routine migrations (configurations)	Carmen	Preferences	12 (Mobility support)	61, 133, 82	User Interface, MSP

	same (e.g. when the user comes to the office).						
95	Users want a personalised OPEN application on their own devices, e.g. filtered or sorted due to their preferences.	When an OPEN application migrates to a personal device, it might interact with a local profile to personalise its appearance.	Ernö	Preferences	general		
50	User interface content should consider user preferences that can be inferred also from people's behaviour (i.e. what they usually put in the fridge).	Simplify the identification of products, which are interesting for the user.	Fabio	Preferences	7 (Migration over platforms)	137, 94, 56	User Interface, MSP
138	Each time a migration occurs, OPEN should take into consideration privacy settings for files/directories and applications.	The user privacy must be preserved	Agnese, Giulio	Privacy	11(IPTV business)	139	MSP
140	Personal data stored on any OPEN platform	The user privacy must be preserved	Agnese, Giulio	Privacy	general	141	MSP

	public Data Base should be protected.						
36	Users must be able to define privacy policies for application on shared/public displays.	Send applications to shared/public devices.	Ernö	Privacy	5 (Shopping Spree)		
39	OPEN should take control of my privacy settings.	Do not want to show/share all data.	Manuel	Privacy	5 (Shopping Spree)	36, 37, 39, 138	MSP
21	Users need to reserve resources (display, input-output)	Don't' get disturbed by fight for devices.	Ernö	QoS	5 (Shopping Spree)		
18	Open must be extremely reliable.	It's used in life threatening situations.	Miquel	QoS	8 (Emergency/Flood)		
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.	Miquel	QoS	5 (Shopping Spree)		
102	If migration brings a latency users must be helped to wait less.	Users do not want to wait.	Stefano (at) AD	QoS	general	11, 32, 54, 55, 60, 69, 71, 82, 93, 131, 158	

128	For migration occurring between devices in a (W)PAN, OPEN platform must perform application logic reconfiguration between multiple devices: • which is/are the destination device/s • which application modules have to be migrated to each destination device • as application modules running on different devices need to interact, OPEN platform must set up the connection among the modules User experience issue: when the game input (green	The user does not want to set up connection, he want to go on playing	Agnese, Giulio	Reconfiguration	2 (Pac-Man), 14 (Racing game)	129, 130, 132	Application logic, network, MSP

	box) migrates from device A to device C, the user expects automatic connection setup between device C and device B (where all the other application modules have moved)						
129	OPEN platform must perform application logic reconfiguration between multiple devices and verify the presence of all necessary modules. If one or more modules are missing on the target device, the platform must: set the connection to	The user does not want to set up connection, download files, install modules,...he want to go on playing	Agnese, Giulio	Reconfiguration	10,10b(IPTV gaming), 2 (Pac-Man), 14 (Racing game)	128, 130, 132, 133	Application logic, network, MSP

	the modules repository, download the required modules, install and configure the modules on the device.						
74	Users must be able to migrate identified parts of the application to other devices e.g. with high score list.	User has control.	Ernö	Reconfiguration	2 (Pac Man)		
153	In the multiplayer game, if one of the players leaves the match, it has to be replaced by a virtual player controlled by AI.	The players can keep playing even if other players disconnect	Francesca and Stefano	Reconfiguration	2 (Pac-Man)	4, 16, 63, 99	App. Logic
76	It should be possible, that parts of the application migrate and also that the whole application migrates.	Sometimes there are pre-installed parts of the applications on the target device, so you don't need to migrate these.	Holger	Reconfiguration	2 (Pac Man)	128, 129, 74, 10, 85	Application Logic, Migration Service Platform

10	The application must support being split into components, such that different pieces can be sent to different devices.	Splitting is a core innovation, and this scenario requires to split the game.	Miquel	Reconfiguration	10 (IPTV Gaming)		
141	Any personal data transferring (device-device, device-platform, platform-platform) should be safe.	The user privacy must be preserved	Agnese, Giulio	Security	general	140	MSP
15	Wireless communication should be encrypted.	Eavesdropping is easy on unencrypted air.	Anders	Security	8 (Emergency/Flood)	No	network
118	OPEN enables the user to know (seamlessly over migrations), which information is important and which is not.	Emergency staff must decide quickly.	Andreas F.	Session	8, 8b (emergency/flood)	121	UI

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.	Andreas F.	Session	8, 8b (emergency/flood)	all ;-), especially 43	UI
43	Recording of sessions.	Archive for later use and analysis. Security: be able to track back sessions.	Armin	Session	12 (Mobility support), 8 (Emergency/Flood), 3 (Video Telephony)		Migration Service Platform, Network, (UI, App. Logic)
77	Users want to store an "intermediate" state for later re-storing, continuation..	Cheating at games…	Ernö	Session	2 (Pac Man)		
45	Long activities carried out through different devices in a seamless way.	Don't bother to start from the beginning at every change of device.	Fabio, Carmen	Session	7 (Migration over platforms)	61, 163, 54	Network, User Interface, MSP
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	Manuel	Session	7 (Migration over platforms)	9, 61, 81, 51	MSP

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.	Stefano (at) AD	Session	14 (Racing Game), 2 (Pac Man)	18	MSP
143	the migration UI should manage permission settings	The user could set permission settings during the migration	Agnese, Giulio	UI	7(Migration over platforms)	142	MSP
125	The platform must make it possible for the application developer to utilize dedicated hardware for video (de)coding and processing, 3D graphics and audio	The user expects that all features of his device are supported	Armin, Clemens	UI	3,8,10,14	Yes: 126, 124	Migration Service Platform
164	The user interfaces of the devices involved (source and target) should be able to support the same tasks but using interaction techniques more suitable for the interaction resources available	The user should be able to accomplish the same task but through interaction techniques more suitable for the current device	Carmen and Fabio	UI	5(Shopping Spree)	47	User Interface

44	Users want to copy the user interface to another device (fully or partially, with or without input-output consistency)	Copy shopping list to family board.	Ernö	UI	7 (Migration over platforms)		
75	Users must be able to push and pull user interfaces.	Annie wants to push the game to her little sister versus her little sister wants to pull the game.	Ernö	UI	2 (Pac Man)		
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	Francesca and Stefano	UI	General	151, 156	MSP, UI
108	OPEN must be able to express/handle temporally changing information in a (in visual modality) three-dimensional map.	OPEN offers this opportunity in different modalities and devices for simulation data or real-world data in huge emergencies. In particular, this makes the evaluation of simulations and the comparison to real-world measurements possible.	Manuel	UI	8, 8b (emergency/flood)	9, 17, 105, 58, 52	UI
47	User interface that adapts the choice of the layout structure and	Improve usability at the various user interfaces.	Fabio, Carmen	UI Adaptation	7 (Migration over platforms)	59	User Interface

	interaction technique (widget) to the available resources.						
11	Delay of migration should be low.	Long waiting times are not fun.	Anders	Usability	10 (IPTV Gaming)	32,69,102,104	MSP
69	The game migration must be as smooth as possible.	The game experience must be preserved.	Francesca	Usability	2 (Pac Man)	11, 32, 54, 55, 60, 71, 82, 93, 102, 131, 158	MSP
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.	Francesca and Stefano	Usability	2 (Pac-Man)	58, 70, 152, 156	UI
27	OPEN should clearly show who has control in a multi-user scenario.	User wants to have feedback.	Manuel	Usability	5 (Shopping Spree)	26, 52, 138	MSP, UI
41	OPEN should be able to learn my preferred modality for a given application and device.	User does not want to configure.	Manuel	Usability	3 (Video Telephony)		UI
71	The interaction with migration phases should be as much as possible	Users don't want to be disturbed in their work/game.	Manuel	Usability	2 (Pac Man)	69, 88, 95	MSP

	unobtrusive.						
88	OPEN should handle service and user interaction problems.	Multiple users in a room might want to grab an input or output channel.	Manuel	Usability	12 (Mobility support)	20, 21, 27 , 77, 30, 31, 130	MSP, App. Logic
101	OPEN should provide the user with information, how much a migration would potentially cost.	There might be costs caused by licenses, if you want to have an application on multiple devices.	Manuel	Usability	general		MSP, App. Logic
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.	Miquel	Usability	5 (Shopping Spree)		

97	OPEN must be a single unified solution by the end of the project.	We need to work for our funding.	Miquel	Usability	general		
107	We need good applications that involve long operations making it worth to migrate the application. It's arguable if such long operations would be present in good applications.	No matter how nice, migration is a hassle, so we need to make it worthy.	Miquel	Usability	general		
17	Migration should make my work easier in difficult situations.	I must be calm and fast in decisions.	Stefano (at) AD	Usability	8 (Emergency/Flood)	28, 29	MSP
72	Games must become more enjoyable if migrated.	Migration must bring value to the experience.	Stefano (at) AD	Usability	14, 10, 2		MSP, App. Logic
103	I want to use OPEN-enabled applications even if I did not plan it in advance.	I don't want to plan in advance my user needs	Stefano (at) AD	Usability	general		MSP

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.)	Armin	User Support	5 (Shopping Spree)	Yes: 22	User Interface, (Application Logic)