# Project Deliverable

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## Title

**D1.2 - Refined Proof of Concept and Field Trial Specification**

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- **PU** Public
- **PP** Restricted to other programme participants (including the Commission)
- **RE** Restricted to a group defined by the consortium (including the Commission)
- **CO** Confidential, only for members of the consortium (including the Commission)
Authors (organizations):
Aliaksei Andrushevich, Rolf Kistler, Martin Wüthrich, Marcel Mathis, Clemens Nieke (IHL)
Bertrand Copigneaux, Franck Le Gall, Fabrice Clari (Inno)
Maria Fernandez Salazar, Miguel-Angel Monjas, Alejandro Bascuñana (ERC)
Massimo Valla, Carmen Criminisi (TIL)
Levent Gurgen, Mathieu Gallisot, Ozan Gunalp (CEA)
Philippe Smadja (Gemalto)
Stefano Pascali, Fabien Castanier, Antonio Vilei (ST-I)
Davy Preuveneers, Arun Ramakrishnan (KUL)
Juan Sancho, Bruno Cendón (TST)
Anup Shrestha, Erik Mademann (ZigPos)
Katharina Liebrand (Swisscom)
Foued Melakessou, Thibault Cholez (UL)
Simona Maria Poilinca, Stefano Severi (JUB)
Francois Nacabal (Maya)

Reviewers (organizations):
Friedbert Berens (FBC)

Abstract:
This document, deliverable 1.2 defines the refined specifications and complete plans for all project trials consisting of proofs of concepts and field trials. Chapter 1 introduces all the used acronyms and definitions. Chapter 2 gives the execution summary. Chapter 3 is focused on overall BUTLER trial objectives. Chapter 4 explains the general methodology designed and suggested by BUTLER consortium and planned to be followed by all BUTLER trials. Chapter 5 reminds about month 12 Proof of Concepts and describes the lessons learned from the 1st project review demonstrations. Chapter 6 defines trial validation targets and metrics followed by the vertical field trials descriptions mainly to be executed between months 12-24. Chapter 7 is focused on horizontal Proof of Concept definition and implementation. Chapter 8 gives the vision on the final BUTLER field trials to be executed between months 24-36.

Keywords:
BUTLER Proof of Concept, BUTLER Field Trial, BUTLER Trial Methodology, BUTLER Trial platform requirements.

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- Multimedia field trial description  
- Public transportation field trial description  
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# 1. Acronyms and Definitions

## 1.1. Acronyms

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<td>[ACM]</td>
<td>Association for Computing Machinery</td>
</tr>
<tr>
<td>[API]</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>[CPU]</td>
<td>Central Processing Unit</td>
</tr>
<tr>
<td>[DoW]</td>
<td>Description of Work</td>
</tr>
<tr>
<td>[EU]</td>
<td>European Union</td>
</tr>
<tr>
<td>[FT]</td>
<td>Field Trial</td>
</tr>
<tr>
<td>[GIS]</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>[GPS]</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>[GUI]</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>[GW]</td>
<td>Gateway</td>
</tr>
<tr>
<td>[HTTP]</td>
<td>Hypertext Transfer Protocol</td>
</tr>
<tr>
<td>[HTTPS]</td>
<td>Hypertext Transfer Protocol Secured</td>
</tr>
<tr>
<td>[IETF]</td>
<td>Internet Engineering Task Force</td>
</tr>
<tr>
<td>[IoT]</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>[IP]</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>[IT]</td>
<td>Information Technologies</td>
</tr>
<tr>
<td>[JS]</td>
<td>JavaScript</td>
</tr>
<tr>
<td>[JSON]</td>
<td>JavaScript Object Notation</td>
</tr>
<tr>
<td>[LAN]</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>[LED]</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>[MAC]</td>
<td>Media Access Control (address)</td>
</tr>
<tr>
<td>[NFC]</td>
<td>Near Field Communication</td>
</tr>
<tr>
<td>[NIST]</td>
<td>National Institute of Standards and Technology (US)</td>
</tr>
<tr>
<td>[NWK]</td>
<td>Network</td>
</tr>
<tr>
<td>[OASIS]</td>
<td>Organization for the Advancement of Structured Information Standards</td>
</tr>
<tr>
<td>[OS]</td>
<td>Operating System</td>
</tr>
<tr>
<td>[OWL]</td>
<td>Web Ontology Language</td>
</tr>
<tr>
<td>[PAN]</td>
<td>Personal Area Network</td>
</tr>
<tr>
<td>[PHY]</td>
<td>Physical Layer</td>
</tr>
<tr>
<td>[PoC]</td>
<td>Proof of Concept</td>
</tr>
<tr>
<td>[REST]</td>
<td>Representation State Transfer</td>
</tr>
<tr>
<td>[RFID]</td>
<td>Radio Frequency Identification</td>
</tr>
<tr>
<td>[SDK]</td>
<td>Software Development Kit</td>
</tr>
<tr>
<td>[SNR]</td>
<td>Signal to Noise Ratio</td>
</tr>
<tr>
<td>[SOAP]</td>
<td>Simple Object Access Protocol</td>
</tr>
</tbody>
</table>
### Table 1 - Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL</td>
<td>Structure Query Language</td>
</tr>
<tr>
<td>TCP</td>
<td>Transmission Control Protocol</td>
</tr>
<tr>
<td>TV</td>
<td>Television</td>
</tr>
<tr>
<td>UART</td>
<td>Universal Asynchronous Receiver/Transmitter</td>
</tr>
<tr>
<td>UDP</td>
<td>User Datagram Protocol</td>
</tr>
<tr>
<td>UI</td>
<td>User Interface</td>
</tr>
<tr>
<td>UoPnP</td>
<td>Universal plug and Play</td>
</tr>
<tr>
<td>URI</td>
<td>Uniform Resource Identifier</td>
</tr>
<tr>
<td>URL</td>
<td>Uniform Resource Locator</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>WEKA</td>
<td>Waikato Environment for Knowledge Analysis</td>
</tr>
<tr>
<td>WSN</td>
<td>Wireless Sensor Network</td>
</tr>
<tr>
<td>WP</td>
<td>Work Package</td>
</tr>
<tr>
<td>XML</td>
<td>eXtensible Markup Language</td>
</tr>
</tbody>
</table>

#### 1.2. Definitions

**Horizontality** – is technically understood as complementary data exchange between different application domains generating the added value through availability of the non-core (also called contextual) information for a given application domain. Horizontality is a key feature of BUTLER’s SmartLife Vision for ubiquitous context-aware and secure Internet-of-Things.

**Proof-of-Concept** is a technical setup clearly and impressively demonstrating a certain method, idea or functionality of a system. The main purpose is to verify that some concept or theory has the potential of being used. Specifically in the context of BUTLER the PoCs are used as a vehicle to show a feature, epic (collection of user stories) or technology relevant to the BUTLER project. It mainly targets an interested audience which will mostly (but not necessarily) have a technical background such as conference, review participants or EC representatives. The key characteristics of BUTLER PoCs are high reliability with easy to understand and attractive to present story behind that are the most important components of horizontal storyline product / system marketing. The PoC may but does not necessarily directly involve the end-users. The PoC can have stationary, portable (preferred) and movie editions / versions.

**Field Trial** is a real life system setup involving the end users. Apart of proving the main functionality of BUTLER architecture, the field trial gathers and evaluates the data from its operations and from users. The field trial setup may include:
- Fixed infrastructure installed at partner sites
- Real mobile devices of the end users
- Real objects equipped with electronic identification tags

**Trial** The term “Trial” is used throughout the document to refer to both Proof-of-Concepts and Field Trials.
2. Executive Summary

The D1.2 report is a major milestone of the BUTLER project. Issued at the middle of the project (M18), it summarizes the effort done and also describes in details the forthcoming project impact, with a focus on defining the adequate implementation and evaluation methodology for Proofs-of-Concepts and field trials towards fulfilling the project objectives in terms of validating horizontal IoT services of BUTLER platform and measuring impact on the efficiency of processes.

All the consortium partners involved in the definition, implementation, evaluation and impact measurement of proof-of-concepts and field trials have been contributing to the report which thus includes views from industrial partners (being both large organizations and SMEs) as well as research oriented partners (universities and research centers).

The report has been prepared over more than 6 months of work, with the work of the teams synchronized through plenary meetings and specific conference calls. Working teams have been organized to separately tackle each main section of the report defining the objectives, methodology as well as describing the implementation, evaluation and impact measurement for initial proofs of concepts, vertical field trials, horizontal proofs of concepts and final field trials.

This document, the final specifications and complete plans for all project trials consisting of proofs of concepts and field trials are defined. After updating used definitions the authors describe the motivation behind project trials in terms of general project objectives and validation needs. Further, the document explains chosen trial modes in terms of purpose and justification for platforms and requirements validation where trial results are also considered as an additional input for research and development tasks. The overall trial plans are sequentially detailed in vertical and horizontal proof of concepts and field trials plans that are rounded by key performance indicators for progress monitoring purposes.

The section on trial methodology gives a common understanding on selection, definition, implementation, integration and execution procedures used within overall project trials. Special attention is devoted to involvement management of users and stakeholders. User involvement process is viewed as a key success factor for innovative business models and that is why it is also of high significance to choose the appropriate communication channels and to define the unified feedback collection process through all the trials. Data privacy, ethics and security are crucial for acceptance of IoT applications and are covered in this document from technology and from policy-making sides.

Talking about initial vertical proofs of concepts we split the section into relevant scenario and technological descriptions followed by lessons learned from demonstrations during the first project review in Regensdorf after the month 12.

For second year field trials we provide the detailed descriptions and planning according to Smart Home / Office, Smart City, Smart Shopping, Smart Health and Smart Transport field trial application domains, called verticals within BUTLER. According to unified template every vertical field trial description covers trial motivation, description, metrics, technical implementation, trial execution as well as data analysis and interpretation aspects.

Going to cross-domain or so-called horizontal proofs of concepts the project consortium firstly defines success objectives and metrics followed by BUTLER reference horizontal scenario definition process. Afterwards we present two tentative scenarios defined within consortium until month 18 that are also used by consortium for demonstration and dissemination purposes. The most important function of these scenarios is however in providing input for BUTLER smart platforms implementation bundled in platform requirement list as well as validation and updating process.
The final trial plans are based on continuation and extension of second year trials as well as on opportunities outside of BUTLER consortium like broad IoT community, extended members group and friendly users of IoT products and services.

This document is finished by annexes that are mainly devoted to working materials used during execution of BUTLER trials and include the identified project requirements list, list of open issues, data privacy regulations, letters of consent with end-users as well as questionnaire forms from particular field trials.
3. BUTLER Trials Objectives

3.1. Project objective and need for validations

_The BUTLER project objective of a technical platform for secure and context-aware IoT requires many technical and user validations._

Acknowledging the transforming potential of IoT on many aspects of our societies, the BUTLER project aims to:

- **Develop a natively secure, pervasive, energy-efficient and optimized context-aware opened architecture, by bundling and integrating IoT technologies and services to transparently learn and infer the behaviors and needs of users, acting on their behalf, and protecting them, so as to improve their quality of lives.**

Existing research and development work deals with IoT from a given vertical application domain, while BUTLER, in contrast to the state-of-the-art, aims to:

- **Design and demonstrate the first prototype of a comprehensive, pervasive and effective Context-Aware information system, which will operate transparently and seamlessly across various scenarios towards a unified smart urban environment.**

To achieve this goal, the BUTLER project lead research activities on the enabling technologies (covered by Work Package 2) necessary to solve the major challenges faced by the IoT community:

- **Personalized and Dynamic Demands:** How to handle large and dynamically varying demands for personalized services, goods and information with vast heterogeneity of context?
- **Transparency, Privacy and Security in Heterogeneous Systems:** How to maintain transparency to end-users while ensuring the privacy and security of information in such heterogeneous environments?
- **Collective Behavior Modeling to Maximize Efficiency:** How to optimize the impact that ICT systems have in influencing human behavior towards best practices?

The BUTLER project also work on the definition of an _open, modular and flexible architecture_ (in Work Package 3) necessary to enable the easy, seamless, secure and horizontal integration of various context-aware services from different stakeholders.

The implementation of this architecture and integration of the enabling technologies leads to the creation of the BUTLER horizontal platforms (Work package 4), which aims to provide a usable and efficient technological platform for the creation and deployment of secure, context-aware IoT applications.

The development of such a platform requires several validations both on technical ground and on user perception.
To conduct these validations, the BUTLER project is conducting (Work Package 5) throughout the duration of the project, several proofs of concept and field trials, essentials to gather crucial feedbacks on the technical qualities, usability and user acceptance of the BUTLER platform.

This document presents the global trial methodology followed by the BUTLER project and the detailed specifications of the four main trial campaign of the BUTLER project, examining for each, the objective and rational behind the trial definition and selection, the planned implementation, the gathering of technical and user feedback and the interpretation and application of the results and findings of the trials.

3.2. Purpose and justification for BUTLER field trials and proof of concepts

The Proofs of Concept and Field Trials of BUTLER aim to validate the identified system requirements and quality of the system. They are also in themselves a source of requirement and can be viewed as a defining roadmap for the project.

3.2.1. BUTLER Platforms Validation

As presented above, the first and foremost objective of the field trials and proof of concepts is to validate several technical and non-technical aspects of the platform. Each proof of concept or field trial will have to enable the validation of at least one of the following element, defining the quality of the BUTLER system:

- **Technical feasibility:** The ambitious requirements of the creation of a secure and context aware IoT environment require many breakthroughs in the necessary enabling technologies. Several proofs of concepts must therefore be designed to evaluate and demonstrate the technical feasibility of the technical solutions envisioned.

- **Technology integration and interoperability:** The integration and interoperability of the different technical solutions necessary to reach a horizontal IoT is a capital challenge in itself. The BUTLER proof of concept will thus have to aggregate heterogeneous technologies to assess their interoperability in a unified environment.

- **Deployment and scaling:** The feasibility of a large scale deployment of the BUTLER platform will also have to be examined to evaluate the technical complexity of a field deployment and the evolution of performances when face with an increasing quantity of data, connections and users. Field trials involving numerous users over real life applications will be necessary to get such feedbacks.

- **Usability and acceptance:** As the BUTLER targets the societal progresses and commercial opportunities offered by IoT (studied in Work Package 1), the usability, user perception acceptance of the solution proposed needs to be carefully studied. The involvement of users (including not only end-users but also all the involved stakeholders) is essential to the success of the project. The Field Trials campaigns will have to focus on the gathering and analysis of the user feedbacks to determine the most promising applications as well as the potential user concerns (such as impact on privacy) that needs to be addressed.

- **Standardization and regulation:** The field trials in BUTLER will provide feedback to the running standardization processes in the IoT domain. The deployed use cases and scenarios including the received feedback are very valuable input to the work in e.g. oneM2M and ETSI M2M. The results can influence the further evolution of the requirements and can validate initial assumptions.
### 3.2.2. Validation of requirements

The technical and non-technical requirements that the project platforms will have to fulfill has been studied during the first year of the project. The following table lists the existing sources of requirements (click on the links for more details out of the original documents).

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D1.1 - Requirements and Exploitation Strategy</strong></td>
<td>This deliverable provides a first collection of early system requirements for the BUTLER project. The requirements presented were mostly based on the vertical domains identified. They are completed by an initial definition of global, horizontal, requirements for the platform (presented here in Annex A).</td>
</tr>
<tr>
<td><strong>D2.1 - Requirements, Specifications and Security Technologies for IoT Context-Aware Networks</strong></td>
<td>This deliverable examines the specific requirements related to security, privacy, and data protection. Each requirement of the vertical scenario has been examined to validate its feasibility and technological solutions have been proposed.</td>
</tr>
<tr>
<td><strong>D2.2 - Requirements, Specifications and Localization and Context-acquisition for IoT Context-Aware Networks</strong></td>
<td>This deliverable examines the specific requirements related to Localization and Context Acquisition. Each requirement of the vertical scenario has been examined to validate its feasibility and technological solutions have been proposed.</td>
</tr>
<tr>
<td><strong>D2.3 - Requirements, Specifications and Behavioral Modelling and Synthesis Technologies for IoT Context-Aware Networks</strong></td>
<td>This deliverable examines the specific requirements related to Localization and Context Acquisition. Each requirement of the vertical scenario has been examined to validate its feasibility and technological solutions have been proposed.</td>
</tr>
<tr>
<td><strong>D3.1 - Architectures of BUTLER Platforms and Initial Proofs of Concept</strong></td>
<td>Finally deliverable 3.1 provided a first view of the possible architecture necessary to fulfill the requirements. It also provided a description of the expected qualities of the system (section 6) which can be considered as requirements for the BUTLER system: Performance, Scalability, Dependability, Availability, Resilience, Evolution, Adaptability, Manageability, Interoperability, and Respect of Ethical Issues.</td>
</tr>
</tbody>
</table>

**Table 2 – BUTLER requirement sources**

This list is completed by the requirements defined in this document, such as the technical and non-technical expectations (section 4.2. and 4.3.) and the objectives and metrics of each trial campaign. The Proof of Concepts and Field Trials of the project have been designed with these requirements in mind to ensure they can be tested and validated on the BUTLER platform.
3.2.3. Trials as a source of requirements

As we’ve seen above, the Proof of Concepts and Field Trials have a central role in the project as a validation tool for the project technical and non-technical requirements. However they also have a strong role as source of platform requirements. The Proof of Concepts and Field Trials are built on scenarios defined both to correspond to the identified scientific challenges of the project and to match business cases. Based on these scenarios, technical specifications and non-technical requirements of the trials are produced, and these specifications define the expectations, roles and features of the BUTLER platforms.

![Figure 2 - Trial as a source of requirements](image)

This circular process of scenario, requirements, specification and trial is repeated several times throughout the project (as presented below in section 3.3.) and is used as a high-level roadmap in the project. The following document

3.3. Project trial plans

_Presentation of the project high level plan for proof of concept and field trials, each of the trial campaign is described in more details later in the document._

3.3.1. Overall plan for Proof of Concepts and Field Trials

The following plan has been set up for validating technologies through Proof of Concepts and involving users in and Field Trials.

<table>
<thead>
<tr>
<th>Trials</th>
<th>Date</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Proof of Concept</td>
<td>Month 12 (end of year 1)</td>
<td>• Integrate user and technical requirements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Demonstrate integration of partners’ assets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Vertical use cases</td>
</tr>
<tr>
<td>Vertical Field Trials</td>
<td>M12 – 24 (Throughout year 2)</td>
<td>• Involve user in vertical use cases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gather user feedback on requirements</td>
</tr>
<tr>
<td>Horizontal Proof of Concept</td>
<td>Month 24 (end of year 2)</td>
<td>• First integration of the project horizontal technical platform</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Demonstrate a horizontal storyline</td>
</tr>
</tbody>
</table>
Horizontal Field Trial M24 – 36 (Throughout year 3)

- Gather feedback on horizontal storyline
- Gather feedback on project technical platform
- Provide inputs for possible exploitation of project results

Table 3- Overall Trial Plans

As presented in the following diagram, each trial campaign (PoC or Field Trials) is a central validation point of the project work and provide feedbacks and new inputs for the continuation of the project activities:

3.3.2. Vertical Proof of Concept

Over the first and second year of the project, some initial IoT applications are created within the project, with the target to validate requirements. These first applications are verticals as: they may share some technologies but are not based on a similar architecture or platform.

Y1 : Vertical Proof of Concepts

Figure 4 - Vertical Proof of Concepts
3.3.3. Vertical Field Trials
The requirement gathering through vertical applications continues throughout the second year of the project. Some of the Proof of Concepts have been selected and will be transformed into field trials (involving real users) to gather not only technical feedbacks but more importantly user requirements and feedbacks.

3.3.4. Horizontal Proof of Concept
Based on the architecture defined in the first year of the project the implementation of the platform started in month 12. This Platform will integrate the "Enabling Technologies" identified by the scientific contributions to the project. A first definition of the platform interfaces (API) will be available by month 18, enabling the creation of the first horizontal proof of concept.
This first horizontal proof of concept will be based on an horizontal scenario and will use the first available elements of the platform.

3.3.5. Horizontal Field Trial
The next step for the project will be to deploy the platform into real field trials. Several field trials will be conducted along the third year of the project; all these trials will be based on the platform and architecture created during the project, enabling communication and interoperability between them.
For obvious logistic and scaling (project partners spread across several industries and countries) as well as user location issues the project will probably not reach in the field trials the same level of horizontality than demonstrated in the proof of concept. But the goal of the project is to demonstrate that this horizontality is technically possible (through the proof of concept) and partially attainable (through the field trials).
The goal of the third year field trials will be to extend the reach of the project beyond the initial partners. Member of the External Member Group (which has a focus group targeted on user involvement) and the partner who will join the project after the Open Call (which will run in 2013), will participate to the creation of field trials using the BUTLER platform and architecture. This will not only extend the user basis of the project (and the associated users’ feedbacks) but also test and demonstrate the readiness of the platform to be used by new stakeholders.
3.4. Key Performance Indicators (review: iHL / inno)

*Presentation of the indicators monitored to follow the progresses and success of the project trials.*

The following performance indicators have been defined in the project Description of Work.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Indicator</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Platform and Proof of Concept</td>
<td>Finalized Architecture definition</td>
<td>Available by month 18</td>
</tr>
<tr>
<td>Technical Platform and Proof of Concept</td>
<td>Technical Platform API first definition</td>
<td>Available by month 18</td>
</tr>
<tr>
<td>Technical Platform and Proof of Concept</td>
<td>Selected enabling technologies to be implemented in the platform</td>
<td>Available by month 18</td>
</tr>
<tr>
<td>Technical Platform and Proof of Concept</td>
<td>Finalized scenario of the Horizontal Proof of Concept</td>
<td>Available by month 18</td>
</tr>
<tr>
<td>Technical Platform and Proof of Concept</td>
<td>Finalized Architecture description</td>
<td>Available by month 24</td>
</tr>
<tr>
<td>Technical Platform and Proof of Concept</td>
<td>Finalized Platform description</td>
<td>Available by month 24</td>
</tr>
<tr>
<td>Field Trials</td>
<td>First Horizontal Proof of Concept</td>
<td>Demonstrated at 2nd review</td>
</tr>
<tr>
<td>Field Trials</td>
<td>Number of vertical field trial started by month 18</td>
<td>2</td>
</tr>
<tr>
<td>Field Trials</td>
<td>Number of vertical field trial implemented by month 24</td>
<td>4</td>
</tr>
<tr>
<td>Field Trials</td>
<td>Number of participating users by month 24</td>
<td>1500+</td>
</tr>
<tr>
<td>Field Trials</td>
<td>Number of user feedback on a single use case</td>
<td>100-500</td>
</tr>
<tr>
<td>Field Trials</td>
<td>Number of external stakeholders involved in the External Member Group “Demonstrations and field trials group”</td>
<td>5</td>
</tr>
</tbody>
</table>

*Table 4 - Key Performance Indicators*
4. Trial Methodology

In general, BUTLER project follows an iterative approach in the field trials design and organization process consisting of the following steps that are also illustrated in the Field Trials Design Process figure 7 below:

1. Identification of technological assets within consortium – includes products, technological and methodological know-how, testing and deployment experience, etc
2. Identification of user involvement assets within consortium – includes user access channels like customer bases, friendly user communities, interest groups, etc.
3. Identification of validation targets – includes technical targets, feasibility studies, acceptance evaluation, etc
4. Field trial scenario definition – includes the description of concrete trial execution steps and all the involved stakeholders
5. Field trial metrics definition – includes ways every field trial is going to be measured towards achieving previously defined targets
6. Deployment and setup of technical infrastructure – includes installation manual for trial setup team staff
7. User feedback collection – describes methods, tools and conditions the users data is gathered within field trial execution
8. User feedback analysis, interpretation - describes methods, tools and approaches the users data is analyzed and interpreted within and after field trial execution
9. Integration of user feedback into new technology standards and into the next trial iteration – defines input interfaces for technology standardization and for the next iteration of trials

Figure 7 – Field Trials Design Process
4.1. Trial definition methodology

This section gives an insight in the way the BUTLER project defines, creates and selects all the trials (including PoCs and Field Trials). We especially emphasize the need on requirement validation.

4.1.1. Scenario definition

In general, BUTLER project follows internal unified scenario definition process that consists of several parallel steps:

- Based on D1.1 the consortium has developed a common horizontal storyline / scenario presenting a selected set of user stories out of the requirements catalogue worked out in WP1
- Based on defined within Task 1.2 system requirements, potentially interesting user stories have been identified for further selection.
- Collection of existing assets in form of available products, technological know-how and experiences within partners
- Identification of user involvement opportunities within consortium and outside

Within the first year project trials this scenario definition process has resulted in:

- One visionary horizontal storyline
- Twenty voted user stories, potentially interesting for implementation with PoCs and field trials
- Ten vertical PoC descriptions, that concretely defined the PoC implementation way for the first year PoCs

Resulting implementation schedule until the 1st project review has foreseen the following steps:

- Five selected vertical PoCs,
- Five vertical PoC technical specifications,
- Five vertical PoC implementations,
- Five verified vertical PoCs demonstrations.

Demonstrations during the 1st project review have proven the feasibility of BUTLER scenario definition process.

4.1.2. Metrics definition and Requirement validation

The validation of the conformity of the results of the project with the identified requirements needs a particular attention. The User stories identified in deliverable 1.1 provided the first requirements from the user point of view (user requirements). These stories had been further analysed to extract system requirements, i.e., what the system needs to satisfy the user requirements. During this analysis, each partner identified a set of requirements each one belonging to one of the following three types:

- **Functional requirements**: What the system is supposed to do in terms of functionality.
- **Non-functional requirements (quality attributes)**: How the system should perform its functions, with which values for its quality attributes, for instance in terms of latency, availability, scalability, correctness, durability, fault tolerance, simplicity, mobility, ubiquity, portability, precision, security, privacy or other ethic issues, etc.
- **Constraints (on design and implementation)**: The constraints of the design and development such as required standards, technologies, languages, databases, operating systems, etc.
The project paid a particular attention that the requirements stay unambiguous, modular, consistent, verifiable, prioritized and traceable.

The requirements have gone through a second iteration in order to assign each requirement to a task of Work Package 2 (security and privacy on low and high levels, localisation and context modelling, behaviour mining) and Work Package 3 (communication infrastructure, data/context management, system/device management and service layer). The following figure illustrates this process.

![Requirement Analysis Process](image)

**Figure 8 - Requirement Analysis Process**

The requirements exposed in the technical deliverables of the first year (D3.1, D2.1, D2.2, and D2.3) will be validated throughout the project:

- In the **Proof of Concepts** (validating the technical requirements)
- In the **Field Trials** (validating the technical and user requirements).

Each test will produce feedbacks that will be re-injected in the next iteration. The following table shows how the successive updates of the technical and user requirement in the project, based on the feedbacks and lessons learned from the PoC and Trials, and where they are documented:

<table>
<thead>
<tr>
<th>Feedbacks from</th>
<th>Technical Requirements</th>
<th>User Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Requirement Collection</td>
<td>D2.1, D2.2, D2.3, D3.1 (Month 12)</td>
<td>D1.1 (Month 4)</td>
</tr>
<tr>
<td>Feedbacks from first vertical proof of concept</td>
<td>D3.1 (Month 12)</td>
<td>-</td>
</tr>
<tr>
<td>Feedbacks from first vertical field trials</td>
<td>D3.2 Annex (Month 24)</td>
<td>D3.2 Annex (Month 24)</td>
</tr>
<tr>
<td>Feedbacks from first horizontal proof of concept</td>
<td>D5.1 (Month 30)</td>
<td>-</td>
</tr>
<tr>
<td>Final feedbacks from final horizontal proof of concept and field trials</td>
<td>D5.2 (Month 36)</td>
<td>D1.3 (Month 36)</td>
</tr>
</tbody>
</table>

**Table 5 - Evolution of technical and users requirements**
4.2. Implementation

Since the final BUTLER trials are based on BUTLER technological platform, the trial implementation description is an important input to define requirements for BUTLER platform in general. Trial implementation process within BUTLER is based on the inputs from BUTLER enabling technologies from WP2, BUTLER architecture from WP3 and BUTLER platform implementation from WP4. Hence, the following sections summarize the view on trial implementation from all these perspectives.

4.2.1. Enabling technologies

4.2.1.1. Security and privacy:

4.2.1.1.1. Mechanisms for secure communications and applications:

- The ZigBee security architecture supports confidentiality, integrity, authenticity, authority, availability and non-repudiation. Entity authentication, access control, key management and establishment functionalities are supported within a ZigBee Network. To this aim, security features have been introduced within the nodes and coordination functionalities have been defined within the ZigBee Coordinator and the Trust Center. The integration of SEP2.0 into the BUTLER architecture at the smart object level will depend on the communication protocol selected for the Wireless Sensor Network. The other main candidate is 6loWPan.

- 6LoWPAN - The original goal of 6LoWPAN was to run IP on smart objects [6]. 6LoWPAN architectures often consist of host and router nodes connected to one or several edge routers which share a common IPv6 address prefix. In fact, all network interfaces of 6LoWPAN nodes share the same IPv6 prefix distributed by the edge router and thereafter routers throughout the 6LoWPAN network. If 6LoWPAN is selected as the communication protocol for the wireless sensor network, DTLS, LSEND and AES encryption are the related security components that the BUTLER architecture must use.

- IPSec (Internet Protocol Security) is a standard defined by IETF to assure secure private communications on IP networks. IPSec is mandatory for IPv6 and optional for IPv4. It provides authentication, confidentiality and integrity at the Network layer. IPSec implementation is CPU and memory consuming. - EAP (Encapsulated Authentication Protocol) runs over Data Link layer; EAP-SIM is an authentication method that uses the authentication engine of a SIM card (A3/A8 algorithm, IMSI/Ki) and the authentication infrastructure of a telecom operator (HLR) to prove user’s identity. It provides mutual authentication, confidentiality (Link Layer can use EAP-SIM generated encryption key) and integrity (Link Layer can use EAP-SIM generated MAC key); EAP-TLS (Transport Layer Security) uses PKI to secure communication to the RADIUS authentication server or another type of authentication server.

- EAP (Encapsulated Authentication Protocol) runs over Data Link layer. It is designed for use in network access authentication. In the nominal use case, the Peer Identity is sent in clear text, therefore it is subject to privacy issue (an attacker can retrieve the identity) or security (the attacker modifies the identity). The EAP is best suited to perform the authentication tasks at the Smart Server-Smart Mobile level or at the Smart Gateway-Smart Server level.

- TLS (Transport Layer Security) is a major protocol securing communications on the Internet. TLS will be integrated in the BUTLER architecture on Smart Gateway, Smart Server and Smart

- DTLS (Datagram Transport Layer Security) provides communications privacy for datagram based networks. It includes a cookie exchange designed to protect against denial of service. It includes a cookie exchange designed to protect against denial of service. Reliable transmissions are achieved by implementing suitable packet loss handling mechanisms and
re-ordering techniques. Message encryption and integrity is performed using symmetric cryptography (AES) which is well suited for smart objects. Therefore, DTLS can be integrated to secure SmartObjects communications, especially if the selected routing protocol is 6lowpan.

- SAML (Security Assertion Markup Language) is issued by the OASIS standard in 2005. This is a XML-based framework for federated identity management. SAML could be an alternative to EAP to perform the authentication tasks at the Smart Object level.
- OAuth is an open protocol that allows an application to access protected resources from a Resource Provider.
- GBA (Generic Bootstrapping Architecture) provides an application free mechanism able to build a shared secret between a user agent (generally running on a mobile phone) and a server. This shared secret enables client-server authentication. GBA is a low consuming protocol that runs at the SIM card. Sensor embedding MIM card can easily rely on SIM based security. GBA could replace EAP to perform the authentication tasks at the Smart Server-Smart Mobile level and even at the Smart Object level if the sensors are compatible.

4.2.1.2. Contextual geo-localization:

4.2.1.2.1 Measurement techniques

- Received Signal Strength Indicator (RSSI) - Ranging estimation based on the RSSI method, firstly introduced in [7], consists in measuring the power of the received radio frequency (RF) signal. This type of measurement is available also in cheap devices, because it is relatively simple to be implemented. Moreover, every radio chip performs the RSSI measurement at each received packet in order to give support to MAC and networking layer protocols. Since the radio propagation in indoor environments is affected by different factors, such as multipaths and attenuation from obstacles, it results that the RSSI measurement is a variable with a large variance and less correlate with the true distance. In fact, the main drawback of the RSSI ranging method is not so accurate due to the strong variability of the propagation environment.

- Time of Arrival (ToA) ranging technique, known also as time of flight (ToF) estimation method, the distance between two nodes is obtained by measuring the propagation time of the RF signal and then multiplying it with the speed of the electromagnetic waves, i.e., the speed of light \( c = 3\cdot10^8 \) m/s. The ToA range estimation method can be classified into two main categories: one-way ranging (OWR) and two-way ranging (TWR).

- Time Difference of Arrival (TDoA) method is typically employed when some nodes, e.g. anchor nodes, are synchronized among them to a common clock while the mobile node, whose position is unknown, is not synchronized with the anchors. In particular, this method consists in measuring the difference of time of flight between the mobile node with respect to two anchors.

4.2.1.2.2 Localization and tracking algorithms

- Super Multidimensional Scaling (SMDS) is a deployable localization method which relies on ranging and angle measurements, acquired by the system itself after deployment, suitable for static positioning and tracking as well by combining it with filters such as Particle Filter (PF), Interacting Multiple Model (IMM), Extended Kalman Filter (EKF), etc.

- The Interval-Scaling (I-SCAL) algorithm presented in [8] is designed to solve static positioning problem in centralized manner.

- The ‘Energy Efficient Tracking’ (EET) algorithm [9], proposed and presented in detail in [4], is based on the Extended Kalman Filter (EKF) approach.
• Energy & Traffic Efficient Tracking through Cooperative Links Selection and Optimized Medium Access Mechanisms (E&TET)

• The distance contraction (DC) algorithm copes with distance-based positioning scenarios of a single target under non-line-of-sight (NLOS) channel conditions. The proposed approach is based on a non-Bayesian framework, namely a least-squares (LS) optimization, and offers a robust solution to circumvent the well-known non-convexity problem of the LS objective function and mitigate errors due NLOS channel conditions.

• Semantic Localization: This semantic localization scheme does not aim to position or track entities on its own, but builds upon other localization schemes, and aims to extend it with semantic topological and directional information. As such, we see Smart Objects and Smart Mobiles play a role in providing the lower level location information upon which the semantic localization is built. Furthermore, semantic localization would offer qualitative reasoning capabilities which the aforementioned algorithms do not focus on.

4.2.1.3. Behavior awareness of single (and multiple) users

• Pre-defined activities planned in space and time: Strong conditional independence assumption is incorporated in the Naïve implementation of the tool. A Bayesian implementation with more relaxed independence will be considered if any of the BUTLER scenarios need it.

• Spontaneous activities: Multi-context fusion is another major concern in IoT where the possibility of acquiring multiple contexts is substantial but the availability of all these contexts (at all time) is unforeseeable. Hence, a hybrid Bayesian fusion algorithm - Globally Connected Locally Autonomic Bayesian Networks (GCLABN) is proposed and implemented

4.2.1.4. Contextual networking

Contextual networking in BUTLER refers to the ability of the system to model the preferences, intentions and activities of a group on the whole as a single entity.

• Context-based Optimized Communications to Gateways in Wireless Networks of Smart Objects: The core concept within this proposed technology is to define priority metrics and mechanisms to establish adaptive and optimized wireless communications between mobile sensing nodes or end-devices (i.e. Smart Objects) and Gateways or WSN sinks, depending on the local and temporal context (i.e. in terms of nodes density, activity, mobility, energy autonomy, etc.).

4.2.2. Architecture

From an architectural point of view, metrics must determine how compliant with the BUTLER architecture the specific trial implementation is. Not all the trials will require relying on all the functional components considered in the BUTLER architecture, so that the lack of use of some of them does not turn the trial into a not compliant implementation.

The BUTLER architecture follows a layered approach as shown in the figure below. There is a Communications layer dealing with the practicalities of the connection with devices. A Data/Context Processing layer deals with making sense of the information provided from the Communication layer and providing the means for further actuation on the devices. Finally, the Services layer hosts the functionalities enabling developers to create domain-specific applications (also some built-in services supporting the BUTLER scenarios). A separate System/Device Management layer enables the management of the components into the rest of layers.
The layers described in the image above are broken down into a number of functional components as shown in the figure below (in blue those functional components belonging to the System/Device Management layer). Further details about field trials compliance to the BUTLER architecture can be found in Annex B.
A core distinctive element of BUTLER is the horizontal approach it takes. Linked with this horizontal approach there are related horizontal services that the BUTLER platform provides to the domain-specific applications that finally are provided as end-user services. A non-exhaustive list of horizontal services provided by the BUTLER platform is listed below:

- Access to sensor data (e.g., simple physical quantity measurements)
- Actuation (e.g., simple actions such as turn on/tun off, open/close, switch on/off, play/pause, etc.)
- Definition of and access to Context Data, including location (e.g., high level information over sensor data)
- User profile management
- Data stream processing
- Device/Service discovery
- Authorization / authentication

The access to such horizontal services will be carried out by means of the interaction with the functional components defined in the BUTLER architecture and their interfaces. Therefore, to be BUTLER compliant, the domain-specific applications built to provide the end-user services in the field trials should have to rely in the following horizontal functional components in the BUTLER architecture:

- **Resource Directory**: access to the Resource Directory will be done, when needed, at development and execution time. At development time, developers in charge of domain-specific application will use the BUTLER Resource Directory to get the information about the Resource Exposition API and to get the...
specific details of any resource instance the domain-specific application relies on for subsequent access. At execution time, the domain-specific applications could access, if needed, to the Resource Directory to get the specific details of any resource instance the domain-specific application relies on for subsequent access.

- **Resource Exposition**: access to resource information shall be done by means of the API exposed by the BUTLER Resource Exposition functional component.

- **Context & Location Exposition**: in the same way as with the Resource Exposition, access to context information (location being included within the context definition) shall be done by means of the API exposed by the BUTLER Resource Exposition functional component. Access to context information can be static (access to the actual value of the context of a given entity) or dynamic (subscriptions to notifications when the context changes).

- **Generic Notification Mechanism**: domain-specific applications shall use the Generic Notification Mechanism when they need to send a notification to the domain-specific applications hosted in Smart Mobiles.

- **Data Marketplace**: the Data Marketplace shall be used by developers at development time to access the Resource Directory, purchase specific data sources and obtain necessary information to build domain-specific applications.

- **Stream Processing**: the Stream Processing functional block shall be used by domain-specific applications wishing to handle large amounts of information coming from devices. Several scenarios can be envisioned: on one hand, the Stream Processing functional block shall provide built-in mechanisms for the distribution of information coming from devices to different clients of said data; also for the management of context. Domain-specific applications may take advantage of said built-in services by means of the Context and Resource Exposition functional blocks. On the other hand, domain-specific applications could include specific event management business logic that could be executed by the Stream Processing functional block.

- **Context Manager**: the Context Manager functional block supports the Context & Location Exposition functional block and needn’t be used directly in any of the field trials.

- **User Location Manager**: the User Location Manager functional block supports the Context & Location Exposition functional block and needn’t be used directly in any of the field trials.

- **User Profile Management**: the User Profile Management shall be used by domain-specific applications that need to access global elements of the user profile (that is, not specific to a given domain-specific application). Domain-specific applications shall be encouraged to implement their own profile management functionalities only for profile information specific to the applications themselves.

- **User Authentication and Identity Management**: the User Authentication and Identity Management framework shall be used by domain-specific applications for guaranteeing a single sign-on experience across applications.

- **Authorization Service**: the Authorization Service shall be used by domain-specific applications to get authorized to consume the services provided by the BUTLER platform.

- **User Registration & Management**: the User Login and Registration shall be used by applications in combination with the User Authentication and Identity Management functional group.

- **Smart Object and Entity Management**: the Smart Object and Entity Management shall be used in development time by domain-specific applications developers in order to manage smart objects and entities that represent concepts relevant for them.

- **Context Definition**: the Context Definition functional component shall be used in development time by domain-specific applications developers in order to manage context definitions in entities or smart objects relevant for them.

- **Smart Object Register**: the Smart Object Register functional component shall be used to manage the registration of smart objects and the resources associated to them.

- **Smart Object Federation Manager**: the Smart Object Register functional component shall be used if the association of them to users is desired.
• **Smart Object Monitoring and Diagnostics**: the Smart Object Monitoring and Diagnostics shall be used to guarantee Smart Objects are working

### 4.2.3. Platforms

From the BUTLER platforms point of view, the objective is to make available in an horizontal way all those components that are needed to run the trials and that will be integrated in WP5.

In particular, the three tasks defined in WP4 T4.1/2/3 are responsible to deliver the three software platforms: SmartObject-Gateway, Smart Mobile, and SmartServer over which the BUTLER services and applications used in the trials are implemented.

In the following we describe how the three platforms developed in WP4 will help in the implementation of BUTLER Trials.

#### 4.2.3.1. SmartObject/Gateway platform for the Trials

Each IoT object involved in the trials, for example a sensor or actuator, should be connected to the rest of the platforms in an uniform way. So for example if a service would like to interact with a specific object, it should be able to be directed by a discovery service (Smart Object Management functional component in the architecture) to the object. To guarantee that all Smart Objects, even those using communication protocols that are incompatible with actual internet standards, can communicate with Smart Mobile and Smart Server platform components, a Smart Object Gateway (or simply Smart Gateway) is needed to integrate objects used in the trials with the other platforms.

#### 4.2.3.2. SmartMobile platform for the Trials

To deliver the trial applications, user interfaces should be developed for the mobile user to offer an access to the services provided.

Thanks to the Smart Mobile platform, the integration and the customization of BUTLER applications used in the trials should be as little as possible. The Smart Mobile platform represents the software framework where trial application developers can find those components that are common to all applications.

The Smart Mobile platform will contribute to implement the BUTLER horizontal experience, because will enable the user to access applications with a single user profile and authentication and preserving the same look and feel through uniform Graphical User interface components.

Other commons features are: protected access, notification, navigation technologies and data-mining algorithms.

Given the fragmented nature of mobile devices, the Smart Mobile platform will also provide the required abstraction form the specific mobile operating systems, thanks to standard technologies such as HTML5.

BUTLER trial applications will run on top of the SmartMobile framework and re-use components to simplify and uniform functionalities that are common to all of them.

#### 4.2.3.3. SmartServer platform for the Trials

In BUTLER a Smart Server is a set of software components that provide to applications, SmartObjects /Gateways and SmartMobile functionalities through a set of APIs.

SmartServers implement also server-side application functionalities to support the specific trial application business logics.

In the BUTLER horizontal architecture used for the trials there will be several SmartServers that provide different functionalities and APIs: the BUTLER trial application developer will be able to select the required functionalities and invoke the corresponding APIs.
Some of these functionalities are common to several applications: for example: transparent access to the context data collected by SmartObjects (sensors and actuators) and aggregation of information provided by various sources, data processing and integration in the cloud, localization engine, behavior model and prediction system, market-place/advertising services and security strategies.

To implement the trials, Smart Servers will be deployed in different ways. For some trials the server functionalities will be co-located in the same environment, and provided by a Local SmartServer. In this case server side functionalities will be offered again through a set of APIs, but directly accessible within the local network. Service discovery and security could be offered through the same Local Smart Server. Other “remote” (or “Cloud”) SmartServers providing general functionalities and offering a horizontal set of APIs will be deployed in what could be defined as “the BUTLER Cloud”.

Integration with external services and 3rd party applications will be mediated by the SmartServer deployed in the cloud.

Each platform will communicate with the others through a set of uniform designed RESTfull APIs.

Figure 11 – The three platforms used in the Trials and their relation from a software integration perspective

Figure 10 illustrates the relation of the three BUTLER platforms from a software integration point of view and the underlying “application communication channels” (arrows) existing between the three platforms and the APIs frontends that will enable the communication.

4.2.4. Integration

Integration and testing of BUTLER achievements will be done in the Work package 5. During the first year of the project, the Task 5.3 (Testing: Smart Scenarios and Pervasive Context-awareness) have started the integration work of the partner assets into the BUTLER’s target vertical application domains (see Figure 12).
This integration allowed the partners to make an inventory of what exists within the consortium in terms of know-how and to see clearly the potential of the consortium for the coming years. This first collaboration has brought 6 proofs of concept demonstrations at the first year of the project.

![Figure 12 - First Year Integration: Integration of Partner Assets into Vertical Domains](image)

Technical and scientific achievements in WP2 in terms of localisation mechanisms, security protocols, context and behaviour modelling and mining techniques, and platform developments in WP4 are progressing in parallel by taking into account the architectural work that has been ongoing in the WP3 (see Figure 13). The first integration of those results will be accomplished at the end of the 2\textsuperscript{nd} year of the project and demonstrated via new trials detailed in this deliverable.

![Figure 13 - Second and Third year Integration: integration of the project achievements and partner assets into the BUTLER platforms](image)

On the other hand, WP5 continue supporting the integration work between the smart life scenarios that have been defined in the WP1 and WP5 ensures that the proposed architecture responds the requirements that have been identified in the WP1.
Figure 14 - Integration of the smart life scenarios with the horizontal BUTLER architecture.

The final integration of the platforms will provide its testing and validation via proofs of concept and field trials.

4.3. User and stakeholder involvement management

In this section we focus on general methods BUTLER project uses to gather, compile, analyse and interpret feedbacks in field trials (end-users and all the relevant stakeholders). We explain firstly why we involve end-user, how we categorize all the stakeholder groups and what is expected from
them. Further, we give an overview on communication channels and correspondent way to collect the feedback.

4.3.1. **User Involvement as a key success factor for innovative business models**

A key success factor for today’s companies is their ability to integrate customers into the innovation process, both to learn from them and with them. A growing number of firms pay attention to users and their views as sources of useful feedback, relevant user experiences, important ideas, and new information. The BUTLER project has embraced this approach in the innovation process from the ideation to the market deployment of new products and services. It is of great value to know the customer needs better beforehand, hence it reduces market risk when launching new offerings and it improves the return on investment and time to market, which are of particular importance for fast internationalization.

Looking at the comprehensive approach for gathering users’ data that has been set at the beginning of the BUTLER Project in D1.1 (see figure 1) the great importance of human centric approach, characterized by strong involvement of different kind of stakeholders and users, from the end user to any other groups of interest (see definition of specific target groups below) and the variety of methods being applied in specific phases of the project in order to acquire differentiated information to meet the needs and interests better during the development process already was shown. The figure below illustrates the key elements of the approach.

![Figure 16 - Schematic Overview of the Methodology (Chapter 3; D1.1)](image)

The purpose of the Insights has been defined as follows:

- to derive further business requirements or use cases for the BUTLER demonstrators
- to identify ethical, social and legal concerns that have to be adhered to by the internet of things or even may have to be addressed by future legislation of the European Union

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1. « Service Innovation and Customer Co-development » Edvarsson et al., 2010
• to develop and describe possible business models, market partnerships and complete business ecosystems for an Internet of Things
• to extract additional requirements for standardization
• to validate assumptions and requirements used in standardization processes like in oneM2M or ETIS M2M

In the initial phase of the project the first impressions of user’s needs, motivations and barriers have been collected. In face-to-face interviews the focus has been set on deeper analysis of motivations, and interests in the life style context of the end users. For this purpose 10 (in total: 70) in depth-interviews in each country have been conducted including Switzerland, Italy, Spain, Luxembourg, Germany, Finland, France. So we could achieve better understanding about the end user interests, their fears and their background in buying and using decision process.

Since there were none use cases prototypes existing at that time, the illustrated user stories from the “One day in 2020” vision have been used in order to help the interviewees imagine the BUTLER Product better.

While in the first step of user involvement we focused on analysis of the motivations and emotions of the end user rather relying on their imagination abilities, the second step in the involvement process should extend the group in terms of the number of the users (4,000 users) and variety of the user group.

All the results will again influence the requirements or opportunities enable us to derive a tailored customer experience design also contribute to possible business models and the future exploitation.

4.3.2. Stakeholders group and expected contribution to Business Models

Within project duration the consortium deals with the following organizational stakeholder categories (including example in bracket):

• Regulatory bodies (Governments and municipalities adopting IoT applications and services),
• NGOs (represent condensed worries and concerns of end-users),
• Professional unions (IoT experience exchange and after diploma education),
• Education institutions (professional IoT education),
• System integrators (use the IoT technologies and deliver services to IoTSP),
• Service providers (IoT service operators deliver IoT services to end-users),
• End-users (organizations and physical persons)
• Standardization organizations (e.g. ETSI, oneM2M, IETF, Broad Band Forum)

In order to better distinguish between different feedback types the BUTLER project defines the following end-user categories:

1. Public visitors of portable BUTLER exhibition stands and demonstrations: IoT Week, Future Network and Mobile Summit, etc (See Annex E for questionnaire form)
2. Visitors of fixed public sites of BUTLER consortium partners: iHomeLab Demonstration facility, Telecom Italia Shops (See Annex E for questionnaire form)
3. Participators of BUTLER project online / offline questionnaires and interviews. The questionnaires will be maintained by by the following consortium partners: Inno, iHomeLab, Swisscom, Telecom Italia, Cascar, ZigPos
4. Beta-tester groups firstly using developed prototypes of BUTLER components and giving first feedback from real environments to developers. The prototypes will be delivered and beta-tests will be supervised by the following consortium partners: TST, ZigPos, iHomeLab, Inno, ST-I, JUB, CEA, Gemalto, Maya
5. Early adopters of new BUTLER-related products from consortium partners: ZigPos proximity sensing solution, Gemalto authentication and access control devices, Maya multimedia applications and services, Telecom Italia

Through the Proof of Concept and Field Trial process, the different stakeholders and user groups will be actively involved, providing inputs about the application designs, their features and functionalities required or missing, but also key inputs supporting the business model design question such as:

- Value propositions,
- Service provider
- Evaluation of service offering (B2B, B2C)
- Payment scheme per stakeholder if applicable (flat, pay per use etc.)
- Willingness to pay, share of wallet
- Distribution channels,
- Customer relationships/partner choice
- Service streams and revenue streams
- Risks

The following table illustrates a catalogue of possible aspects, which we regard as to be covered by survey in the Field Trial context. The listed aspects are still in the working status and can be refined based on insights we will achieve, continuing our studies on this topic. Also here the meaning of the implementation using the listed aspects is strongly dependent on the level of the service description presented to the user in the field trials.

<table>
<thead>
<tr>
<th>Expected Insights</th>
<th>End User</th>
<th>Business Partner</th>
<th>Others (Stakeholders)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Design</strong></td>
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<tr>
<td>Expectations on:</td>
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<tr>
<td>- Features &amp; Functionality</td>
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<td>(X)</td>
<td>(X)</td>
</tr>
<tr>
<td>- Usage (Usability &amp; Acceptance)</td>
<td>X</td>
<td>(X)</td>
<td>X</td>
</tr>
<tr>
<td>- Strategic design elements (scalability, security, etc.)</td>
<td>(X)</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Expectation on the Simplicity / Complexity of Usage</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Expectation on the installation procedures</td>
<td>X</td>
<td>(X)</td>
<td></td>
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<tr>
<td>Expectation on service &amp; support</td>
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<td>X</td>
<td>(X)</td>
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<tr>
<td>Willingness to buy (3 key elements)</td>
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<td>X</td>
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<tr>
<td><strong>Trust &amp; Reliability</strong></td>
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<tr>
<td>In the technological solution</td>
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<tr>
<td>In the provider of the solution</td>
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<tr>
<td>In Data security model / data storage concept</td>
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<tr>
<td><strong>Collaboration Partner</strong></td>
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<tr>
<td>Role in the ecosystem of oneself:</td>
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<tr>
<td>- At the moment</td>
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<tr>
<td>- In the future</td>
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<td>X</td>
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<tr>
<td>Key elements driving the choice of collaboration partner</td>
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<td>X</td>
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<tr>
<td><strong>Revenue Streams</strong></td>
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</tbody>
</table>
4.3.3. Communication channels and feedback collection process

In order to receive sustainable and reliable results it is required that the service model for the particular stakeholder / customer (B2B / B2C) is described respectively shown on a detailed level. If the service model / service description is still on an abstract base, users will not be able to give comprehensive and realistic answers. Additionally the horizontal view of the product / service and the value of its nature need to be recognized by the field trials participants which is again depending on how specific the solution is described and transferred to the user.

Quantitative research method will be applied here using structured questionnaires. In addition to the structured quantitative research, Qualitative research is also recommended with regard to fine-tuning of service offerings (product design).

The following communication methods are being used within collecting feedbacks from and about BUTLER PoCs and FTs:

- Informal feedback during exhibitions and demonstrations
- Offline questionnaire forms
- Online questionnaire surveys
- Focused user interviews
- Prototype feedbacks from beta-testers
- Product feedbacks from early adopters

Several end user questionnaire samples can be found in the Annex E at the end of this document.

4.4. Data privacy, Ethics and Security

BUTLER project fully recognizes the need to ensure the end user privacy / security during the trials and the following section is devoted to this crucial topic.

We refer to Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. The Directive lays down a series of rights of the data subject. These are:

- The right of access to his / her personal data
- The right of erasure, blocking or rectification of the data, which do not comply, with the provisions of the Directive, are incomplete or inaccurate.
- The right to be informed of all relevant details relating to the data processing and the rights granted to him/her
- The right to a judicial remedy for any breach of the above mentioned rights.

As stated in the Seventh Framework Programme (Decision nº 1982/2006/EC), Article 6: “All the research activities carried out under the Seventh Framework Programme shall be carried out in compliance with fundamental ethical principles”.

As already recognized in the Description of Work, BUTLER deals with a number of aspects that might impose ethical issues. Firstly, the project involves tracking the location of people, consumer behaviour modelling and user profiling. Moreover, focus groups will be created to receive feedback. Thus, the project raises ethical issues mainly related to data security and privacy. The awareness list presented in Annex C.1 presents in more details the issue raised by BUTLER and the responses envisioned.

As part of Work Package 1 (Use cases and requirements) and Work Package 6 (Exploitation), BUTLER not only considers ethical issues of the conducted research but also include considerations on ethical impact of the potential use of its research. Deliverable 1.4: Ethics, Privacy and Data Security in the BUTLER project (requested at the 1st year review and scheduled for Month 20, May 2013) will cover in more details these topics and especially the potential impact of the technologies developed in BUTLER. This section will however present the security mechanisms that will be implemented in the BUTLER project and examine in details how the user data will be handled in the project Proof of Concepts and Field Trials.

### 4.4.1. Technical computer and information security mechanisms in field trial

Security and Privacy remain important characteristics of the BUTLER’s architecture. They include the security of the source of data, the accuracy of the data (personal identity, billing information), and the security of data exchange over the network (encryption keys and Smart Server’s security). The implementation of privacy requirements may rely on security properties such as confidentiality, integrity, authentication and authorization. Confidentiality ensures that only the destination node can understand the message. Integrity ensures that the received message is the same transmitted by the source without modification during the transport phase. Authenticity certifies that the received message was really sent by the correct sender. An authority can verify that a node has the authorization to do some operations within the network. In fact, authorization specifies the access rights to resources. Availability ensures that the network continuously operates as expected. Non-repudiation avoids that a node maliciously declares that it did not receive a message.

Information security mechanisms will be included in BUTLER’s field trials. There is a need to restrict the access to any information available within the BUTLER system that intrinsically collects discrete data about users. The users’ profile must be securely stored and transferred, and any access to it by an application must be monitored and controlled. Thus it is important to authenticate, authorize and account users for accessing data sensed by smart objects. Privacy needs to be also taken into account as users may not disclose their personal information stored in their profile. Authentication consists of assuring the authenticity of each interlocutor involved in the communication process. Users’ authentication can be based on Login/password or PIN, software-based such as Facebook login, Fingerprint, SMS on users’ phone, One Time Password or Smart Card.

Once nodes authenticated and supplied their own secure communication channel, they can exchange confidential messages. Communications also need to be secured in order to avoid any wrong usage of data collected by the system. Cryptographic techniques are used to encrypt messages and ensure confidentiality (for example, based on TLS, etc.). Smart objects can take advantage of specific security feature included inside the communication standard they use (802.15.4, 6LoWPAN, ZigBee, COAP, ISA100.11a). Messages may also be signed in order to prove the senders’ identity.
Smart mobiles may enable users’ authentication and authorization. Users must be aware and consent that their private data can be partially used by the BUTLER’s system for operational reasons. They should have a total control on their profiles and what information can be accessed by the BUTLER’s system and disclosed to a defined application. Users may grant the needed right for an application to retrieve a restricted view of their global information. Profiles must be protected in specific repositories stored on secured smart servers. The users’ context may also be included inside their profiles. Thus security and privacy issues can appear as applications can store users’ private data.

A smart object gateway may be needed in order to ensure interoperability between smart objects and a smart server. In fact it is possible that smart objects cannot directly communicate with a smart server but through a smart gateway. The smart gateway can also administrate the sensor network and provide, for instance, a key management scheme to secure communications within the wireless sensor network.

4.4.2. Data policy within field trials

In preparing the pilot operations in proof of concepts and field trials, we will seek to guarantee the comfort and safety of participants and/or professionals who take part in them, as well as the security of their personal data (on preferences, profile and localization), acquired during the pilot evaluations.

This means in detail that:

- All the test subjects will have the ability to give informed written consent to participate (a sample consent form is shown in Annex D.1).
- All the subjects will be strictly volunteers and are able to withdraw from the trials at any time without any restraints.
- All personal data collected during the Pilots on the subjects’ preferences and habits will be strictly confidential.

In addition, all test volunteers, following detailed oral information, will receive:

- A commonly understandable written description of the project, the project objectives, and the planned project progress.
- The awareness list describing the procedures set forth by the project to guarantee their privacy in the course of the field trial. (Annex C.1)
- Access to a complaints procedure. (Annex D.2)

Thus, the consortium shall implement the project in full respect of the legal and ethical national requirements and code of practice. Whenever authorizations have to be obtained from national bodies, those authorizations shall be considered as documents relevant to the project. Copies of all relevant authorizations will be submitted to the Commission prior to commencement of the relevant part of the project and will include in project periodic reports. Finally, Annex X.X presents the individual situation for each partner regarding the data protection issue.
5. Initial Proofs of Concepts (year 1)

5.1. Objective and presentation of Proofs of Concepts

In the first year the focus of the BUTLER project mainly lay on the gathering of the requirements in form of use cases and user stories by the experts and users of the different vertical domains. Further, the assets of the different partners were collected, the existing technologies evaluated and the first design concepts for the BUTLER platform created.

In terms of demonstration and presentation it was the aim to find a set of vertical user stories that could be implemented in order to show meaningful IoT applications in the SmartHome, SmartCity, SmartTraffic, SmartShopping and SmartHealth domains. It was also the clear goal to involve more than one partner already in the design and implementation of the so-called proof of concepts of the first year, which were shown at the review in Regensdorf. On the one hand the consortium wanted to show and prove that the partners could work together in order to create first demonstrators based on very (yet) heterogeneous IoT technologies. In a joint effort the BUTLER partners were able to integrate their assets into a homogenous – actually already horizontal – storyline showing a day in the life of Donald and his wife Daisy.

The intention behind this procedure was to first show vertically separated applications in the context of a horizontal story. However, as the vertical domains where connected through the storyline but not yet over an IoT network, many of the strengths of the BUTLER platform still lay in the dark.

The following metrics were applied for the proof of concepts regarding their aim to demonstrate the team work in the consortium and the presentation of relevant vertical applications:

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value (Goal)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td># PoCs</td>
<td>&gt;5</td>
<td>The number of PoCs BUTLER wants to implement and show at the 1st project review</td>
</tr>
<tr>
<td># Vertical Domains</td>
<td>5</td>
<td>The number of vertical domains involved in all PoCs. The consortium wanted to have one PoC for every vertical domain described in the proposal</td>
</tr>
<tr>
<td># User Stories per PoC</td>
<td>5</td>
<td>Each PoC representing a vertical domain shall implement a number of user stories which have been defined for that domain in the requirements of BUTLER</td>
</tr>
<tr>
<td># Participating partners per PoC</td>
<td>&gt;2</td>
<td>Each PoC must at least be supported and developed by two or more partners of the consortium</td>
</tr>
<tr>
<td># Assets/Solutions per PoC</td>
<td>&gt;2</td>
<td>Each PoC shall at least integrate two heterogeneous assets or different solutions to prove that integration in vertical domains can already be achieved</td>
</tr>
<tr>
<td># Communication technologies per PoC</td>
<td>&gt;3</td>
<td>Each PoC shall at least integrate three heterogeneous communication technologies to prove that integration in vertical domains can already be achieved</td>
</tr>
</tbody>
</table>

Table 7 - Vertical PoC Metrics

The goal of the horizontal proof of concepts of the second year is to develop the first components of the BUTLER platform infrastructure and use them to glue these first year proof of concept applications together. The new services allow the horizontal applications to share context and user information coming from the BUTLER servers in order to increase the real user value in a horizontal scenario thus implementing the first presentation of BUTLER SmartLife.
5.2. Smart Home - monitoring and controlling home appliances

5.2.1. Brief description
The SmartHome PoC integrates solutions and platforms of the four consortium members which form the SmartHome Cluster group (iHomeLab, Swisscom, ST Micro, Ericsson). The idea is to bring together contributions of all partners to prove interoperability among the solutions. They are integrated into one scenario presenting a selected set of user stories out of the requirements catalogue worked out in WP1. The presented user stories are mainly related to energy management and security and show how IoT may support the user (Donald in our case) providing true user value through context awareness and ease of use while hiding the heterogeneity of the underlying infrastructure.

5.2.2. Context of the Proof of Concept

5.2.2.1. Storyline

The PoC tells a few scenes out of the life of Donald. It is an excerpt from the motivating story line that has been described in the first BUTLER deliverable (Chapter 5.1.1 in D1.1). This is the storyline:

Donald lives together with his wife and the two children in his own one-family house in a suburb of a bigger city. While he enjoys living and working near the city, he loves to spend his holidays in the mountains. That was the reason why he bought a chalet in a famous skiing resort two years ago. The family is just about to go there for a skiing week...

Donald is at home watching TV when a notification pop-up on the screen notifies him that the laundry has been done and for tomorrow, when they drive to the mountains, he will need to take the snow chains with him. He uses his tablet to check on the chalet and recognises that the inside temperature is only 10°C. Is the heating broken? BUTLER should have started heating the chalet up.

He turns on the heating manually over his tablet and a second later the system comes up with another notification: The alternative wind energy he chooses for the operation of the electric heating system is very expensive at the moment as there is not much wind to drive the wind farms during the next 5 hours. So that was the reason why BUTLER hasn’t yet turned on the heating. However, the system predicts low energy prices for the night and still enough time to heat up the chalet to 20°C by tomorrow morning. It also gives Donald the opportunity to switch the energy source and/or turn on the heating anyway. No, that is not necessary. Finally, BUTLER reminds Donald again that his old electric heating system is very inefficient and a nasty waste of energy. It context-sensitively calculates what he could save by replacing it.

During the night, the heating turns on and the energy display shows that.
When leaving the home for their holidays, Donald tells the house to switch to the holiday mode over his tablet. The energy screen shows how the energy consumption immediately decreases.

On Monday morning, Donald’s tablet suddenly buzzes. Someone stands at the door of his home back in the city. Donald uses the app on the tablet to look who this could be. The front door is lit (BUTLER turned on the lights) and the postman stands there. Donald shortly opens the door and lets him enter the home with the packet. A minute later, he sees the postman leaving the house and BUTLER notifies him that the door has been locked again.

5.2.2.2. Enabling technologies
The final PoC will involve BUTLER enabling technologies (security, location, behaviour modelling and synthesis) in discussed in the tasks of WP2. These technologies are not yet ready to be integrated by the time this deliverable is due (M12), but the PoC is designed in order to incorporate these technologies in a later stage of the project bringing new services and extended functionalities. However, IoT and Smart Home related enabling technologies are already working together in the current first Smart Home PoC:
- Secure, low power WSN technologies based on IEEE802.15.4/6LoPAN and ZigBee
- OSGi Middleware servers
- RESTful Web-services based cloud interfaces
- Rich client user interfaces based on Flash / HTML5

5.2.3. Technical description of the Proof of Concept

![Figure 18- PoC system overview](image)

The solutions of Ericsson Spain, ST Microelectronics and IHL are connected to the cloud publishing their data and control API to the IHL control and visualisation server. This server accesses the gateways and web
services in order to fetch data coming from the attached sensors as well as from the prediction algorithms (green lines). It processes the data and finally generates the information to be visualised and sent to the TV as well as the tablet (red lines). Interaction with the user happens over the tablet.

Although all platforms come with their own visualisation and input variants, this “central” approach over the IHL server and its connected IHL Flash Clients running on different target hardware was chosen in order to provide the PoC with a homogenous user interface (red lines). The data interfaces to get to the data and switch the loads still needs to be defined between the PoC cluster members (green connections).

For more details on the communication flow and functionalities of the different components, see deliverable D3.1, chapter 5.2.4.

5.3. Smart Home – multimedia everywhere

5.3.1. Brief description
This demonstrator consists of a typical multiroom audio/video environment, consisting in at least two rooms, each of them being equipped with a followme-capable multimedia player, a TV set, and presence of location sensors. The presence of the user in one room is detected, and as soon as he leaves the room, the system put the playing video in pause, power off the TV set in this room, power on the TV set in the other room, and waits for the user to enter the second room to resume the playing video.

This PoC is based on the user story SmartHome_User_Story_14, namely “Video follow me at home”:

- As a home user, Alice would like to instruct the home automation system to power on and off multimedia devices so that she can move from one room to another without missing a single second of the TV show she is watching.

A list of enabling technologies and a table of the involved partners and their role can be found in D3.1 (chapter 5.3.1).

5.3.2. Technical description of the Proof of Concept
For this PoC, two families of common products are combined: environmental sensors and brown goods. The latter must co-operate with each other for this case. Localization is done using environmental sensors and, alternatively, other relevant data source which can be collected.

Due to the high number of physical devices used, a distributed architecture has been selected. In this OSGi based distributed architecture, each device can embed enablers, such as:

- WSN stacks and abstraction layer
- Localization algorithm
- Media renderer capabilities
- Media server capabilities

An instance of this PoC is described in Figure 197, with a media server and two media renderers, each augmented with sensing capabilities.
The technical architecture is distributed to dissociate software and hardware components. Use of an OSGi framework for software integration enables dynamicity, and further integration of BUTLER’s technology enablers.

Localization in this PoC is based on various ambient sensors, such as sampled in Figure 198.

### 5.3.3. Test and analysis

This PoC has been deployed and tested in two environments. A first one targeted providing a realistic environment for integration. This deployment takes place in CEA/Leti office, in which three
rooms have been equipped with numerous heterogeneous sensors and multimedia capabilities. Another instance of PoC has been designed with fewer devices, in order to be portable for demonstrations. It uses two media renderers and a limited set of sensors, which provides the most relevant presence information.

For this PoC, tests are organized given the following flow:

<table>
<thead>
<tr>
<th>Context</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>An occupied space with a enabled renderer, playing a media</td>
<td>The space occupied must be detected by the system, and other spaces must be seen as unoccupied. All renderers in unoccupied spaces must not render anything.</td>
</tr>
<tr>
<td>The user leaves the space</td>
<td>The location system must detect the new occupancy state as unoccupied. The coordinator must pause the renderer, and store current media ID, position, volume and preferences, if any (language, subtitles, etc.)</td>
</tr>
<tr>
<td>The user enter a new space</td>
<td>The location system should detect the new occupancy for the new space, as occupied. The coordinator must play previously stored media, and apply all stored data.</td>
</tr>
<tr>
<td>Another user arrives</td>
<td>The location system should update with two occupied spaces. The previous renderer must not be affected by this new localization state.</td>
</tr>
</tbody>
</table>

**Table 8 - The test flow for PoC**

This PoC includes many challenges, which couldn't be addressed for M12. Thus, tracks are being prospected in order to improve accuracy, performance and portability of this PoC, with more partners within the consortium (details can be found in D3.1).

5.4. Smart Health – personalized diabetes self-healthcare

5.4.1. Brief description

This Proof of Concept (PoC) allows a patient diagnosed with diabetes to manage its health condition by means of a context-aware diabetes diary running on a handheld or smartphone. The added value of this proof of concept is the personalized recommendations based on the typical context of the user.

5.4.2. Context of the Proof of Concept

Key features of this PoC are the seamless integration between the mobile phone and glucose meters, and contextual augmentation of the diary: while the mobile phone can provide contextual information about the location, eating habits and activities of the user, the gluco-meter provides all relevant blood glucose values. The PoC will aggregate this knowledge, and exploit it to find similar health patterns in the past to find good suggestions for the current situation. The user can then decide to either accept or ignore the suggestions of the application.

The POC relates to use case “SmartHealth_UC_6: Providing advice and assistance to improve personalized diabetes self-healthcare”, and to user story “SmartHealthCare_UserStory_1: Personalized health recommendations”: 
1. The user measures his blood glucose levels with the glucose meter,
2. The glucose value as well as the calorific intake about the meal is synchronized with his smartphone over Bluetooth
3. The smartphone acquires other relevant contextual information (including locations, past and planned activities, ...)
4. The application on the smartphone compares the current context and health values with prior entries
   The application finds the best match and presents this information as decision support to the user for his insulin dosage.

![Diagram of Smart Health PoC](image)

**Figure 21 - Smart Health PoC**

5.4.3. **Technical description of the Proof of Concept**

The Proof-of-Concept relies on the following components:

- **LifeScan’s OneTouch Ultra Easy**: glucose meter, supporting RS-232 communication through proprietary protocols.

 ![LifeScan’s OneTouch Ultra Easy](image)

**Figure 22 - Lifescan’s OneTouch Ultra Easy**

- **PolyMap Wireless**: Provide Bluetooth communication capabilities to glucometer.

 ![PolyMap wireless module](image)

**Figure 23 - PolyMap wireless module**

- **Fitbit**: Commercial component for activity recognition, using a 3-axis accelerometer. It tracks activities and steps, computes calories burned and floors climbed. It uses the ANT WSN...
protocol to communicate with a base station connected to laptop to upload that to the Fitbit portal.

![Figure 24 - Fitbit device](image)

- **Android smartphone**: This device runs the mobile diabetes application, collects context and recognizes activities through its built-in accelerometer

### 5.4.4. Test and analysis

The technical test plan mainly consists of verifying the Bluetooth connectivity between the smartphone and the glucometer, as well its indirect connection with the Fitbit device through the laptop. The laptop requires network connectivity to the Fitbit portal to upload all relevant activity information. The smartphone synchronizes with this portal to collect the latest activity intensity.

In further iterations, more contextual knowledge will be incorporated with input envisioned from iHomeLab to provide more fine-grained activity recognition in the home environment. For back-end analysis, a cloud-like infrastructure as a service may be leveraged to ensure scalability.

### 5.5. Smart City - Smart parking space management

#### 5.5.1. Brief description

The SmartParking PoC allows citizens to interact with the parking spaces in a smarter way by using a regular smartphone and/or a NFC card. In this ways, citizens can make a reservation for a parking space and pay for it via a NFC payment. Along with some context-aware dynamic parking allocation techniques, these functionalities are being developed for the first period release (September 2012).

What this PoC demonstrates:
- A parking space can be booked remotely by an authorized user (*disposal of a virtual permit*).
- A limited parking space can be wirelessly requested, paid and extended.
- A set of parking spaces can be monitored remotely by the local authorities to control illegal parking.
- A set of parking spaces can be commanded to change their state of availability in response to city requirements using context-aware information.

#### 5.5.2. Technical description of the Proof of Concept

The SmarTObject connects with a self-designed lighting system to signalize the state of availability of each parking space. This lighting system consists in a set of low power LED bulbs. On the user side, a SmartMobile provided with NFC and 3G/4G connectivity is required to interact both with the above platform and with an application server. This SmartServer can be a computer with internet connectivity providing a web-service to manage the entire SmartParking system.

In order to show this working demo, an experimental video of the prototype was recorded in TST’s lab facilities the 23rd of July, 2012. A second video was recorded in the city of Santander for the 3rd Plenary Meeting of BUTLER held the 11th of September, 2012. These videos are published in the BUTLER project’s website [http://www.iot-BUTLER.eu/news/tst-released-an-initial-proof-of-concept-on-the-smart-city-use-case] and in TST’s website [http://www.tst-sistemas.es/en/rd/BUTLER].
TST develops modular wireless communications platforms designed to facilitate the development and implementation of M2M, monitoring and remote control applications in different markets.

For this first year’s PoC the SmartObject device will be implemented using a TSmoTe platform. The TSmoTe is an embedded system designed to enable fast and simple development of wireless monitoring applications, remote control and M2M solutions. It includes multiple interfaces to connect sensors and actuators to it.

The API provided by TST offers a hardware abstraction layer for the TSmarT platform, enabling a high-level programming of the expansion modules with no need to learn their native commands and programming languages.

5.5.3. Test and analysis

The demonstrator is build up with 3 elements: SmartObject, SmartServer and SmartMobile. A SmartObject interconnects with a SmartServer to monitor and signal the availability of a set of parking spaces, a SmartServer controls overall parking management system and a SmartMobile implements the interface between the user and the system.

The in-site demonstrator is deployed in a street of the city of Santander where some vehicle detectors are installed in each parking space. The TSmarT platform is placed in a post lamp near those parking spaces and an individual light indicator is situated in each parking space ensuring good visibility. The application server is running a Java application whose main task is to maintain an up-to-date database of the characteristics of each parking space (state of occupancy, by whom it is being used, for how long will be occupied, etc.). On the one hand, the application server has to connect with the SmartSantander service access point to collect information regarding the state of availability of each parking space. On the other hand, it has to provide an
interface to the users of the system to show the functionalities of the application, which can be done using a computer and a personal smartphone.

The space needed for the PoC will be approximately 3 parking spaces plus the pavement space corresponding to those parking spaces, thus, about 50 square meters. As it has been explained before, the PoC is composed primarily by the TSmTe platform from TST. As the duration of this PoC could last around 2 hours, a battery will be enough to supply power to the TSmTe platform. If case that the duration of the PoC increases, an additional power source such as a power socket shall be used. The location in which the PoC demonstration will take place shall provide mobile connectivity (2G/3G/4G). As the PoC is using the SmartSantander architecture, at least 2 or 3 parking spaces with SmartSantander’s vehicle detection devices must be present. This PoC relays on the SmartSantander’s service provider architecture in order to satisfy the requirement of acquiring the state of availability of a certain parking space in real-time.

5.5.4. Other technical characteristics

The embedded platform of the PoC is programmed using standard ANSI C language, while the application running in the server and the one running in the smartphone is made in Java. The Operating System used is FreeRTOS, a popular real time OS for embedded devices, with specific implementation for ARM Cortex-M3 family chips. In order to reduce its footprint as much as possible, it is based on standard ANSI C, enabling the creation of understandable code (something difficult in other reduced low footprint OS such as TinyOS or Contiki).

The interface between the embedded platform and the application server is done via GPRS communication. The embedded platform also controls the lighting system using a RS485 interface.

It is important to point out that all the toolchain of this development can be performed with free software tools. It is possible to do so by using Eclipse as development platform and GCC (Codesourcery edition) as compiler. That implies no extra costs required when developing applications based on this hardware platform.

For more technical characteristics and references see D3.1.

5.6. Smart Shopping – context-aware sparkdeals (product discounts)

5.6.1. Brief description

This Proof of Concept (PoC) allows merchants (store and restaurant managers) to create mobile ads which contain a discount of a certain product (= Sparkdeals). The ad contains navigation instructions for the consumer to find the merchant’s premises. When a consumer enters the store and purchases the advertised product by using a credit card, the consumer will get an automatic discount. The added value of this proof of concept is the closed redemption loop service where the merchant pays only on the successful advertising thus eliminating the mass marketing uncertainties.

5.6.2. Context of the Proof of Concept

The PoC integrates the location based delivery of mobile ads, navigation instructions for consumers to enter the store premises and the confirmed purchase which leads to the discount given to the consumer user. It relates to use cases “SmartShopping_UC_1: Create a new Sparkdeal” and “SmartShopping_UC_2: Consume a Sparkdeal”. It is relevant for the BUTLER project as it demonstrates and proves the mobile user experience flow from the advertisement discovery to the actual purchase action so that the merchant can be invoiced for the service based on successful advertisement events.

The use cases involve first the merchant creating the Sparkdeal with a web-based storefront-tool and then publishing the Sparkdeal. Published Sparkdeals are discovered by the consumer users, those interested can navigate to the store and redeem the offered deal.
5.6.3. Technical description of the Proof of Concept

The Proof-of-Concept relies on the following components:

- Sparkdeal web service for creating, delivering and consuming the Sparkdeals.
- Smartphone having GPS positioning and Internet connectivity
- Payment terminal that is connected to the payment service operator First Data (currently active only in North America, ongoing work to enable same/similar service in Europe; if no access to the First Data system, the payment action can be emulated with a web UI)
- Optional: Gemalto’s eGo Bubble technology (see detailed description in this document)
- Optional: Ericsson’s stream analyzer and notification delivery system

5.6.4. Test and analysis

The technical test plan mainly consists of verifying the following steps:

1. Sparkdeal discovery by the end user either through the 3rd party publication or from the Sparkdeal mobile web site with location based filtering
2. Sparkdeal navigation instructions based on the user’s geolocation
3. Consumer redeeming the offer, making the payment and receiving the discount

The PoC is prepared so that it can be executed as a field trial with a number of real-life consumer users. The analysis part is concentrated on receiving user experience and usability feedback on the service flow.

The next phases will include the multi-user scenario for activating the Sparkdeal when a certain number of users have checked in to the store, ad targeting logic and adding more volume to the test user mass.

5.7. Smart Transport – safe transportation of school kids

5.7.1. Brief description

The selected Smart Transport service is planned to offer aid to school-buses and transportation of kids with public transportation. A tag with identification number, as form of key-chain necklace, is provided to all the kids that are allowed to get on/off the bus or other public transportation. The accompanying person (e.g. teacher) knows how many children are supposed to be in/out when the
bus/tram/train is ready to close the doors and intends to leave. A very accurate indoor localization system is therefore able to localize exactly all the tags inside/outside the bus (all members of the group need to be in or out respectively) and it allows for the doors to be closed only when all the kids are safety in or out with some minimum distance from the doors.

5.7.2. Context of the Proof of Concept

5.7.2.1. Storyline
The PoC is demonstrated as a portable version, where it will show that a door of a public transportation vehicle (model size) will only be closed if all members of a group are in or out of the public transportation vehicle (modelled as a room). An example to illustrate the PoC: as a teacher or childcare person, Maria would like to make sure the bus or the tram is not leaving a station before all members of her children group are on/off board the vehicle.

5.7.2.2. Enabling technologies
The PoC uses so-called “dongles” and positioning devices: A dongle is a small piece of hardware that plugs into an electrical connector on a computer. The used ZIGPOS dongle (see image below) acts as an interface for iPhone to communicate with ZigBee network. The dongles can be plugged into mobile iOS devices and form a management part of the positioning system. Positioning devices are tags and anchor nodes. Anchor nodes are assumed to be mounted inside the public transportation vehicle and form an integral part of that vehicle. Tags are carried by the group members and the caretaker (e.g. teacher). The technology applied for ranging and positioning is a proprietary radio technology from ZIGPOS operating in the 2.4 GHz ISM bands, the same bands where the devices also communicate via an IEEE 802.15.4 based radio stack.

![Figure 29 -- Zigpos Tag](image)

![Figure 30 - Zigpos Anchor Node](image)

We consider the simultaneous localization of multiple sources from distance and angle information. An extension of the multidimensional scaling (MDS) technique is given, which allows for both distance and angle information to be processed algebraically (without iteration) and simultaneously. Details can be found in D3.1.
5.7.3. Technical description of the Proof of Concept
The demonstrator is based on a Java-application where the virtual room must be described. The radio modules are capable of finding their role inside the network. Only the master module (e.g. the teacher in a child-class) should declare an own state. The PoC can be started via a graphical user interface and can be setup via xml-files and images (background-images of the demonstrating room, size, height etc. can be defined via XML or in the GUI in real-time).

The hardware is composed by different peripherals integrated in ZIGPOS modules (i.e. ZP2.4rnCD):
- Accelerometer (3 axis), used to save power: decides if object is moving or standing still and powers the other components only if necessary
- Battery, radio nodes will be battery powered in order to demonstrate a small form factor, portable and energy efficient way to locate via short range radio
- Gateway / server station, to harvest all information and visualize actual state of swarm modules, coupled with a virtual bus-door that shows the actual state of closing or opening bus door depending on the positions of each node

5.7.4. Test and analysis
For the initial PoC the tests are planned to be performed in three major steps: i) basic interfaces, ii) adjacent subsystem coupling and iii) full integration.

If the basic structure works within the expected accuracy and time frame the analysis in some example model rooms as well as a real public transportation means can be processed resulting in an extensive data set for post-processing.

5.8. Lessons learned
Based on PoCs setup, deployment and operation reports at the first project review in Regensdorf the BUTLER consortium partners could gain insights in several aspects of PoC execution process. This section aims to present the lessons learned. We describe our gathered experiences in a subsections devoted to every deployed PoC.

5.8.1. SmartHome

5.8.1.1. Energy Awareness
Within the energy awareness proof-of-concept in smart home cluster consortium partners have tested how to inform people about the energy consumption of different applications like lighting, heating, consumable electronics devices, etc. The meaning is to inform people in an easily understandable way so that they are more aware of the energy consumption of a specific device at a given time and are motivated by themselves to save some energy. Another aim of this proof-of-concept is the interoperability for M2M communication between different providers of services. For example the front-end visualization application communicates with an application from Ericsson at another location in Spain. Visualization front-end queries prediction of energy prices for the near future. That makes it possible for visualization application to calculate the optimal time to switch on/off devices at the moments of cheap energy prices and alternate energy sources.

Main lessons learned about the visualization front end:
The results of resource measurements should not be visualized directly with the physical unit. It should be shown in a simple and easy for understanding way. It also doesn’t make sense to show each single measurement. It should instead show the information the user could be interested in most at the moment (context awareness). Moreover, the system should show tips for saving energy as far as possible. These tips should not be general tips like they appear for example at a program start; they should be individually personalized for current user and his specific environment and
they also only should appear if the information really is relevant at this specific time. Additionally the information should be sorted by their relevance. So the user finds the information it’s most important directly at his first look on the screen. It’s also important not only to show the total energy consumption but also the detailed information like which device creates the main part of energy bill or how high is the consumption of new TV set or the information with recommendations if it’s worth to replace a device.

Main lessons learned about the motivation of users:
The tips mentioned before also could be used to motivate the user. It can show for example that a specific device needs more energy than a similar reference device with modern standards. It also could contain some information about return of investment time if the user replaces this particular device today. Another motivation could be statistical information comparing the energy consumption of the past days or with neighbors. The system can for example reward the user if he behaves better. The user can be motivated and interested more as well if he can use a well-known device for displaying additional information about the system and its energy consumption. For this purpose the Proof-of-Concept has been extended with Android Smartphone application, developed by Telecom Italia. Using the smart phone camera to identify an electrical device and after to visualize the information about that specific energy consumer on smartphone screen means easy to handle way for the user that can motivate to use this functionality more often.

However, the most intelligent system is never perfect and can’t predict the exact behavior and interests of the user. So it’s important always to give the user the opportunity to over control the system. The user wants to remain the boss so it should be possible at any time to switch a device on or off even if it’s a very bad time according to energy cost or if it doesn’t make sense for the system.

Main lessons learned about technological research and development:
Ones more this proof-of-concept showed the importance to not only specify a concrete communication interfaces, but also the need to be tested as early as possible. For these tests the real components should be used, although they are still in a development state. This applies for software and for hardware components.

From the aspect of software architecture the GUI is strictly split from business logic. The business logic has a one way communication to the GUI over a TCP socket to stick to this concept. Unfortunately, the visualization front-end of proof-of-concept is based on Flash technology so far. Flash is demanding a lot of CPU power; almost too much for a current smart device and Flash is also not a further developed technology. It is planned to switch to HTML5 based BUTLER SmartMobile application platform in the next iterations of this proof-of-concept and following field trial.

5.8.1.2. Multimedia
The Multimedia proof of concepts aimed to explore possible applications based on connected devices within a smart environment. Indeed, two proof of concepts have been made: “follow-me”, which renders a multimedia stream given the user location, and “pick me”, a similar application based on portable devices. In the “follow-me” PoC, a localization system, localize the user within a zone, in which a media renderer is present. This localization system is based on two kind of sensor: a movement detector and sonar. While the movement detectors ensure the detection of an arrival or departure in the given zone, the sonar sensors ensure the detection of the user while he is not moving, to enforce the confidence of the algorithm that this user is still in the detected zone. Upon a localization change event, the multimedia content is switched from the previous zone to the new zone in which the user is localized, keeping settings such as volume and position of the media. The “pick-me” proof of concept replaces the localization part of the previous PoC with a pointing system, based on NFC. While pointing a media renderer with a device, identified with an NFC tag, the user
can pick the current media and its parameters within the portable device, if supported. It can then push back the media pointing another renderer.

**Main lessons on the technical infrastructure**

Both of these proofs of concepts included many connected devices, which prove to be technically heterogeneous. A first challenge was to ensure interoperability amongst these devices in order to build the proper application. This interoperability resides in the sensor network used for the user localization, and the multimedia devices. Two wireless sensors network have been used in order to localize the user: ZigBee Pro and 6LoWPAN/COAP. End sensors included movement detectors and sonars, and were used in this scope to evaluate the potential presence of a user in front of the TV. A first level of interoperability was to ensure a protocol independent representation of these devices and their data, in order to be processed by other parties, in this case, a localization algorithm. Multimedia devices are also known to be hardly interoperable, at different levels: content (broadband streaming vs. persistent storage, encoding and format), devices (capacities, APIs exposure) and deployment (standalone devices or composed devices (TV + set top box)). In a similar way, they must be handled in order to coordinate the distributed content, which implies a proper abstraction.

**Main lessons about the user experience**

Using both the “follow-me” and “pick-me” applications in the position of a regular user, we discovered some tracks to enhance the pertinence of such applications. Concerning the follow-me scenario, many requirements haven’t been implemented, such as parental control. Indeed, most of these requirements are dependent of user identification in addition to user localization. Experience also showed that rendering parameters (language, subtitles, volume, etc) must be kept from one renderer to the other, which is rather complex to design concerning volume for example: the volume provided by an API is slightly different from the one perceived by a user (different speaker, transparent amplifier, etc). Finally, the current implementation doesn’t handle the event “user has left the room”, has we suppose that this event is similar to “user entered another room”.

In conclusion, these two PoC centered on multimedia applications has proven interesting challenges on both technical and user perspectives. The BUTLER final horizontal architecture brings solutions to these challenges, bringing us confidence to continue in this track.

**5.8.2. SmartHealth**

In this section, we will provide some lessons learned with respect to the technical feasibility and the integration of the technologies into the proof-of-concept. We tested our initial proof-of-concept by having the mobile application deployed on a variety of Android devices, with operating system versions ranging from version 2.3 up to version 4.0. While it was fairly straightforward to adapt the application to the different OS versions, we noticed subtle differences with respect to the sensors offered by the devices, and more specifically the accelerometer which we use for human activity recognition:

- The sampling rate of the accelerometer is different for many devices. The Android platform only standardizes on 4 different sampling rates (i.e. NORMAL, UI, FASTEST and GAME), but the sampling rates themselves have not been standardized. Furthermore, it is not straightforward to get the sampling rate at runtime by using predefined APIs. This means that the application first has to estimate the number of accelerometer updates per second, as well as calibrate the different accelerometer data filters and processing components.
- A second problem deals with acquiring accelerometer updates. Many devices stop producing updates when the screen of the device is turned off (either manually or through power
saving mode). This is not a bug within Android, but rather a design decision by the manufacturer of the device. This basically means when the device goes into sleep mode, that the phone screen will be turned off and as a result the application is no longer able to obtain accelerometer updates (even though the application itself remains running). The only workaround we were able to produce is to keep the screen always turned on by acquiring a partial wake lock from the power manager. This way, the display remains on and the accelerometer keeps on producing updates, but energy consumption increases quite significantly (due to the always-on display) and this severely limits the practical use of the healthcare application on certain devices.

From an integration perspective, the Fitbit device produces accurate values for step counting and calorific expenditure, but the integration of the sensor in the healthcare application is not straightforward nor practical. First of all, the Fitbit device we used for our experiments communicates with a gateway using a proprietary wireless protocol. The gateway (a desktop or laptop) must run certain Windows software to upload the data to a remote service hosted by the Fitbit company. The company offers libraries to access this remote data, but relies on OAuth to restrict access to the data. Rather than being able to communicate directly to the Fitbit sensor (e.g. through Bluetooth or ZigBee), the healthcare application can only indirectly access the data, and it is fairly unlikely that the Fitbit components can be easily integrated into the overall horizontal BUTLER architecture due to their proprietary software components.

From a user perspective, integrating other glucose meters was not possible because the Polymap Bluetooth extension was only compatible with the glucometer we offered. Furthermore, the Polymap extension was not really reliable nor user friendly. Uploading data can take up to half a minute without any visual indicators about the progress. Preliminary experiments with smartcard technology from Gemalto produced much better performance results with respect to synchronizing the data on the glucometer with the healthcare application on the mobile. Furthermore, compared to the Polymap extension, this device provides security building blocks which the other utility completely lacks.

5.8.3 SmartCity (Smart Parking)

The process for deploying the first version of the Smart Parking solution has been tough. The very first step consisted in the exploration of the services a city offers right now and which of them don’t. After that, a brainstorming with the topic A City in 2020 lead to discover which services could be improved to cover those areas that potential citizens may enjoy the more. For a more accurate history selection we run some researches focused on actual trends on citizen’s willing, going mainly through other European projects of the same matter. Finally, the parking topic aroused as one of the market niches in which the development of a context aware management system could be profitable for both users and city authorities. Once selected, functional and non-functional requirements where written so to make a first technological selection.
Having in mind the architecture of the demonstrator shown in \textit{Erreur ! Source du renvoi introuvable.}, we encountered some problems during the deployment of the elements in an on-site scenario, as for example the lighting power was not enough for the bulbs to be seeing during a sunny day. In addition, the GPRS connectivity required different SIM cards in different countries, so the application running in the SmartObject had to be configured accordingly. Similarly, the SmartServer had some specific issues regarding port forwarding and NAT addressing. In addition, the cooperation with an existing live test-bed produced an amount of legal issues which are close to what usually happens in real deployment scenarios compared with the experience TST has in this matter.

Some aspects concerning user experience showed that users prefer to be provided with an alternative to NFC payment methods just in case, as for example regular credit card or coins/notes. Furthermore, most of the users were worried about malfunction system usage by a malicious group of users. From our side these concerns are synonym of the unfamiliarity the users have with the system, probably because of the features introduced to enhance the parking management system are still too complex to be understood as safe. In this sense, during the following field trial tests we will make an extra effort when it comes to disseminate the system as a safe and secure platform.

In conclusion, the on-site installation of the PoC, the dissemination of the system features beyond the state of the art in several workshops and conferences, and the usage of this PoC by selected users, provided us with valuable information, really useful for getting a better understanding of the strong/weak points of the system. In a next iteration, i.e. when running field trials, this information will be extended and crosschecked with the previous collection of user feedback.
5.8.3. SmartShopping
Briefly reminding the developed SmartShopping PoC for the 1st year, the following platform for context-aware mobile ads with discounts has been deployed:

- 1st year PoC introduces the retailer tools for instantly creating Sparkdeal mobile ad campaigns.
- 1st year PoC introduces the Mobile User Experience flow for consumer user to navigate to store and to redeem an offer.

**Added value:** Merchant pays a fee only on the successful transaction. Consumers get personalized discounts to products and services of their preferences.

The biggest challenge was to find all the required technologies for universal solution that integrates with common payment terminals. For example, the notification event had to be replaced for now with an URL, which “Daisy” opens to discover the sparkdeal.

Unfortunately, main responsible partner (CasCard) of SmartShopping PoC of the 1st year had to leave BUTLER consortium making impossible for us to fully reproduce all the lessons learned from this PoC.

5.8.4. SmartTransport - The Glacier Express
The first trial with the glacier express was successful even though we had to go through the challenges. The field trail was conducted with the main objective to open the doors between the wagons automatically when an employee arrives. The radio module of Zigpos GmbH was installed on the Glacier Express trains as shown in Figure 33. The radio module senses the Electronic tags as shown in Figure 34 which is provided to the users whose position is then determined with in the specified distance like 2 to 3 meters. The radio module is connected to the circuitry that triggers the opening of the door as soon as it senses the authorised user. The position can be determined using different algorithms to optimize distances to doors. Therefore, it is useful to measure distances to more than just one door in order to enhance position accuracy. As the position is only in one dimension, the improvements of well-known position algorithms cannot be used inside trains, wherein you only have anchors in a single line. The multipath propagation scenario of the trains is properly considered to make our system more accurate and robust. Multipath effect causes a stationary user to be located as if it is randomly hopping or moving which degrades the accuracy. Using the proper filtering techniques like Kalman constant velocity (CV), the multipath problem is significantly reduced.

![Zigpos radio module in a Glacier Express](Figure 33)
After the successful installation of the system the users are allowed to experiment the system and the real feedback is collected from them formally and also informally. Rarely, the users recognize a delay before the door gets opened automatically. The delay is not that noticeable for the time being since it is relatively faster than pushing a button to open it, however the system can be improved to have complete non-perceptible delay. Some users, they simply put the electronic kit in their back pocket which leads to the false interpretation of the device performance. The users don’t know the technical details of the device and hence may lead to incorrect use and then eventually misinterpretation of the system effectiveness. We might need to consider on the number of ways the lay people would mishandle the device. Moreover, during the trial the train was so crowded that it disturbed the train personnel to experiment the system. The trial could be planned during the time when only few people would likely to use the train. In addition, some train personnel preferred to possibly embed the kit in existing transponders they are already using. Also some would love to use their smart phone as the replacement of the tag.

In a nut shell, we had successfully completed the first iteration of the field trials in spite of few hindrances. The user’s feedback analysis provided us with valuable information which indeed are the guidelines for us to get a better picture of the affirmative aspects of the system as well as to understand the short comings of the system. During the next iteration of the field trial these information will be considered and substantiated to make our system more robust and much accurate.
6. Vertical Field Trials (year 2)

6.1. Objectives and metrics of success

Considering real deployments resulting in user- and business relevant applications of IoT technologies, the BUTLER project understands the need of setting added-value-driven and solution-oriented objectives as well as adequate metrics for progress monitoring and success measurement within PoCs and field trials. In this regard a very promising approach for modelling the adoption process of consumer wireless initiatives has been recently presented by S. Roebuck and S. A. Snyder in [10]. According to this approach the IoT application adoptions are often less a challenge of technical implementation and are more a question of identifying / validating use cases that drive real business benefits. Having this in mind, the proposed score framework recognizes four key driving factors for the adoption of IoT solutions:

1. **Strategic purpose:** the offered solution has to be a part of the general strategy followed by the company implementing it.

2. **Solution integration:** the entire value chain of interconnected solutions has to be able to benefit from the existing frameworks, technologies and services.

3. **Consumer value proposition:** only appropriate quantitative and / or qualitative rewards motivate the end-users to be a part of a solution ecosystem in a long-term.

4. **User experience:** minimal intrusion and seamless integration into existing processes of end-users are success factors for adoption.

We would like to briefly list all the parts of the driving factors here. The full explanation can be found in [10]. Strategic purpose factors include customer retention, revenue generating, new channels and brand enhancement. Solution integration factors include ease of integration, internal device capabilities, connectivity standards (wired/wireless) and data analytics. Consumer value proposition factors include convenience, fiscal incentive, personalization and effective results. Finally, user experience factors include engagement, simplicity, security/privacy and reliability.

Inspired by this approach but realizing the differences between business product adoption and experimental field trial execution in a research project, the BUTLER consortium has extended the above list. A list of possible validation targets has been defined in regard to the BUTLER specific objectives (Table 9 - Vertical Field Trial objectives or validation targets).

<table>
<thead>
<tr>
<th>Validation target</th>
<th>Values</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical feasibility</td>
<td>Feasible now</td>
<td>Field Trial aims to validate if the proposed IoT solution, service or application can be technically implemented using a state-of-the-art technology set today or within the next years to come</td>
</tr>
<tr>
<td></td>
<td>Feasible in less than 3 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feasible in more than 3 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not feasible until 2020</td>
<td></td>
</tr>
<tr>
<td>Deployment efforts</td>
<td>Low – Remote automatic</td>
<td>Field Trial aims to validate if the proposed IoT solution, service or application can be easily deployed</td>
</tr>
<tr>
<td></td>
<td>Feasible – Remote semiautomatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Considerable – Onsite semiautomatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High – Onsite manual</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>Low – Remote automatic</td>
<td>Field Trial aims to validate if the proposed IoT solution, service or application can be easily deployed</td>
</tr>
</tbody>
</table>

These objectives, validation targets and metrics have formed the base for BUTLER field trial templates used to describe all the projects’ field trials.
efforts | Feasible – Remote semiautomatic  
Considerable – Onsite semiautomatic  
High – Onsite manual  
application can be easily maintained
---|---
Scalability | > 1’000’000 connected nodes  
100’000 – 1’000’000 connected nodes  
10’000 – 100’000 connected nodes  
1’000 – 10’000 connected nodes  
< 1’000 connected nodes  
Field Trial aims to validate if the proposed IoT solution, service or application can be scaled to a large amount of nodes
---|---
User experience / comfort / perception | User-friendly, simple, secure, reliable, privacy-driven  
User-affine - Any three properties  
Limited - Any two properties  
Very limited - Any property  
Field Trial aims to validate if the proposed IoT solution, service or application attracts with a well-designed user experience
---|---
User acceptance | High – Daily usage  
Considerable – Weekly usage  
Borderline – Monthly usage  
Low – Less than monthly usage  
Field Trial aims to validate if the proposed IoT solution, service or application is widely accepted
---|---

<table>
<thead>
<tr>
<th>Metric</th>
<th>Values</th>
<th>Relation to target</th>
</tr>
</thead>
</table>
| Technical performance | Timing processing delays  
Average time between technical problems  
System stability over daily, weekly, monthly, annual periods  
... | Delivers measurements for all validation targets |
| Trial duration | Longer than 12 months  
6 – 12 months  
3 - 6 months  
1 - 3 months  
Shorter than 1 month | Delivers measurements for maintenance and user acceptance targets |
| Dissemination impact | High – at least 75% would recommend to others  
Considerable – at least 50% would recommend to others  
Borderline – at least 25% would recommend to others  
Low – less than 25% would recommend to others | Delivers measurements for user perception and user acceptance targets |
| Types of end-users | Categories According to section 4.3.2 of this document:  
Public visitors of portable BUTLER demonstrations  
Visitors of fixed public sites of BUTLER  
Participators of BUTLER online / offline questionnaires and interviews  
Beta-testers firstly using prototypes of BUTLER components  
Early adopters of BUTLER-related products | Delivers measurements for user perception and user acceptance targets |

In order to adequately measure the progress towards the objectives defined above, the BUTLER consortium has further come up with the following trial metrics.
| Number of involved users | >1’000 users  
500 – 1’000 users  
100 – 500 users  
10 - 100 users  
< 10 users | Delivers measurements for all validation targets |
|-------------------------|-------------------------------------------------|
| User Satisfaction       | High – at least 75% positive feedbacks  
Considerable – at least 50% positive feedbacks  
Borderline – at least 25% positive feedbacks  
Low – less than 25% positive feedbacks | Delivers measurements for user perception and user acceptance targets |

Table 10 - Vertical Field Trial Metrics

6.2. Common technical infrastructure (GTO)

The second year field trial initial deployments are mainly made on separated technical platforms. As the project progresses toward a unified, horizontal BUTLER technological platform, the field trial will more and more make use of this platform and of common technical infrastructure. One of the main common infrastructures to be rapidly deployed is the Authorization Server provided by Gemalto. This server will register the metadata of the resources of the system. The Authorization Server is one component to support the Security Framework described in deliverable D2.4 / 6.2 Security Framework. The high-level framework is summarized in the figure below.

![Security Roles - High Level Interactions](image)

Figure 35 - Security Roles - High Level Interactions

Authorization Server.

Gemalto will provide an Authorization Server (AS) which will be available on the Internet. It will be open for all BULTER Trials users and applications relying on authorization paradigm. The server encompasses Metadata Resource Database and User Database. For the AS, the user is identified with a user-name. The implementation authentication is based on username-password. The server does not implement the User Profile database and does not register any User context. We shall federate the User Profile database server and the Authorization User Database. The server will implement OAuth 2.0 protocol and the access-token generation protocol defined in D2.4 / Security Framework.
What will be learned from the trials?
The main lessons will be the acceptance of the user experience that obliges the user to authenticate to the server to retrieve access-token allowing him/her accessing a resource.
The lesson will be also the lessons according the implementation of the access-token verification at resource-provider which could be also difficult, especially taking into account security key deployment and management.
6.3. Selected trials

Following the trial definition methodology that is described in section 4.1 of this document, BUTLER consortium has defined a number of IoT application vertical field trials. The overview with all selected field trials is given in the table below.

<table>
<thead>
<tr>
<th>Title</th>
<th>Partner involved</th>
<th>Application Domains</th>
<th>Start Date</th>
<th>End Date</th>
<th>Planed implicit public awareness (user number)</th>
<th>Planed explicit user feedbacks (number)</th>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibitions &amp; Demos</td>
<td>Inno, ERC, TIL, CEA, IHL, ST-I, KUL, TST, JUB, Maya, FBC, ZigPos, SWC, UL</td>
<td>X X X X</td>
<td>01.10.2012</td>
<td>30.09.2014</td>
<td>2000</td>
<td>400</td>
<td>X</td>
</tr>
<tr>
<td>Office Information</td>
<td>IHL, Inno, TIL, CEA, UL</td>
<td>X X</td>
<td>18.03.2013</td>
<td>01.11.2013</td>
<td>100</td>
<td>50</td>
<td>X X X</td>
</tr>
<tr>
<td>Inactivity recognition</td>
<td>iHL, KUL</td>
<td>X X</td>
<td>01.05.2013</td>
<td>21.10.2013</td>
<td>50</td>
<td>25</td>
<td>X</td>
</tr>
<tr>
<td>Activity measurement</td>
<td>KUL, iHL</td>
<td>X X X</td>
<td>11.03.2013</td>
<td>01.11.2013</td>
<td>50</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Multimedia</td>
<td>CEA, Maya</td>
<td>X X</td>
<td>11.07.2013</td>
<td>15.11.2013</td>
<td>50</td>
<td>25</td>
<td>X X X</td>
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<tr>
<td>Home Security</td>
<td>SWC</td>
<td>X</td>
<td>tbd</td>
<td>tbd</td>
<td>500</td>
<td>tbd</td>
<td>X X</td>
</tr>
<tr>
<td>Train Staff Assistance</td>
<td>ZigPos, JUB, IHL</td>
<td>X</td>
<td>01.12.2012</td>
<td>30.09.2013</td>
<td>50</td>
<td>25</td>
<td>X X</td>
</tr>
<tr>
<td>Public Transportation</td>
<td>ZigPos, JUB</td>
<td>X</td>
<td>01.12.2013</td>
<td>30.09.2014</td>
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<td>50</td>
<td>X X</td>
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<tr>
<td>Parking Monitoring</td>
<td>TST</td>
<td>X X</td>
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<td>01.12.2013</td>
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<tr>
<td>Total</td>
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<td></td>
<td>01.10.2012</td>
<td>30.09.2014</td>
<td>11050</td>
<td>2720</td>
<td>4 5 5 11</td>
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</table>

Table 11 – Planed field trial implementation
In order to monitor the progress for gathering user feedback the following table on table 12 has been created. One can see that consortium has already secured more than 2500 users and stakeholders to be involved in validation and feedback collection process based on BUTLER IoT applications.

<table>
<thead>
<tr>
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<tbody>
<tr>
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Table 12 – Planed field trial explicit user feedback collection progress

Based on the objectives and metrics of success introduced in section 6.1 the authors have defined a unified BUTLER field trial description template that has been used to describe every BUTLER field trial in details. All these field trial descriptions contain motivation, scenario, metrics, implementation, execution as well as data analysis and interpretation sections. Hence, the rest of this section is devoted to detailed field trial descriptions.
6.3.1. Energy Awareness

6.3.1.1. Trial motivation, description and metrics

<table>
<thead>
<tr>
<th>Field Trial Title</th>
<th>Energy Awareness Field Trial (EAFT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involved partners</td>
<td>iHomeLab, ST Microelectronics, Telecom Italia, Ericsson Spain</td>
</tr>
<tr>
<td>Authors</td>
<td>Aliaksei Andrushevich, Rolf Kistler, Stefano Pascali, Massimo Valla, Maria Fernanda Salazar</td>
</tr>
<tr>
<td>Description Date</td>
<td>08.02.2013</td>
</tr>
</tbody>
</table>

**Trial motivation**
- Technical feasibility
- Technology integration
- Deployment and maintenance efforts
- Scalability
- User comfort
- User acceptance

**Trial scenario**
End-users (Donald and Daisy) are informed about current resource consumption (energy, water, gas) and are emotionally motivated to act environmentally friendly.

**Relevance to BUTLER horizontal storyline**
The user scenario mainly relates to energy management and security and shows how IoT may support the user in more sustainable and environmentally-friendly behaviour while preserving comfort via hiding the heterogeneity of the underlying energy measurement and connectivity infrastructures.

**Disseminated messages**
Clever combination of detailed real time information about energy consumption with intuitive and persuasive user interfaces can be a motivator for saving natural resources in everyday life.

**Trial metrics**
- Technical performance
- Trial duration
- Dissemination impact
- Types of end-users
- Number of involved users
- User Satisfaction

**Security concerns**
The following information may become known to the system from the detailed monitoring of the energy consumption:
- Personal activity profile of the home owners derived from the detailed energy consumption data summing up the usage of all energy consumers in the house (load profiles).

6.3.1.2. Technical implementation

| Implementation versions | Demonstration movie
|-------------------------|-----------------------------|
|                         | Portable BUTLER demonstrator for exhibitions
|                         | Fixed BUTLER demonstrator installed at public sites of partners
|                         | BUTLER cloud services including online user feedback mechanisms
|                         | Prototypes of BUTLER platform components
|                         | BUTLER related products

<table>
<thead>
<tr>
<th>Involved partners</th>
<th>iHomeLab, ST Microelectronics, Telecom Italia, Ericsson Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development start</td>
<td>01.10.2012</td>
</tr>
</tbody>
</table>
The following hardware is needed by the energy awareness field trial:
- Energy awareness screen
- Personal mobile devices
- Intelligent plugs for real time energy measurement
- Smart Object Gateways
- Connecting adapters and cables

EAFT system application is meant to be based on Smart Server, Smart Mobile and Smart Object BUTLER platforms and is therefore initiated using the following common software components:
- Application Server
- Virtual Machine
- FTP-Server
- Web-Server
- Smart Object Gateways
- Visualisation frontend

Technical testing is the last development stage being done before starting deployment and configuration (functional tests as well as non-functional tests like performance, reliability, adaptability and interoperability). Long run tests are considered to be done during configuration and data gathering phases.

BUTLER platform authorization and authentication mechanisms
6.3.1.3. Trial execution

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>iHomeLab, Inno, Telecom Italia</td>
</tr>
<tr>
<td>Installation requirements</td>
<td>- Power 230V</td>
</tr>
<tr>
<td></td>
<td>- LAN connection</td>
</tr>
<tr>
<td></td>
<td>- Wi-Fi connection</td>
</tr>
<tr>
<td>Trial environment</td>
<td>Offices and private households of the involved partners including colleagues from other projects, departments as well as technical staff</td>
</tr>
<tr>
<td>User feedback types</td>
<td>- Questionnaires from BUTLER demonstrations at exhibitions</td>
</tr>
<tr>
<td></td>
<td>- Questionnaires from BUTLER fixed demonstrators of partners</td>
</tr>
<tr>
<td></td>
<td>- BUTLER online questionnaires and surveys</td>
</tr>
<tr>
<td></td>
<td>- Feedback on prototypes of BUTLER platform components</td>
</tr>
<tr>
<td></td>
<td>- Feedback on BUTLER related products</td>
</tr>
<tr>
<td>Execution structure</td>
<td>Three iterations with the following four steps are foreseen until M24:</td>
</tr>
<tr>
<td></td>
<td>1. Deployment and configuration – 2 weeks</td>
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<td>2. Data gathering – 14 weeks</td>
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<tr>
<td></td>
<td>3. Data analysis – 2 weeks</td>
</tr>
<tr>
<td></td>
<td>4. Implementation update – 2 weeks</td>
</tr>
<tr>
<td>Execution schedule per iteration</td>
<td>W1</td>
</tr>
<tr>
<td>Number of involved users</td>
<td>Iteration 1</td>
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<td>5</td>
</tr>
<tr>
<td>Used methods to address the security concerns of involved users and stakeholders</td>
<td>In order to address the identified security concerns several measures have to be taken:</td>
</tr>
<tr>
<td></td>
<td>- Informed consent from all the involved end-users</td>
</tr>
<tr>
<td></td>
<td>- Average and anonym data</td>
</tr>
<tr>
<td></td>
<td>- Datasets with max duration of 14 weeks</td>
</tr>
<tr>
<td>Trial feedback collection questions</td>
<td>The following feedback is going to be collected from EAFT users:</td>
</tr>
<tr>
<td></td>
<td>- General impression, do you like the interface?</td>
</tr>
<tr>
<td></td>
<td>- Advantages, does it help to save natural resources?</td>
</tr>
<tr>
<td></td>
<td>- Potential for improvement</td>
</tr>
<tr>
<td></td>
<td>- Concerns, disadvantages, downsides</td>
</tr>
<tr>
<td></td>
<td>- Readiness to buy</td>
</tr>
</tbody>
</table>

6.3.1.4. Data analysis and interpretation

| Usage statistics preparation process | Daily, Weekly and Monthly resource consumption data has to be available in the following form: |
|                                    |  - Datasets for later integration into data mining tools |
| User feedback analysis | Systematization of informal and formal user feedback received from EAFT users during workshops, filled-in questionnaires and available statistics |
| Interpretation process | The interpretation of the collected data is planned to be done from the perspective of different stakeholders: |
|                                                                           |  - Resource consumers |
|                                                                           |  - Resource suppliers (utilities) |
|                                                                           |  - Operations and maintenance team |
| Results and conclusions | Interpreted data will be summarized into general statements regarding system usefulness in regard to the long term resource savings as well as critical points and next improvement steps |
| Integration in the implementation | Critical points and next improvement steps serve as update for system and user requirements in the next iteration of the EAFT development |
### 6.3.2. Energy Forecasting

#### 6.3.2.1. Trial motivation, description and metrics

<table>
<thead>
<tr>
<th>Field Trial Title</th>
<th>Energy Forecasting Field Trial (EFFT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involved partners</td>
<td>FBConsulting, iHomeLab, Ericsson Spain</td>
</tr>
<tr>
<td>Authors</td>
<td>Friedbert Berens, Aliaksei Andrushevich, Rolf Kistler, Maria Fernanda Salazar</td>
</tr>
<tr>
<td>Description Date</td>
<td>08.02.2013</td>
</tr>
</tbody>
</table>

**Trial motivation**
- Technical feasibility
- Technology integration
- Deployment and maintenance efforts
- Scalability
- User comfort
- User acceptance

**Trial scenario**
End-users (Donald and Daisy and children) are informed about the future available solar energy based on a detailed weather forecast. The prediction will have a 15 minutes resolution for the next day and a two hourly prediction for the following 3 days. This prediction will then be compared to the real generation.

**Relevance to BUTLER horizontal storyline**
The user scenario mainly relates to energy management and security and shows how IoT may support the user in more sustainable and efficient use of the self generated energy (Solar Panels) by providing the relevant prediction for the planning of the energy consumption like controlled E-Car charging, washing machine or dryer. In a second step the prediction should be used for a control of the mentioned devices (example: e-car charging).

**Disseminated messages**
Collection and combination of detailed prediction and real time information about energy production and consumption.

**Trial metrics**
- Technical performance
- Trial duration
- Dissemination impact
- Types of end-users
- Number of involved users
- User Satisfaction

**Security concerns**
The following information may become known to the system from the detailed monitoring of the energy production and consumption:
- Personal activity profile of the homeowners derived from the detailed energy consumption data summing up the usage of all energy consumers in the house (load profiles).
- Potential tax relevant income from generated PV power

#### 6.3.2.2. Technical implementation

<table>
<thead>
<tr>
<th>Implementation versions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstration movie</td>
</tr>
<tr>
<td>Portable BUTLER demonstrator for exhibitions</td>
</tr>
<tr>
<td>Fixed BUTLER demonstrator installed at public sites of partners</td>
</tr>
<tr>
<td>BUTLER cloud services including online user feedback mechanisms</td>
</tr>
<tr>
<td>Prototypes of BUTLER platform components</td>
</tr>
<tr>
<td>BUTLER related products</td>
</tr>
</tbody>
</table>

**Involved partners**
iHomeLab, FBConsulting, Ericsson Spain

**Development start**
01.01.2013
<table>
<thead>
<tr>
<th>Release dates</th>
<th>V1: planned for October 2013</th>
</tr>
</thead>
</table>

**System overview**

**GUI mock up**

**Hardware infrastructure**

The following hardware is needed by the energy forecast field trial:
- Energy prediction screen
- Energy generation screen
- Personal mobile devices
- Intelligent plugs for real time energy measurement for comparison
- Smart Meter for overall energy monitoring in real time
- Smart Object Gateways
- Connecting adapters and cables
- Smart Charging device for e-car

**Software infrastructure**

EFFT system application is meant to be based on Smart Server, Smart Mobile and Smart Object BUTLER platforms and is therefore initiated using the following common software components:
- Application Server
- Virtual Machine
- FTP-Server
- Web-Server
- Smart Object Gateways
- Visualisation frontend

**Technical tests**

Technical testing is the last development stage being done before starting deployment and configuration (functional tests as well as non-functional...
6.3.2.3. Trial execution

<table>
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<tbody>
<tr>
<td>Hosting partners</td>
<td>FBConsulting, iHomeLab, Ericsson Spain</td>
</tr>
</tbody>
</table>
| Installation requirements | ☒ Power 230V  
| | ☒ LAN connection  
| | ☐ Wi – Fi connection |
| Trial environment | Offices and private households of the involved partners including colleagues from other projects, departments as well as technical staff |
| User feedback types | ☒ Questionnaires from BUTLER demonstrations at exhibitions  
| | ☒ Questionnaires from BUTLER fixed demonstrator of partners  
| | ☐ BUTLER online questionnaires and surveys  
| | ☒ Feedback on prototypes of BUTLER platform components  
| | ☐ Feedback on BUTLER related products |
| Execution structure | Three iterations with the following four steps are foreseen until M24:  
| | 1. Deployment and configuration – 2 weeks  
| | 2. Data gathering – 14 weeks  
| | 3. Data analysis – 2 weeks  
| | 4. Implementation update – 2 weeks |
| Execution schedule per iteration | W1 W2 W3 W4 ... W18 W19 W20 W21 W22 |
| Number of involved users | Iteration 1 | Iteration 2 | Iteration 3 |
| | 5 | 15 | 25 |
| Used methods to address the security concerns of involved users and stakeholders | In order to address the identified security concerns several measures have to be taken:  
| | ☐ Informed consent from all the involved end-users  
| | ☐ Average and anonym data  
| | ☒ Datasets with max duration of 14 weeks |
| Trial feedback collection questions | The following feedback is going to be collected from EAFT users:  
| | ☐ General impression, do you like the interface?  
| | ☐ Advantages, does it help to save natural resources?  
| | ☐ Potential for improvement  
| | ☐ Concerns, disadvantages, downsides  
| | ☐ Readiness to buy |

6.3.2.4. Data analysis and interpretation

| Usage statistics preparation process | Daily, Weekly and Monthly resource consumption data has to be available in the following form:  
| | ☐ Datasets for later integration into data mining tools |
| User feedback analysis | Systematization of informal and formal user feedback received from EFFT users during workshops, filled-in questionnaires and available statistics |
| Interpretation process | The interpretation of the collected data is planned to be done from the perspective of different stakeholders:  
| | ☐ Resource consumers  
| | ☐ Resource suppliers (utilities)  
| | ☐ Operations and maintenance team |
### 6.3.3. Office Information

#### 6.3.3.1. Trial motivation, description and metrics

<table>
<thead>
<tr>
<th>Field Trial Title</th>
<th>Smart Office Field Trial (SOFT)</th>
</tr>
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<td>Involved partners</td>
<td>iHomeLab, Inno, Telecom Italia, CEA, UL</td>
</tr>
<tr>
<td>Authors</td>
<td>Aliaksei Andrushevich, Rolf Kistler, Bertrand Copigneaux, Massimo Valla</td>
</tr>
<tr>
<td>Description Date</td>
<td>08.02.2013</td>
</tr>
</tbody>
</table>

**Trial motivation**

- Technical feasibility
- Technology integration
- Deployment and maintenance efforts
- Scalability
- User comfort
- User acceptance

**Trial scenario**

SOFT implements and validates an information system that allows easy sharing of data amongst geo-temporally distributed project- and company-colleagues and/or family members by presenting commonly relevant sensor data and day flow information. The data is presented on public displays at often attended user locations like building/office entrances, workplaces, corridors, etc. Common information examples include but are not limited to:
- Presence of colleagues
- Common tasks to finish
- Project information (reached milestones, current state etc.)
- Information about missed calls
- Room reservations and current status information
- Information about the weather/stocks an many more
- Important common information (events, visits, meetings)

**Relevance to BUTLER horizontal storyline**

BUTLER supports people in everyday life not only through personalized mobile devices but also using public displays installed at locations commonly frequented by the end-users.

**Disseminated messages**

Increased community awareness in distributed collaborative and family environment

**Trial metrics**

- Technical performance
- Trial duration
- Dissemination impact
- Types of end-users
- Number of involved users
- User Satisfaction

**Security concerns**

The following information may become available to sharing system or to 3rd parties:
- Confidential organisational data
- Unintended to share personal data
6.3.3.2. Technical implementation

**Implementation versions**
- Demonstration movie
- Portable BUTLER demonstrator for exhibitions
- Fixed BUTLER demonstrator installed at public sites of partners
- BUTLER cloud services including online user feedback mechanisms
- Prototypes of BUTLER platform components
- BUTLER related products

**Involved partners**
iHomeLab, Inno, Telecom Italia, CEA, UL

**Development start**
27.11.2012

**Release dates**
- V1: 15.03.2013
- V2: 24.05.2013
- V3: 02.08.2013

**System overview**

**GUI mock up**

**Hardware infrastructure**
The following hardware is used in SOFT:
- Public displays
- Embedded computers (for example Raspberry PI) responsible for displayed content
- Sensors
- Connecting adapters
- Cables

**Software infrastructure**
SOFT system application is meant to be based on Smart Server, Smart Mobile and Smart Object BUTLER platforms and is therefore initiated using the following common software components:
- Application Server
- Virtual Machine
Technical tests
Technical testing is the last development stage being done before starting deployment and configuration (functional tests as well non-functional tests like performance, reliability, scalability, adaptability and interoperability). Long run tests are considered to be done during configuration and data gathering phases.

Security mechanisms
BUTLER platform authorization and authentication mechanisms

6.3.3.3. Trial execution

Deployment date
V1: 18.03.2013; V2: 27.05.2013; V3: 05.08.2013;

Hosting partners
iHomeLab, Inno, Telecom Italia, CEA, UL

Installation requirements
- Power 230V
- LAN connection
- Wi-Fi connection

Trial environment
Offices of the involved partners including colleagues from other projects, departments as well as technical staff

User feedback types
- Questionnaires from BUTLER demonstrations at exhibitions
- Questionnaires from BUTLER fixed demonstrators of partners
- BUTLER online questionnaires and surveys
- Feedback on prototypes of BUTLER platform components
- Feedback on BUTLER related products

Execution structure
Three iterations with the following four steps are foreseen until M24:
1. Deployment and configuration – 2 weeks
2. Data gathering – 4 weeks
3. Data analysis – 2 weeks
4. Implementation update – 2 weeks

Execution schedule per iteration

<table>
<thead>
<tr>
<th></th>
<th>W1</th>
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<th>W7</th>
<th>W8</th>
<th>W9</th>
<th>W10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iteration 1</td>
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<td>Iteration 2</td>
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<tr>
<td>Iteration 3</td>
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</table>

Number of involved users

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<thead>
<tr>
<th></th>
<th>Iteration 1</th>
<th>Iteration 2</th>
<th>Iteration 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>35</td>
<td>50</td>
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</tr>
</tbody>
</table>

Used methods to address the security concerns of involved users and stakeholders
All personal information must be excluded from sharing. Therefore the application operators have to define the common policy for:
- information sensitivity measurement
- sharing and accessing information depending on sensitivity level

Trial feedback collection questions
The following feedback is going to be collected from SOFT users:
- General impression about the usefulness of the services
- Advantages, is there a need for such a system, motivation
- Potential for improvement
- Concerns, disadvantages, downsides
- Readiness to buy, pricing

6.3.3.4. Data analysis and interpretation

Usage statistics preparation process
Daily, Weekly and Monthly data from users and sensors has to be available in the following forms:
- Number of messages from users and sensors
- Number of senders (users and sensors)
- Number of the distributed messages per user and sensor (with mean and variance)
- Time distribution (with mean and variance) between 2 messages

User feedback analysis
Systematization of informal and formal user feedback received from SOFT
The interpretation of collected data is planned to be done from the perspective of different stakeholders:
- Information consumers
- Information producers
- Operations and maintenance team
- Service owners (organizations)
- Service providers

Interpreted data will be summarized into general statements regarding system feasibility, critical points and next improvement steps.

Critical points and next improvement steps serve as update for system and user requirements in the next iteration of SOFT development.

### 6.3.4. Inactivity recognition

#### 6.3.4.1. Trial motivation, description and metrics

**Field Trial Title**
Inactivity Recognition Field Trial (IRFT) (assistance at home)

**Involved partners**
iHomeLab, KULeuven

**Authors**
Clemens Nieke, Aliaksei Andrushevich, Rolf Kistler, Davy Preuveneers, Arun Ramakrishnan

**Description Date**
12.03.13

**Trial motivation**
- [ ] Technical feasibility
- [ ] Technology integration
- [X] Deployment and maintenance efforts
- [ ] Scalability
- [X] User comfort
- [X] User acceptance

**Trial scenario**
A conventional system for emergency calls triggers the alarm by pressing a button. This approach has a drawback in situation like falling down with sub sequential unconsciousness, disorientation and other critical situations when the person will be mostly not able to press a button. The automatic sensor-based detection of the “inactivity” can give more security and confidence to living alone elderly people and their relatives.

**Relevance to BUTLER horizontal storyline**
Many people would like stay as long as possible in their own homes. So, BUTLER system supports alone people by giving them security and confidence feeling.

**Disseminated messages**
More safety and confidence at home.

**Trial metrics**
- [X] Technical performance
- [X] Trial duration
- [X] Dissemination impact
- [X] Types of end-users
- [X] Number of involved users
- [X] User Satisfaction

**Security concerns**
The following information may become available to sharing system or to 3rd parties:
- Unintended to share personal data
- Illegal information about the lifestyle habits

© BUTLER – Page 76/166
### 6.3.4.2. Technical implementation

<table>
<thead>
<tr>
<th>Implementation versions</th>
<th>□ Demonstration movie</th>
<th>□ Portable BUTLER demonstrator for exhibitions</th>
<th>□ Fixed BUTLER demonstrator installed at public sites of partners</th>
<th>□ BUTLER cloud services including online user feedback mechanisms</th>
<th>☒ Prototypes of BUTLER platform components</th>
<th>☒ BUTLER related products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involved partners</td>
<td>iHomeLab, KU Leuven</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development start</td>
<td>01.01.2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Release dates</td>
<td>V1: 15.03.13; V2: 31.06.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### System overview

![Inactivity Recognition](image)

#### GUI mock up

None for V1; Integration with BUTLER GUI for V2 possible

#### Hardware infrastructure

The following hardware is used:
- Sensor for the detection of inactivity
- Embedded low power micro controller (MSP 430)
- Reference sensors
- Rack for the temporary installation at home

#### Software infrastructure

IRFT system application is meant to be based on Smart Server, Smart Mobile and Smart Object BUTLER platforms and is therefore initiated using the following common software components:
- Application Server
- Visualisation frontend
- Smart Object Gateways
- PIR sensing platform

#### Technical tests

Technical testing is the last development stage being done before starting deployment (functional tests as well non-functional tests like performance, reliability). Long run tests are considered to be done in a second phase of the technical test.

#### Security mechanisms

IRFT does not foresee the authentication and identification in the observed apartments. Sensing platform itself will not include any stored user profiles. Only field trial managers will have the knowledge on the association of gathered activity data and can possibly use BUTLER platform authorization and authentication mechanisms at later stage.

### 6.3.4.3. Trial execution

<table>
<thead>
<tr>
<th>Deployment date</th>
<th>V1: 01.05.2013; V2: 15.07.2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>iHomeLab</td>
</tr>
<tr>
<td>Installation requirements</td>
<td>□ Power 220V</td>
</tr>
<tr>
<td></td>
<td>□ LAN connection</td>
</tr>
<tr>
<td></td>
<td>□ Wi – Fi connection</td>
</tr>
</tbody>
</table>

© BUTLER – Page 77/166
Trial environment

- households with and without pets

User feedback types

- questionnaires from BUTLER demonstrations at exhibitions
- questionnaires from BUTLER fixed demonstrators of partners
- BUTLER online questionnaires and surveys
- feedback on prototypes of BUTLER platform components
- feedback on BUTLER related products

Execution structure

Two iterations with the following four steps are foreseen until M24:
1. Deployment and configuration – 2 weeks
2. Data gathering – 4 weeks
3. Data analysis – 2 weeks
4. Implementation update – 2 weeks

Execution schedule per iteration

<table>
<thead>
<tr>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
<th>W7</th>
<th>W8</th>
<th>W9</th>
<th>W10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Number of involved users

- iteration 1: 25
- iteration 2: 25

Used methods to address the security concerns of involved users and stakeholders

All personal information will be excluded from sharing. All households get a random numeric id. Only the field trial manager together with second independent person (possibly from KU Leuven team) will be able to rebuild the correlation between id and the real persons in the household together.

Trial feedback collection questions

The following feedback is going to be collected from IRFT users:
- the usability of PIR sensing platform
- acceptability from the time period of inactivity
- easiness of integration in the home environment
- the enhancement for the quality of life and security

6.3.4.4. Data analysis and interpretation

Usage statistics preparation process

Daily and weekly data from the sensors has to be available in the following forms:
- detection times of motions (with the Sensor and IR-light barriers)
- detection times of activities
- start times of the emergency call
- total amount of emergency calls

User feedback analysis

- statistical evaluation from the number of emergency calls
- interviews about the experience of the user

Interpretation process

The interpretation of collected data is planned to be done from the perspective of different stakeholders:
- for the installation process from a technical support person
- for the usability from the end user
- for the emergency calls from the carers or family members

Results and conclusions

Interpreted data will be summarized into general statements regarding system feasibility, critical points and the user experience.

Integration in the implementation

Critical points and next improvement steps serve as update for system and user requirements in the next iteration of IRFT development.
6.3.5. Activity measurement and classification

6.3.5.1. Trial motivation, description and metrics

<table>
<thead>
<tr>
<th>Field</th>
<th>Trial Title</th>
<th>Involved partners</th>
<th>Authors</th>
<th>Description Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Activity Measurement Field Trial (AMFT)</td>
<td>KULeuven, iHomeLab</td>
<td>Davy Preuveneers, Arun Ramakrishnan, Aliaksei Andrushevich, Rolf Kistler</td>
<td>10.03.2013</td>
</tr>
</tbody>
</table>

**Trial motivation**

- Technical feasibility
- Technology integration
- Deployment and maintenance efforts
- Scalability
- User comfort
- User acceptance

**Trial scenario**

AMFT implements and validates personal sensor-based activity recognition augmented with semantic localization and context information to improve the accuracy of activity recognition and prediction. The trial scenario mainly focuses on mobility, wellbeing and assisted living scenarios. Several common examples include but are not limited to:

- Step counting analysis
- Sleep analysis
- Fall detection
- ...

**Relevance to BUTLER horizontal storyline**

BUTLER aims to assist people in a variety of everyday life scenarios, requiring activity recognition support in diverse circumstances and situations.

**Disseminated messages**

- Increased activity and behaviour awareness in distributed collaborative and family environment

**Trial metrics**

- Technical performance
- Trial duration
- Dissemination impact
- Types of end-users
- Number of involved users
- User Satisfaction

**Security concerns**

The following information may become available to sharing system or to 3rd parties:

- Unintended to share personal data

---

6.3.5.2. Technical implementation

<table>
<thead>
<tr>
<th>Implementation versions</th>
<th>Demonstration movie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Portable BUTLER demonstrator for exhibitions</td>
</tr>
<tr>
<td></td>
<td>Fixed BUTLER demonstrator installed at public sites of partners</td>
</tr>
<tr>
<td></td>
<td>BUTLER cloud services including online user feedback mechanisms</td>
</tr>
<tr>
<td></td>
<td>Prototypes of BUTLER platform components</td>
</tr>
<tr>
<td></td>
<td>BUTLER related products</td>
</tr>
</tbody>
</table>

**Involved partners**

- KULeuven, iHomeLab

**Development start**

- 27.11.2012

**Release dates**

- V1: 04.03.2013; V2: 20.05.2013; V3: 05.08.2013
System overview

Hardware infrastructure

The following hardware is used in AMFT:
- Mobile phone
- Accelerometer sensors
- Glucometer
- Bluetooth extension for data synchronization
- Fitbit and gateway

Software infrastructure

AMFT system application is meant to be run on a Smart Mobile, but the Fitbit data has to be acquired from a remote Fitbit service (i.e. a Smart
Server) after wireless synchronization of the Fitbit sensor data through the Fitbit gateway to the remote service. Similar functionality of the Fitbit device (step counting, energy expenditure analysis, etc.) is offered by software components directly running on the Smart Mobile, or as services running on a Smart Server (e.g. in the cloud) to reduce the computational overhead on the mobile. The latter implementation requires:
- Application Server
- Virtual Machine

**Technical tests**

Technical testing is the last development stage being done before starting deployment and configuration (functional tests as well non-functional tests like performance, reliability, scalability, adaptability and interoperability). Long run tests are considered to be done during configuration and data gathering phases.

**Security mechanisms**

BUTLER platform authorization and authentication mechanisms

### 6.3.5.3. Trial execution

<table>
<thead>
<tr>
<th>Deployment date</th>
<th>V1: 11.03.2013; V2: 27.05.2013; V3: 12.08.2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>KULeuven, iHomeLab</td>
</tr>
</tbody>
</table>
| Installation requirements | ☐ Power 220V  
☐ LAN connection  
☐ Wi – Fi connection |
| Trial environment | The trial can be executed in any environment where the mobile and the Fitbit device have network connectivity to the Internet. Our trial will involve two categories of people:
- Regular participants who will test the accelerometer-based activity recognition components (step counting, calorific expenditure, sleep analysis, etc.), but not the diabetes application as such.
- Diabetes patients which will test the diary application that is build on top of the aforementioned activity recognition components |
| User feedback types | ☐ Questionnaires from BUTLER demonstrations at exhibitions  
☐ BUTLER online questionnaires and surveys  
☒ BUTLER fixed demonstrators of partners  
☐ Feedback on prototypes of BUTLER platform components  
☐ Feedback on BUTLER related products |
| Execution structure | The trial is planned to be executed in 4 phases for each deployment version,  
1. Configuration and deployment of application components in BUTLER smart platforms (W1-W2)  
2. Trial execution and data collection from the deployed applications (W3-W6)  
3. Analysis and interpretation of user data and feedbacks (W7-W8)  
4. Updating the system for subsequent deployments |
<table>
<thead>
<tr>
<th>Execution schedule per iteration</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
<th>W7</th>
<th>W8</th>
<th>W9</th>
<th>W10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of involved users</td>
<td>Iteration 1</td>
<td>Iteration 2</td>
<td>Iteration 3</td>
<td></td>
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<td>10</td>
<td>20</td>
<td>20</td>
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</tr>
</tbody>
</table>
| Used methods to address the security concerns of involved users and stakeholders | 1. Collecting informed consent from the end-users and other stakeholders involved in the trials  
2. Anonymising user data in the reported results |
The trial feedback collection questions will be formulated mainly to validate the trial motivations with respect to the activity recognition components (step counting, etc.) but not the diabetes application (as the number of participants will be too low to produce any statistically significant results). Some sample questions are,

1. Did the functionality of the application correspond with your expectations?
2. Which device did you use to try out the application?
3. Did you find the configuration of the application cumbersome?
4. Which features did you expect, but were missing?
5. What is your attitude towards the intrusiveness of the application?
6. What is your attitude towards remote processing of your data (compared to all processing being local on your mobile)?
7. Would you be willing to pay for this application?

6.3.5.4. Data analysis and interpretation

| Usage statistics preparation process | Periodic collection and reporting of performance data of the application and the device:
1. Total duration of trial
2. Resource consumption (memory, CPU, energy, data, ...)
3. Sleep levels of the user |

| User feedback analysis | Systematization of informal and formal user feedback received from AMFT users during face to face discussions with field trial participants, filled questionnaires and available statistics |

| Interpretation process | The user feedback and usage data are analysed from the perspective of two major stakeholders,
1. Application developers – about the feasibility and efficiency of the implemented technologies
2. End users – about the user-friendliness and perceived socio-economic value of the systems |

| Results and conclusions | Results will report the technical feasibility of the deployed technologies and their usability. It will wrap up the accomplishments of the applications and their downsides for possible further improvements in the future versions |

| Integration in the implementation | Critical points and next improvement steps serve as update for system and user requirements in the next iteration of AMFT development |

6.3.6. Multimedia

6.3.6.1. Trial motivation, description and metrics

| Field Trial Title | Multimedia Field Trial (MFT) |
| Involved partners | CEA, Maya |
| Authors | Ozan Gunalp, François Naçabal, Mathieu Gallissot |
| Description Date | 21.03.2013 |
| Trial motivation | ☒ Technical feasibility
☒ Technology integration
☒ Deployment and maintenance efforts
☐ Scalability
☒ User comfort |
Trial scenario

MFT implements and validates an information system installment, which allows users to access multimedia content within various situations and through different equipment and aims to maximize user comfort and experience all taking into account context information such as user localization, environmental measurements, etc.

Relevance to BUTLER horizontal storyline

BUTLER aims to bring intelligence into everyday life, including home environments

Disseminated messages

Increased comfort and entertainment in home environment

Trial metrics

- Technical performance
- Trial duration
- Dissemination impact
- Types of end-users
- Number of involved users
- User Satisfaction

Security concerns

Aimed environments are highly implicated with user habits, day-to-day activities and personal belongings. Any information related to these can pose threat to user privacy. In addition to that, scenarios in MFT can involve already present / installed equipment that is used in traditional ways by users (televisions) or in legacy systems (home automation equipment). Integration with those should be cautious to not to pose security vulnerabilities.

6.3.6.2. Technical implementation

<table>
<thead>
<tr>
<th>Implementation versions</th>
<th>Demonstration movie</th>
<th>Portable BUTLER demonstrator for exhibitions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fixed BUTLER demonstrator installed at public sites of partners</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BUTLER cloud services including online user feedback mechanisms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prototypes of BUTLER platform components</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BUTLER related products</td>
</tr>
</tbody>
</table>

Involved partners

CEA, Maya

Development start

April '13

Release dates

V1: 27.06.2013, V2: 05.09.2013
### System overview

#### Hardware infrastructure
- Smart TVs (w/ networking & media rendering capabilities),
- Sensor / actuator nodes (sensors to be specified),
- Application gateway (gateway + local server) capable of bridging different network protocols and executing high-level software components,
- Smartphone

#### Software infrastructure
MFT runs on Smart Object and Local Smart Server platforms and optionally have parts that deploy on Smart Mobile and Remote Smart Server platforms.

#### Technical tests
- Streaming and playing of HD video content (play/pause/stop)
Security mechanisms

- Detection of presence, unique identification of TV sets

**BUTLER defined authorization and authentication mechanisms**

---

### 6.3.6.3. Trial execution

<table>
<thead>
<tr>
<th>Deployment date</th>
<th>V1: 11.07.2013, V2: 19.09.2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>CEA, Maya</td>
</tr>
<tr>
<td>Installation requirements</td>
<td></td>
</tr>
</tbody>
</table>
| ☑ Power 220V
| ☑ LAN connection
| ☑ Wi-Fi connection |
| Trial environment | Offices of the involved partners including colleagues from other projects and departments |
| User feedback types | |
| ☐ Questionnaires from BUTLER demonstrations at exhibitions |
| ☑ Questionnaires from BUTLER fixed demonstrators of partners |
| ☐ BUTLER online questionnaires and surveys |
| ☑ Feedback on prototypes of BUTLER platform components |
| ☐ Feedback on BUTLER related products |
| Execution structure | 1. Deployment and configuration: 2 weeks
|                      | 2. Data gathering: 3 weeks |
|                      | 3. Data analysis: 1 week |
| Execution schedule per iteration | W1 W2 W3 W4 W5 W6 |
| Number of involved users | 25 |
| Used methods to address the security concerns of involved users and stakeholders | In order to address the identified security concerns several measures have to be taken:
| | • Informed consent from all the involved end-users
| | • Average and anonym data |
| Trial feedback collection questions | The following feedback is going to be collected from MFT users:
| | • General impression, is it better than with today products?
| | • Advantages, does it ease the daily life?
| | • Potential for improvement
| | • Concerns, disadvantages, downsides |

---

### 6.3.6.4. Data analysis and interpretation

<table>
<thead>
<tr>
<th>Usage statistics preparation process</th>
<th>Daily tracking of system usage, delay between expected operations (moving from one room to another one, play/replay multimedia content)</th>
</tr>
</thead>
<tbody>
<tr>
<td>User feedback analysis</td>
<td>Systematization of informal and formal user feedback received from MFT users during focus groups, filled-in questionnaires and available statistics</td>
</tr>
<tr>
<td>Interpretation process</td>
<td>The interpretation of the collected data is planned to be done from the perspective of consumers (end-users)</td>
</tr>
<tr>
<td>Results and conclusions</td>
<td>Interpreted data will be summarized into general statements regarding system usefulness</td>
</tr>
<tr>
<td>Integration in the implementation</td>
<td>Critical points and next improvement steps serve as update for system and user requirements in the next iteration of the MFT development</td>
</tr>
</tbody>
</table>
6.3.7. Home Automation Product

6.3.7.1. Trial motivation, description and metrics

<table>
<thead>
<tr>
<th>Field Trial Title</th>
<th>New Launch BUTLER Related Product Satisfaction &amp; User Experience Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involved partners</td>
<td>Swisscom</td>
</tr>
<tr>
<td>Authors</td>
<td>Swisscom representatives</td>
</tr>
<tr>
<td>Description Date</td>
<td>22.04.2013</td>
</tr>
</tbody>
</table>

**Trial motivation**

- Technical feasibility
- Technology integration
- Deployment and maintenance efforts
- Scalability
- User comfort
- User acceptance
- User satisfaction – 1st customer feedback after new product market launch

**Trial scenario**

After a successful market launch of an innovative, home automation product “Quing Home” there is a need to find out what is the attitude, key motivations, degree of product satisfaction of the customers. This allows Swisscom to see, how adaptable the home automation products are and what topics are substantial for the users. Furthermore the inputs are considered as vital for continuous product improvement.

**Relevance to BUTLER horizontal storyline**

The “Quing Home” product value proposition addresses following key topics: comfort, energy and security. These topics are also embedded into the horizontal storyline of the BUTLER project, especially the follow-up developments of the “Quing Home” product family relating smartEnergy, smartHome and smartHealth have been considered in the use cases generating process in BUTLER Project.

**Disseminated messages**

smartEnergy, smartHome and smartHealth

**Trial metrics**

- Technical performance
- Trial duration
- Dissemination impact
- Types of end-users
- Number of involved users
- User Satisfaction

**Security concerns**

Aimed environments are highly implicated with user habits, day-to-day activities and personal belongings. Any information related to these can pose threat to user privacy.

6.3.7.2. Technical implementation

**Implementation versions**

- Demonstration movie
- Portable BUTLER demonstrator for exhibitions
- Fixed BUTLER demonstrator installed at public sites of partners
- BUTLER cloud services including online user feedback mechanisms
- Prototypes of BUTLER platform components
- BUTLER related products
- Online survey

**Involved partners**

SWC, others to be defined

**Development start**

To be defined
### 6.3.7.3. Trial execution

<table>
<thead>
<tr>
<th>Deployment date</th>
<th>To be defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>To be defined</td>
</tr>
</tbody>
</table>

**Installation requirements**
- Power 220V
- LAN connection
- Wi-Fi connection
- None – it is online survey

<table>
<thead>
<tr>
<th>Trial environment</th>
<th>To be defined</th>
</tr>
</thead>
</table>

**User feedback types**
- Questionnaires from BUTLER demonstrations at exhibitions
- Questionnaires from BUTLER fixed demonstrators of partners
- BUTLER online questionnaires and surveys
- Feedback on prototypes of BUTLER platform components
- Feedback on BUTLER related products

**Execution structure**

- **Execution schedule per iteration**
  The results of the survey might be available until the end of the year 2013. The planning phase has been already started.

- **Number of involved users**
  Planned user number: 100

- **Used methods to address the security concerns of involved users and stakeholders**
  none

- **Trial feedback collection questions**
  The questionnaire is in the creating stage. Below you can read the samples of the possible questions:
  1. Where have you got in touch with the product for the 1st time?
  2. What are the most important features for you?
  3. What was the motivation to buy the product?
  4. How do you judge the overall experience with the “quing Home” product? (many other sub questions to the user experience single points)
  5. What can be improved / modified?

### 6.3.7.4. Data analysis and interpretation

<table>
<thead>
<tr>
<th>Usage statistics preparation process</th>
<th>To be defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>User feedback analysis</td>
<td>To be defined</td>
</tr>
<tr>
<td>Interpretation process</td>
<td>To be defined</td>
</tr>
<tr>
<td>Results and conclusions</td>
<td>To be defined</td>
</tr>
<tr>
<td>Integration in the implementation</td>
<td>To be defined</td>
</tr>
</tbody>
</table>
6.3.8. Train Staff Assistance

6.3.8.1. Trial motivation, description and metrics – The glacier Express

<table>
<thead>
<tr>
<th>Field Trial Title</th>
<th>Smart Glacier express</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involved partners</td>
<td>ZPOS, JUB, iHL</td>
</tr>
<tr>
<td>Authors</td>
<td>Anup Shrestha, Erik Mademann, Aliaksei Andrushevich</td>
</tr>
<tr>
<td>Description Date</td>
<td>14.02.2013</td>
</tr>
</tbody>
</table>

**Trial motivation**
- ✓ Technical feasibility
- ✓ Technology integration
- ✓ Deployment and maintenance efforts
- ✓ Scalability
- □ User comfort
- ✓ User acceptance

**Trial scenario**
The system is targeted for automatic opening of the doors between the wagons when an employee arrives. The doors between wagons are equipped with the devices so that the doors will automatically be opened if one employee arrives. The employees are provided with a dongle, the position of which is sensed by the device in the door of the wagon. As the position is determined to be sufficiently close, the device in the door activates and sends the command to the door opening circuit. This is needed because the doors between the wagons cannot be opened via radar or light sensors and the employees mostly have no free hand to push a button. We experimented the trial in a single train with its doors equipped with the device. Also, the employees are provided with the pocket kit. Afterwards we collected feedback from all the employees about the system and their experience.

**Relevance to BUTLER horizontal storyline**
Daisy is now the manager of the transportation system. All the personnel of the train is provided with the pocket kit. Daisy manages the identification of the personnel in particular trains by proper registration of the ID in the central database that is used for the authentication of the personnel in particular trains.

**Disseminated messages**
The system is very convenient to the Personnel in train because they usually don’t have free hand to push a button.

**Trial metrics**
- ✓ Technical performance
- ✓ Trial duration
- ✓ Dissemination impact
- ✓ Types of end-users
- ✓ Number of involved users
- ✓ User Satisfaction

**Security concerns**
The door of the wagons are opened for the registered personnel not for others

6.3.8.2. Technical implementation

| Implementation versions               | Demonstration movie
|                                      | Portable BUTLER demonstrator for exhibitions
|                                      | Fixed BUTLER demonstrator installed at public sites of partners
|                                      | BUTLER cloud services including online user feedback mechanisms
|                                      | Prototypes of BUTLER platform components
|                                      | BUTLER related products
| Involved partners                     | ZPOS, JUB
### Development start
08.2012

### Release dates
04.2013

### System overview
A Kit is installed at the door between the wagons and a Pocket kit is provided to each personnel. The kit equipped in the door senses the pocket kit if it is near enough and activated the door control circuitry that is already present in the train.

### GUI mock up
Not applicable

### Hardware infrastructure
- Door kit - to be equipped at each of the door (Provided by Zigpos)
- Pocket kit – to be provided to each personnel (Provided by Zigpos)
- Batteries and chargers

### Software infrastructure
Firmware programmed in the flash of both the kits.

### Technical tests
Technical tests have been performed in our lab before the first field trial.

### Security mechanisms
AES and DES encryption

#### 6.3.8.3. Trial execution

<table>
<thead>
<tr>
<th>Deployment date</th>
<th>Dec 2012 (first)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>ZPOS</td>
</tr>
<tr>
<td>Installation requirements</td>
<td></td>
</tr>
<tr>
<td>- Power 220V</td>
<td></td>
</tr>
<tr>
<td>- 3,6 V battery</td>
<td></td>
</tr>
<tr>
<td>- GPRS connection</td>
<td></td>
</tr>
<tr>
<td>- LAN connection</td>
<td></td>
</tr>
<tr>
<td>- WiFi connection</td>
<td></td>
</tr>
<tr>
<td>- Provided Kits</td>
<td></td>
</tr>
</tbody>
</table>

| Trial environment |
| Wagon between the trains |

| User feedback types |
| Questionnaires from BUTLER demonstrations at exhibitions |
| Questionnaires from BUTLER fixed demonstrators of partners |
| BUTLER online questionnaires and surveys |
| Feedback on prototypes of BUTLER platform components |
| Feedback on BUTLER related products |

| Execution structure |
| 1. Development |
| 2. Initial filed trial and feedback collection |
| 3. Upgrading and improving |
| 4. Retrial |

| Execution schedule per iteration |
| W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 |

| Number of involved users |
| Iteration 1 | Iteration 2 | Iteration 3 |
| 10 | 15 | 25 |

| Used methods to address the security concerns of involved users and stakeholders |
| Authentication of Personnel |

| Trial feedback collection questions |
| - General impression, how useful is a system. |
| - Benefits, necessities, motivation, advantages |
| - Possibility for improvement |
| - Pricing |
| - Disadvantages, hesitations |

#### 6.3.8.4. Data analysis and interpretation

| Usage statistics preparation process |
| - Messages from users |
| - Number of users and sensors |
User feedback analysis

All the employees were satisfied in overall to have such a system. Most of them had commented that they had to wait for some time before the doors between the wagons get automatically opened. They would be happier if we could improve the latency.

Interpretation process

- Information consumers
- Operations and maintenance team
- Service providers (organizations)

Results and conclusions

The system works well but with little delay between arrival of employee and real opening of the door. The next iteration will be more accurate and much faster.

Integration in the implementation

Modelling of the real field environment for the improvement of delay of the system with sufficient accuracy and optimal energy efficiency.

### 6.3.9. Public Transportation

#### 6.3.9.1. Trial motivation, description and metrics – The smart transport (Year 3)

<table>
<thead>
<tr>
<th>Field Trial Title</th>
<th>Smart Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involved partners</td>
<td>ZPOS, JUB</td>
</tr>
<tr>
<td>Authors</td>
<td>Anup Shrestha, Erik Mademann</td>
</tr>
<tr>
<td>Description Date</td>
<td>28.03.2013</td>
</tr>
</tbody>
</table>

**Trial motivation**

- Technical feasibility
- Technology integration
- Deployment and maintenance efforts
- Scalability
- User comfort
- User acceptance

**Trial scenario**

The trail would demonstrate that a door of a public transportation vehicle will only be closed if all members of a group are in or out of it. The group in the real scenario may be a child group with a teachers. As a teacher or childcare person would like to make sure the bus or the tram is not leaving a station before all members of her children group are on/off board the vehicle.

**Relevance to BUTLER horizontal storyline**

Maria works as a child taker where frequently needs to take the children in different trips. She uses our smart transport – child care system to ensure that no child is left behind at any one of the bus station during the trip.

**Disseminated messages**

The system ensures that no any person is left behind during the trip at any of the station during the trip.

**Trial metrics**

- Technical performance
- Trial duration
- Dissemination impact
- Types of end-users
- Number of involved users
- User Satisfaction

**Security concerns**

The system keeps record of the position of each individual during the trip. People may hesitate to being tracked.
### 6.3.9.2. Technical implementation

<table>
<thead>
<tr>
<th>Implementation versions</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Demonstration movie</td>
</tr>
<tr>
<td>☐ Portable BUTLER demonstrator for exhibitions</td>
</tr>
<tr>
<td>☐ Fixed BUTLER demonstrator installed at public sites of partners</td>
</tr>
<tr>
<td>☐ BUTLER cloud services including online user feedback mechanisms</td>
</tr>
<tr>
<td>☐ Prototypes of BUTLER platform components</td>
</tr>
<tr>
<td>☐ BUTLER related products</td>
</tr>
<tr>
<td>✓ Demonstration</td>
</tr>
</tbody>
</table>

#### Involved partners

ZPOS, JUB

#### Development start

08.2012

#### Release dates

10.2013

---

**System overview**

- Internet
- Gateway, databases
- WSN with RTLS

---

**GUI mock up**

---

**Hardware infrastructure**

The system is composed primarily by the ZIGPOS platform in order to secure a high accurate RTLS for group localization relative to an existing subsystem like a bus or train. Therefore different peripheries are integrated in ZIGPOS modules (i.e. ZP2.4rnCD).

- Accelerometer (3 axis), used for power saving modes and decision making of moving or standing object
- Battery, radio node’s will be battery powered in order to demonstrate a small form factor, portable and energy efficient way to locate via short range radio
- Gateway / Server Station, to harvest all information and visualize actual state of swarm modules, coupled with a virtual bus-door, that shows the actual state of closing or opening bus door depending on the positions of each node

**Software infrastructure**

The Demonstrator will be based on a JAVA-application where one has to describe the virtual train or bus (map). The radio modules are capable of finding their role inside the network. Only the master module (i.e. the teacher in a child-class) should declare an own state. The demonstration can be started via a graphical user interface and can be setup via xml-files and images (Background-images of the demonstrating bus size, height etc. can be defined via XML or in the GUI in real-time).

**Technical tests**

The system will first be technically tested in the virtual bus in our lab before the first field trial.

**Security mechanisms**

AES and DES encryption in the positioning kit, additional security in the gateway and database.

### 6.3.9.3. Trial execution

<table>
<thead>
<tr>
<th>Deployment date</th>
<th>01.12.2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>ZPOS</td>
</tr>
</tbody>
</table>
| Installation requirements | ☐ Power 220V  
☑️ 3,6 V battery  
☐ GPRS connection  
☑️ LAN connection  
☑️ WiFi connection  
☑️ Provided Kits |
| Trial environment | We are collaborating with ITVS (German - Informationstechnik für Verkehrssysteme, literally Transport Systems Information Technology) which is part of Institute for Traffic Telematics at the Faculty of Transportation and traffic sciences “Friedrich List” of the TUD (Technische Universität Dresden) for the year 3 field trial. The trial will compose primarily by the ZIGPOS platform in order to secure a high accurate RTLS for group localization relative to an existing subsystem like a bus or train which will be managed by ITVS. |
| User feedback types | ☑️ Questionnaires from BUTLER demonstrations at exhibitions  
☑️ Questionnaires from BUTLER fixed demonstrators of partners  
☐ BUTLER online questionnaires and surveys  
☐ Feedback on prototypes of BUTLER platform components  
☐ Feedback on BUTLER related products |
| Execution structure | 1. Development  
2. Initial filed trial and feedback collection  
3. Upgrading and improving  
4. Retrial |
<p>| Execution schedule per iteration | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 |</p>
<table>
<thead>
<tr>
<th>Number of involved users</th>
<th>Iteration 1</th>
<th>Iteration 2</th>
<th>Iteration 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used methods to address the security concerns of involved users and stakeholders</td>
<td>Positioning of the users only inside the vehicle. Convince them that they are not tracked outside the bus.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Trial feedback collection questions | • General impression, how useful is a system.  
• Benefits, necessities, motivation, advantages  
• Possibility for improvement  
• Pricing  
• Disadvantages, hesitations |

6.3.9.4. Data analysis and interpretation

| Usage statistics preparation process | • Messages from users  
• Number of users |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>User feedback analysis</td>
<td>Systematization of informal and formal user feedback received from users during workshops, filled-in questionnaires and available statistics</td>
</tr>
</tbody>
</table>
| Interpretation process | • Information consumers  
• Operations and maintenance team  
• Service providers (organizations) |
| Results and conclusions | Interpreted data will be summarized into general statements regarding system feasibility, critical points and next improvement steps |
| Integration in the implementation | Critical points and next improvement steps serve as update for system and user requirements in the next iteration of the development. |

6.3.10. Parking Monitoring

6.3.10.1. Trial motivation, description and metrics

<table>
<thead>
<tr>
<th>Field Trial Title</th>
<th>Parking Monitoring Field Trial (PMFT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involved partners</td>
<td>TST</td>
</tr>
<tr>
<td>Authors</td>
<td>Juan Sancho</td>
</tr>
<tr>
<td>Description Date</td>
<td>18.03.2013</td>
</tr>
</tbody>
</table>

Trial motivation

- Technical feasibility
- Technology integration
- Deployment and maintenance efforts
- Scalability
- User comfort
- User acceptance

Trial scenario

Franck works in the city council. He is in charge of making sure that the parking spaces of the city are being used properly. In this sense, he utilizes powerful mechanisms for controlling the availability and usage of every parking space in the city, them accessible from any smartphone using right credentials.

Relevance to BUTLER horizontal storyline

Parking traffic in a city can be predicted studying the historic evolution of parking space demand at a certain period of day. This info can then be output to an intelligent system which can aid in the redistribution of traffic.
in the city, for example applying different pricing for those parking spaces more demanded at a time, or toggling traffic lights appropriately.

Disseminated messages

A dynamic parking management system predicts and analyzes city requirements for adapting services that it manages.

Trial metrics

- Technical performance
- Trial duration
- Dissemination impact
- Types of end-users
- Number of involved users
- User Satisfaction

Security concerns

Accessing to monitoring services suppose executing actions with critical consequences in a real city environment. For that reason, dedicated profiles with levelled-privileged rights may be created. Users assigned to these profiles must be followed up, for instance recording their actions for future analysis in case malfunctions occur.

6.3.10.2. Technical implementation

Implementation versions

- Demonstration movie
- Portable BUTLER demonstrator for exhibitions
- Fixed BUTLER demonstrator installed at public sites of partners
- BUTLER cloud services including online user feedback mechanisms
- Prototypes of BUTLER platform components
- BUTLER related products

Involved partners

TST

Development start

01.07.2012

Release dates

V1: 01.09.2012; V2: 15.04.2013

System overview
To deploy a complete smart parking system will be necessary:
- Vehicle detection sensors
- Led lamps for displaying the state of availability of each space
- SmartObject for interconnecting the above elements with rest of the system
- Energy supply source or batteries
- Personal mobile devices
- Connecting adapters and cables
- A post where grabbing the SmartObject

The SmartObject has to manage a WSN of vehicle detection devices and provide their information to the SmartServer. In addition, this element will be in charge of actuating the led lamps.

The SmartServer should provide a context-aware reservation system so that bookings can be made in a smarter way.

Some additional features can be reused from other scenarios, such as:
- A secure payment system
- A user authentication system
- A GUI accessible from a SmartMobile, a laptop, a screen panel...

Technical tests have been done in a laboratory and in a controlled street scenario without involving real users. The technology is ready to be deployed for long run tests that may precise additional functional tests as well as non-functional tests like performance, reliability, adaptability and interoperability.

6.3.10.3. Trial execution

<table>
<thead>
<tr>
<th>Deployment date</th>
<th>15.04.2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>TST</td>
</tr>
<tr>
<td>Installation requirements</td>
<td></td>
</tr>
<tr>
<td>☐ Power 220V</td>
<td></td>
</tr>
<tr>
<td>☑ 5V battery</td>
<td></td>
</tr>
<tr>
<td>☑ GPRS connection</td>
<td></td>
</tr>
<tr>
<td>☐ LAN connection</td>
<td></td>
</tr>
<tr>
<td>☐ WiFi connection</td>
<td></td>
</tr>
<tr>
<td>Trial environment</td>
<td>Public parking space near TST facilities or near University of Cantabria</td>
</tr>
<tr>
<td>User feedback types</td>
<td></td>
</tr>
<tr>
<td>☑ Questionnaires from BUTLER demonstrations at exhibitions</td>
<td></td>
</tr>
</tbody>
</table>
Questionnaires from BUTLER fixed demonstrators of partners
☑ BUTLER online questionnaires and surveys
☑ Feedback on prototypes of BUTLER platform components
☑ Feedback on BUTLER related products

1. Development and configuration of the main 3 PoC elements: SmartObject, SmartMobile and SmartServer
2. Installation of the elements in a fixed controlled street scenario
3. Conducting trials with selected users
4. Data gathering and analysis
5. Implementation update

<table>
<thead>
<tr>
<th>Execution schedule per iteration</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
<th>W7</th>
<th>W8</th>
<th>W9</th>
<th>W10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of involved users</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iteration 1</td>
<td>15</td>
<td>35</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iteration 2</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iteration 3</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

All personal information must be excluded from sharing. Therefore the application operators have to define the common policy for:
- Information sensitivity measurement
- Sharing and accessing information depending on sensitivity level

The following feedback is going to be collected from PMFT users:
- Level of understanding of the system. Is it too complex?
- Is it efficient in terms of usability? Excludes users?
- Advantages, improvements
- Concerns, disadvantages, downsides
- Willing to make use of the solution

6.3.10.4. Data analysis and interpretation

<table>
<thead>
<tr>
<th>Usage statistics preparation process</th>
<th>Data collected from monitoring applications and users will be made available for usage statistics, as for example the number illegal parking situations, infringements, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>User feedback analysis</td>
<td>Systematization of informal and formal user feedback received from PMFT users during workshops, filled-in questionnaires and available statistics</td>
</tr>
<tr>
<td>Interpretation process</td>
<td>The interpretation of the collected data is planned to be done from the perspective of different stakeholders: Information consumers, Operations and maintenance team, Service owners, Resource owners</td>
</tr>
<tr>
<td>Results and conclusions</td>
<td>Interpreted data will be summarized into general statements regarding system feasibility, critical points and next improvement steps</td>
</tr>
<tr>
<td>Integration in the implementation</td>
<td>Critical points and next improvement steps serve as update for system and user requirements in the next iteration of the PMFT development</td>
</tr>
</tbody>
</table>

6.3.11. Parking Reservation

6.3.11.1. Trial motivation, description and metrics

<table>
<thead>
<tr>
<th>Field Trial Title</th>
<th>Parking Reservation Field Trial (PRFT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involved partners</td>
<td>TST</td>
</tr>
<tr>
<td>Authors</td>
<td>Juan Sancho</td>
</tr>
<tr>
<td>Description Date</td>
<td>05.03.2013</td>
</tr>
<tr>
<td>Trial motivation</td>
<td>☑ Technical feasibility</td>
</tr>
<tr>
<td></td>
<td>☐ Technology integration</td>
</tr>
</tbody>
</table>
Trial scenario

Daisy will have to drive to the city center for making a purchase at her favorite bag store, thus the day after she makes a reservation for a parking place near that shop.

Relevance to BUTLER horizontal storyline

In a city scenario there are a huge number of users, services and resources whose interactions evolve continuously and provide valuable information for intelligent systems that may make use of it. Collecting, processing and studying this information are efforts in which smart cities nowadays are involved in. In this sense, a smarter parking management system can use that information to provide enhanced services such as an intelligent reservation service with dynamic price assignment.

Disseminated messages

The enrichment of the parking system in a city improves citizen’s quality of life since half of the traffic congestion in urban areas is due to drivers looking for a place to park.

Trial metrics

- Technical performance
- Dissemination impact
- Types of end-users
- User Satisfaction

Security concerns

For a correct usability of this service citizens must be registered into the system. To create a profile will be requested:

- Personal identity of the user.
- Vehicle information (license plate, type of vehicle, ...)

Additionally, users may provide information related to their context such as their daily schedule and real-time localization.

6.3.11.2. Technical implementation

Implementation versions

- Demonstration movie
- Portable BUTLER demonstrator for exhibitions
- Fixed BUTLER demonstrator installed at public sites of partners
- BUTLER cloud services including online user feedback mechanisms
- Prototypes of BUTLER platform components
- BUTLER related products

Involved partners

TST

Development start

01.07.2012

Release dates

V1: 01.09.2012; V2: undefined

System overview
To deploy a complete smart parking system will be necessary:

- Vehicle detection sensors
- Led lamps for displaying the state of availability of each space
- SmartObject for interconnecting the above elements with rest of the system
- Energy supply source or batteries
- Personal mobile devices
- Connecting adapters and cables
- A post where grabbing the SmartObject

The SmartObject has to manage a WSN of vehicle detection devices and provide their information to the SmartServer. In addition, this element will be in charge of actuating the led lamps.

The SmartServer should provide a context-aware reservation system so that bookings can be made in a smarter way.

Some additional features can be reused from other scenarios, such as:

- A secure payment system
- A user authentication system
- A GUI accessible from a SmartMobile, a laptop, a screen panel...

Technical tests have been done in a laboratory and in a controlled street scenario without involving real users. The technology is ready to be deployed for long run tests that may precise additional functional tests as well as non-functional tests like performance, reliability, adaptability and interoperability.

Security mechanisms

<table>
<thead>
<tr>
<th>Deployment date</th>
<th>15.04.2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosting partners</td>
<td>TST</td>
</tr>
<tr>
<td>Power 220V</td>
<td>☑</td>
</tr>
<tr>
<td>5V battery</td>
<td>☑</td>
</tr>
<tr>
<td>GPRS connection</td>
<td>☑</td>
</tr>
<tr>
<td>LAN connection</td>
<td>☐</td>
</tr>
<tr>
<td>WiFi connection</td>
<td>☐</td>
</tr>
</tbody>
</table>
### Trial environment
- Public parking space near TST facilities or near University of Cantabria

### User feedback types
- ✅ Questionnaires from BUTLER demonstrations at exhibitions
- ☐ Questionnaires from BUTLER fixed demonstrators of partners
- ☐ BUTLER online questionnaires and surveys
- ✅ Feedback on prototypes of BUTLER platform components
- ☐ Feedback on BUTLER related products

### Execution structure
1. Development and configuration of the main 3 PoC elements: SmartObject, SmartMobile and SmartServer
2. Installation of the elements in a fixed controlled street scenario
3. Conducting trials with selected users
4. Data gathering and analysis
5. Implementation update

### Execution schedule per iteration
<table>
<thead>
<tr>
<th></th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
<th>W7</th>
<th>W8</th>
<th>W9</th>
<th>W10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of involved users</td>
<td>Iteration 1</td>
<td>Iteration 2</td>
<td>Iteration 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Used methods to address the security concerns of involved users and stakeholders
- All personal information must be excluded from sharing. Therefore the application operators have to define the common policy for:
  - information sensitivity measurement
  - sharing and accessing information depending on sensitivity level

### Trial feedback collection questions
- The following feedback is going to be collected from PRFT users:
  - Level of understanding of the system. Is it too complex?
  - Is it efficient in terms of usability? Excludes users?
  - Advantages, improvements
  - Concerns, disadvantages, downsides
  - Willing to make use of the solution

### 6.3.11.4. Data analysis and interpretation

#### Usage statistics preparation process
- Data collected from sensors and users will be made available for usage statistics, as for example the number of reservations per period, the most demanded spaces, etc.

#### User feedback analysis
- Systematization of informal and formal user feedback received from PRFT users during workshops, filled-in questionnaires and available statistics

#### Interpretation process
- The interpretation of the collected data is planned to be done from the perspective of different stakeholders:
  - Information consumers
  - Operations and maintenance team
  - Service owners
  - Resource owners

#### Results and conclusions
- Interpreted data will be summarized into general statements regarding system feasibility, critical points and next improvement steps

#### Integration in the implementation
- Critical points and next improvement steps serve as update for system and user requirements in the next iteration of the PRFT development

### 6.4. Current status

The following trials have been already launched according to overview and progress monitoring data from section 6.1:
- Energy Awareness Field Trial
- Office Information Field Trial
- Activity Measurement and Recognition Field Trial
• Train Staff Assistance Field Trial
• Parking Monitoring and Reservation Field Trial

6.4.1. Energy Awareness Field Trial
Following field trial description in the section 6.3.1 and apart of energy awareness visualization front-end 5 intelligent energy measurement plugs have been installed in the iHL premises. These intelligent plugs deliver the energy measurement data in the near-to-real-time mode and also allow switching on and off the plugged loads. At first stage the loads consist of office lighting, office computer working stations and small soldering station of electrical engineering lab. This way the office energy awareness field trial is actively involving 20 end-users of category 4 according to definitions from section 4.3.2 (beta-testers of BUTLER prototypes). First acceptance feedbacks are positive. The system is being actively used to raise the awareness on and reduce the energy consumption of office operation. ST-I, ERC and TIL have started the preparation process on integration and installation of their components into the main system.

6.4.2. Office Information Field Trial
Following field trial description in the section 6.3.3, the first prototype of office information sharing system has been deployed on the iHL mail server. Three visualization clients including public displays have been installed in the iHL premises. This way the office information field trial is actively involving 20 end-users of category 4 according to definitions from section 4.3.2 (beta-testers of BUTLER prototypes). First acceptance feedbacks are positive. The system is being actively used to share the informal data in the office. UL, Inno, TIL and CEA have started the preparation process on visualization client installation.

6.4.3. Activity Measurement and Recognition Field Trial
This field trial is currently available for mobile phones as an Android application. A first cross-platform version using Javascript and HTML5 leveraging the PhoneGap framework is also available, but is not yet as mature for field trial purposes.
In its most basic form it captures and classifies motion activity by leveraging the accelerometer for step counting and to differentiate between standing still, walking and running. The implementation offers a visualization component (mainly intended for Android tablets with larger displays) that helps users better understand the inner workings of the algorithms and it enables the users to immediately visually assess the effectiveness of the implemented algorithms. Initial trials with 10 people to verify the technical feasibility using the same Android device result in positive feedback about the accuracy. Similar feedback was received at a local symposium in Belgium attended by about 70 researchers where participants had the opportunity to try out the application. However, the performance results vary when other Android devices are used due to the accelerometer possibly having different sensitivities, sampling rates and jitter characteristics. The feasibility analysis of used machine learning techniques using Weka on the Android device also produced mixed results, with the learning phase requiring several minutes to complete depending on the amount of data being captured during the training phase. Based on this feedback, transfer learning based on existing data sets is being explored as a viable technique to address the aforementioned identified issues.

6.4.4. Train Staff Assistance Field Trial - Smart Glacier Express
So far we have been able to successfully accomplish the first field trial with positive user feedbacks. However, we observed a little latency in our current system during the field trial and we are working to get rid of it. The users sometimes recognize a delay before the door gets opened automatically. The delay is not that noticeable for the time being since it is relatively faster than pushing the button to open it, however we want our system to have complete non-perceptible delay. Currently we are working to reduce the latency or delay nevertheless without degradation in accuracy and energy efficiency. These three parameters are tightly related to each other as shown in Erreur ! Source du renvoi introuvable. and Erreur ! Source du renvoi introuvable.. The low accuracy in the system would mean opening of the door even the user is not close enough. This would lead to non-intentional opening of the door. Low energy efficiency would mean the user needs to replace the battery quite often.
One cannot design the system with minimum latency and at the same time obtain optimal energy efficiency and attain highest accuracy. On the other way round, if we design the system for optimal energy efficiency, we should compromise with the latency and accuracy. We constrain our design with the maximum latency that is not perceptible by human being, make the system accurate enough to protect from non-intentional opening of the door and then optimize the energy efficiency. The system will have highest possible accuracy, with optimum energy efficiency and non-perceptible latency by the users. We are planning to start our second iteration of the field trial by the end of April 2013 (M19).

Figure 37: Accuracy, Energy efficiency and Latency and their impact in user experience
6.4.5. Parking Monitoring and Reservation Field Trial

During the preparation of the 1st SmartParking Proof-of-Concept a demonstrator was produced to showcase the deployment of a real parking solution. The current SmartParking Field Trial is using the previous setup to obtain a valuable feedback from potential users. In particular, right now two groups of users are under study:

1. Regular citizens who have a smartphone
2. Municipality workers related to parking management in the city

We consider these two groups of people as the ones that more probably may use the SmartParking solution in the future. We are aware that within the first group there could be some subsets of citizens which may not, for example those people who don’t have a car yet. But still, we think that getting their feedback could be also a positive way of extracting valuable conclusions.

As presented in previous sections, we get user feedback conducting dedicated surveys after explaining the behavior of the SmartParking solution, its components and the interactions between them, and the application flow for both situations: reserving and monitoring parking spaces. In particular, the first survey was carried out in the 1st PITSaC Workshop held in Barcelona the 26th-27th of March, 2013. Refer to Annex F to dig into the questionnaire. The answers and conclusions extract from it will be made available in coming deliverables. For the time being, we will keep improving the questionnaire, adjusting some questions, producing new ones, creating a second questionnaire for dedicated sessions, etc.
7. Horizontal Proofs of Concepts

7.1. Objective and metrics of success

7.1.1. Enabling technologies viewpoint on trial objectives and metrics of success

Workpackage 2 (WP2) as part of BUTLER provides enabling technologies for pervasive and secure context-aware internet of things for its horizontal platform and architecture. It provides a set of functional enabling technologies which provide scientific technologies and innovations upon which the internet of things would be based.

The Objectives include:

- To develop the core technologies and science for trustful and secure communication and dissemination of context, for acquisition and provision of geo-temporal location awareness.
- To model and exploit user’s behavior, for development of innovative contextualized network functionalities and services.
- The works will be carried out with the vision of a pervasive internet of things that includes multiple technologies, dynamic environmental changes and virtual user definitions.
- This will be aimed at setting a basis of scientific innovation upon which the future Internet of Things will continue to develop in the long-term.

The Metric of Success:

The metric of success are the developed means to track and measure the accomplishment of the objectives stated above for the horizontal PoC. The key is to ensure that the work package goals are met. It involves a composite of measures that yield systematic insight into the state of horizontal PoC and enable appropriate action to be taken. Metrics would be composed of both objective data such as data stored in the database and subjective data such as expert opinions by experts or EU officials.

- **Scalability**: Enabling technologies in the horizontal platform of the PoC should be able to handle a growing amount of work in a capable manner and its ability to be enlarged to accommodate that growth. The horizontal PoC must continue to function well when its context is changed in size or volume in order to meet the need of developers and end users. Typically, the rescaling is to a larger size or volume or in the scalable technologies’ movement to a new context.

- **Technical performance**: The innovated and proposed enabling technologies should perform better and be more efficient and effective that the current state of the art enabling technologies available in the market. They also should have lower latency, higher throughout and performance that the currently available technologies.

- **Impact**: The developed scientific innovations for the horizontal platform of the enabling technologies should influence and impact the current and future internet of things which would be continually developed in the long-term.

- **Security**: In BUTLER, the horizontal PoC should be able to defend its information and technologies from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction. The horizontal PoC should ensure that information is not lost when critical issues arise. These issues include are not limited to; computer/server malfunction, physical theft, or any other instance where information has the potential of being lost. One of the most common methods of providing information assurance is to have an off-site backup of the data in case one of the mentioned issues arises.

- **Interoperability**: The system must be diverse and have the ability to interoperate with other diverse systems seamlessly. The term is often used in a technical systems engineering sense, or alternatively in a broad sense, taking into account social, political, and organizational factors that impact system to system performance.
- Feasibility: This involves the analysis and evaluation of the selected enabling technologies proposed in the work package. This aims to objectively and rationally uncover the strengths and weaknesses of the enabling technologies, opportunities and threats as presented by the environment, the resources required to carry through, and ultimately the prospects for success of the horizontal PoC. In all, the cost required to undergo the enabling technologies of the work package is evaluated and the value to be added would be attained and its potential for success.

7.1.2. Architecture viewpoint on trial objectives and metrics of success

BUTLER will include, as part of its horizontal platform, a set of back and front-ends functional components that will enable device owners to organize and expose the real-time information generated by sensors located in different physical locations. Real-time data flows will be organized by device owners in information packages that later on will be exposed in the BUTLER Marketplace to let external developers discover and purchase them and subsequently use them to build real-time applications. Companies or individuals will be the main target of these real-time applications market.

The set of horizontal back-end functional components will include:

- a geodetic database (for storing the information related to the location of the sensors and the different virtual entities that contains said sensors);
- a Complex Event Processing (CEP) engine and the associated event processing functionality that defines the way the CEP engine processes the real-time information and how it is organized into packages ready to be offered in the market place;
- adaptors to transform the data model of the information coming from sensors to the internal event data model used by the CEP engine;
- a rule engine integrated with the CEP engine and the device owner graphical environment that enables said device owner to organize the real-time data flows into packages;
- a No-SQL database to cache relevant information coming from devices to enable subsequent delivery to customers;
- when dealing with output interfaces and APIs, there will be a set of procedures and technologies to allow developers to use real time data flows.

In the front-end side there will be a web based graphical interface for Device Owners that will enable them to organize real-time devices, packages, entities that later on will be offered in the market-place front-end for being used by developers.

A market place will allow third party developers to buy and use data flows coming from devices already exposed by the Device Owners.

The main goal for this Horizontal Proof-of-Concept will be to set up an end-to-end system including a limited set of data model adaptors, a Device Owner Platform to allow the organization and exposition of real-time data flows and a market place for developers to discover and purchase the information.

Following is provided a summary of the metrics defined to validate the success of this horizontal PoC is provided:

- Max number of concurrent Devices: 500
- Max number of defined Information Packages (rules)/total: 500
- Max Latency: 1 second
- Max Throughput input: 100 ms
- Max Throughput output: 100 ms
- Max number of Device Owners (concurrent): 25
- Max number of Developers in the market place (concurrent): 25
Platforms viewpoint on trial objectives and metrics of success

The three BUTLER horizontal platforms: SmartServer, SmartMobile and SmartObject/Gateway will constitute the ‘building blocks’ for the development of trial applications.

The building blocks are designed using a common approach that should ease their integration into trial applications, leaving to the developers more time to concentrate on the real business logics of the SmartLife services to be offered.

In particular the initial set of SmartServers made available at Month 24, will offer to trial application developers a set of local or remote (cloud) APIs to perform certain horizontal functionalities like: user registration, context awareness, localization, event processing, etc.

On the mobile side, by providing to application developers the SmartMobile common mobile framework based on PhoneGap and JavaScript APIs, many horizontal functionalities like: User Interfaces components, user profiling, authentication and authorization, SmartServer discovery, receiving notifications from servers etc. will all be already provided and implemented, again to simplify the life of the developer.

Finally, the common API design for the SmartObject/Gateway platform will be the key point to be able to integrate easily different Gateways that provide access to different SmartObjects, without requiring the application developer to know the complexity of the interconnection of objects behind the gateway and how functionalities (data gathering, or actuations) are performed on the objects. The objective for the horizontal SmartObject/Gateway approach is to be able to switch easily from one BUTLER gateway implementation to another one, from acting on one object to another one, without radically changing the approach, but on the opposite making only a reconfiguration of the endpoint, or modifying the action to be sent to the object.

The methodology to validate the approach is based on defining appropriate metrics and asking developers to provide their evaluation, based on those metrics, about their experience while developing trial applications using the BUTLER horizontal platforms.

By analyzing those feedbacks on the defined metrics, the second release of the BUTLER platforms will be improved to match developers’ expectations.

In the following we provide the list of the metrics defined to validate the success of the horizontal approach from a platform point of view. As said, these metrics should be used as an evaluation from trial applications developers.

- Effectiveness of Common API design
  - are the building blocks API designed with a common approach?
  - is this approach effective to achieve integration of building blocks into applications?
  - does the chosen API approach favor reuse of building blocks across several IoT application domains?

- Coverage of horizontal functionalities
  - are the building blocks provided in the horizontal platforms covering the majority of required horizontal functionalities of trial applications?

- Correctness of the implementations and documentation
  - is the documentation of the building blocks APIs well structured and effective?
  - do the building blocks implementation provide the expected behavior as documented

Horizontal scenario definition process – one day in 2020

At the beginning of the project BUTLER there were the vertical use cases, derived from the expertise of the participating partners, which led to the initial requirements for the first demonstrators.

But vertical use cases or vertical user stories are not what BUTLER is really about. If BUTLER is truly to be an ubiquitous, pervasive and context aware system a horizontal storyline integrating the vertical approaches was needed. The picture below illustrates the approach developed in the first phase of the
project, which is described in detailed way in D1.1. This approach guides the project across the Workpackages until the end of project.

![Diagram](image.png)

**Figure 39: The Eco-System of a Business Driven Project**

So merging the actors from the individual vertical use cases into fully fleshed personas and taking into consideration the ideal experience we want the user to have with BUTLER, we developed the horizontal storyline, which is illustrated in the BUTLER Vision (Figure 40) below. The horizontal storyline shows a sample day in the life of our 6 personas with the possible interactions the personas have with a BUTLER system. Each persona is related to a specific profile of a possible target group of BUTLER end users according to their specific needs, lifestyles, demographics and other indicators.

The project technical targets related to context and location awareness, security or behaviour predicting algorithm are not an end in itself but rather a means to deliver true value to potential customers. Therefore the project focal point of interest still has to be the human being interacting with BUTLER and not the machines or things BUTLER consists of.
The aggregation of the use cases of each vertical domain (smartHome/Office, smartHealth, smartCity, smartTransport, smartShopping) into one let’s call this “Smart Life Product” from end user perspective generates several challenges behind the scenes, for instance in the process of User/Business Requirements Aggregation across the vertical domains.

The horizontal view of a story on the requirements level, which is a sum of a few use cases of different vertical domain origin cannot be defined as just the sum of User / Business Requirements Sets (BRS) of each single use case. In the process of requirements horizontalization there are a few additional aspects to be considered like interdependencies, restrictions, and conflict resolution mechanism (Figure 41).
7.2.1. Scenario definition process

Let’s have a closer look at one sample episode of the horizontal storyline, because already with just one episode the power and the demands of an integrated BUTLER system become obvious.

In this sample episode Donald, an office worker in his early fifties is looking for a parking place close to his office and is assisted by his BUTLER.

Meanwhile, her husband Donald is late for work and needs a parking space close to his office. He is alerted to one and the parking fee is added to his phone bill.
• find a parking place as close to the office as possible
• take care of all the tasks concerning reservation and payment of this parking place
This is straightforward and still very much a vertical example from the Smart City domain.
But if we consider Donald’s persona description (see Figure 43) we learn that Donald wants to lose some weight, so chances are, that Donald also uses BUTLER to receive fitness tips and has asked BUTLER to set up exercises for him, whenever it’s convenient.

![Donald Oliver, 51 Office job, mid-managerial level in a major bank Married (with Daisy) 2 Children](image)

| Financial Status: |
| Affluent middle class |
| Wife has a part-time job and earns some extra money |
| Living Situation: |
| House Owner (4 bedrooms, 2 living and dining rooms, home office, large family kitchen, wellness area with home sauna) Holiday flat in a tourist area (mountains, seaside, lakeshore) |
| Location of Living: |
| Suburban Countryside |
| Mobility and Transport: |
| Family car (van), mostly driven by wife Electric car driven by husband |
| Hobbies: |
| Member of a male culinary club Jogging |
| Health and Physical Conditions, Diet Preferences: |
| Hip fracture |
| Wants to lose some weight |
| Shopping Behaviour: |
| Internet shopping for special ingredients (spices, exotic food) Makes everyday purchases and prefers to leave that to his wife Orders his shifts massaxter when on demand |

Figure 43: Persona Description for Donald - Extract.

So there may very well be an additional set of business rules stating:
• Make sure I move at least 30-60 minutes per day, preferably integrated in my regular schedule
• As long as it’s not raining, walking from the parking to the office is acceptable

Again fairly straightforward, but potential conflicts are already visible.
• As long as Donald has enough time, he might even enjoy a walk from the parking place to the office, so BUTLER can fulfil both sets of rules.
• But if there is an important meeting in the morning and Donald is already late, he’d probably rather not have to walk as well.

Of course we can imagine conflict resolution rules that deal with this, and since BUTLER probably also manages or at least knows Donald’s schedule, there should be no major problem.

So what happens, if Donald strains his ankle? As long as the ankle has not fully healed, walking longer stretches or up some stairs cases is out of the question and Donald fully expects his BUTLER to know about this – after all BUTLER also keeps the health journal and sets up the communication with the doctor – and to take that handicap into consideration, when selecting a parking place and the correct walking route to the office.

So even more information management and processing, context awareness and conflict resolution is necessary to keep Donald happy.

And what if Donald has a new boss and would really like to “accidentally” meet the boss in the morning and join the new boss on his walk to the office. How would these intents be translated into business rules a machine could understand and follow, or should this be the point, where the system boundaries are finally reached?

From just this one example it becomes painfully obvious, that the integration of vertical and specialised IoT applications into a truly ubiquitous and pervasive IoT system leads to many technical and architectural challenges, for example in
- **Data Modelling**, taking into account the different semantics of data according to the context the data is coming from or used in
- **Data Management**, i.e. topics like
  - Data Collection: which data and how much of it should be collected and how should the collection be done
  - Data Storage: who can access this data, how can the data be protected, how long should the data be available and in which granularity
  - Data Interpretation and Usage: who can use the data, for which purpose, how can context information be transported with the data
- **Conflict Resolution**
  - where automation, following clearly defined business rules or at least needing heuristic algorithms that allow determination of the likeliest response, is clearly necessary
  - and yet, automation without the possibility of interaction with a user may lead to ethical conflicts
- **User Interfaces**, which need to be simple to allow the user to give input in complex situations, when the user is already likely to be under stress and quite possibly was never adept in using technology in the first place.

However this is only one of many aspects we face during the project. In the next steps of our work there are more specifics need to be taken into account on various levels of consideration speaking of horizontalization in the context of IoT.

In the picture below (Figure 44) some sample elements are shown, that illustrate how the commercial, technical and operational spheres influence each other:

![Diagram](image)

**Figure 44 Commercial and Operational Challenges as well as User and Business Requirements influence the Horizontal Architecture**

### 7.2.2. First tentative scenario

First tentative horizontal scenario picks up a few scenes out of the life of Donald and Daisy from the storyline created by Swisscom for BUTLER.
Donald is 51 years old, works at a bank and is married with Daisy. They have 2 children. They live in a nice house in the suburbs and also own a chalet in the mountains. Donald enjoys eating out, despite his food allergies and he is interested in energy efficiency.

Daisy is 45 years old, a housewife and part-time shop assistant. She is married to Donald and has 2 children. Daisy suffers from diabetes, tries to do fitness workouts regularly and likes shopping with her girlfriends. She is glad that machines support her in her daily household tasks.

7.2.2.1. Horizontal storyline

**Story:** Donald lives together with his wife Daisy and the two kids in its own one-family house in a suburb of a bigger city. While he enjoys living and working near the city, he loves to spend his holidays in the mountains. That was the reason why he bought a chalet in a famous skiing resort two years ago. They are just about to go there for a family skiing week...

Donald is at home and watches TV when a notification pops up on the screen to notify him that for tomorrow, when they drive to the mountains, he will need to take the snow chains with him. He uses his tablet to check on the chalet and recognises that the temperature is just 12°C. Is the heating broken? BUTLER should have started heating the chalet up.

He turns on the heating manually over his tablet and a second later the system comes up with another notification: The alternative wind energy he had chosen for the operation of the electric heating system is very expensive at the moment as there is not much wind to drive the wind farms during the next 5 hours. So that was the reason why BUTLER hasn’t yet turned on the heating. However, the system predicts low energy prices for the night and still enough time to heat up the chalet to 20°C by tomorrow morning. It also gives Donald the opportunity to switch the energy source and/or turn on the heating anyway. No, that is not necessary.

By the way, Donald is curious about the real energy consumption of his new TV. Using his tablet, he points the camera at the TV screen and sees the current watts augmented over the cam image. 20W, that’s ok.

But for now Donald decides to watch the news magazine which is just about to start. After a while, his wife enters the living room. She has finished packing and wants to look at the “Ice Age”-Movie she recorded yesterday. No problem. Donald decides to go to the TV in the sleeping room and also start packing there for tomorrow. So he presses a button on his phone and Ice Age starts in the living room. He first goes to the kitchen to drink a glass of water and when he finally enters the sleeping room, the news show continues exactly at the point where he stopped watching them in the living room.

During the movie, her smart phone reminds Daisy of checking her blood values. As it’s very easy, she stops the movie for a moment. Then she takes the small testing kit and starts the app on her phone. A few moments later she sees the actual amount of sugar in her blood. She also takes a look at the measurement history of the last week and the data of her step counter (fit bit). The BUTLER App suggests
more sports and fewer sweets. It was a stressful week and she ate too much of them. So it is about time to go to the mountains for few days of skiing.

After the movie, Daisy gets another notification from BUTLER. Moon boots on sale at xyz-Store. It is one of those spark deal offers where you can register as a customer and get notified if they have your article. It is a very good offer! Those are exactly the sort of boots she wanted to have and they are on sale. She could use them well in the mountains. But she had to buy them today as they are leaving tomorrow morning. There would be even half an hour time to buy them. But finding an available parking space at this time is a nightmare. Let’s ask BUTLER. Thank god, there is a free parking space right down the corner of the shop. She immediately reserves it and heads into the town where her boots already wait for her. When Daisy arrives to the shop, she utilizes her NFC-enabled mobile to pay for the usage of the reserved parking space.

During the night, the heating turns on. BUTLER reminds that the old electric heating system is very inefficient and a nasty waste of energy. It context-sensitively calculates what he could save by replacing it.

When leaving the home for their holidays the next morning, the house automatically switches to the holiday mode.

On Monday morning, Donald’s tablet suddenly buzzes. Someone stands at the door of his home back in the city. Donald uses the app on the tablet to look who this could be. The front door is lit (BUTLER turned on the lights) and the postman stands there. Donald shortly opens the door and lets him enter the home with the packet. A minute later, he sees the postman leaving the house and BUTLER notifies “door locked” again.

### 7.2.2.2. Storyline presentation script

It would be nice to have two persons from the consortium which could play Donald and Daisy. One more option is also to involve the users from wide public by giving them a kind of role and provide them with a script, so they could actually be part of the story.

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Story</th>
<th>Audience View</th>
<th>System View</th>
<th>Resp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>00:00:00</td>
<td>[Welcome the audience and shortly introduce the PoC-Review. Present the personas and the scenario setup.]</td>
<td>3 slides presenting the scenario setup on the beamer wall.</td>
<td>PC and Beamer showing PowerPoint slides</td>
<td>IHL</td>
</tr>
<tr>
<td>2</td>
<td>00:05:00</td>
<td>Donald is at home and watches TV</td>
<td>[Walk to the 1st booth, a poster explains the “SmartHome Energy Awareness”-PoC setup and a picture shows the living room (could also be a poster on the booth or beamer a slide)]</td>
<td>Media PC running a flash client connected to the TV streams a video locally stored on the media PC.</td>
<td>IHL</td>
</tr>
<tr>
<td>3</td>
<td>00:10:00</td>
<td>Notification pops up on the screens with a snow blizzard</td>
<td>TV screen and tablet show a textbox overlay with the notification.</td>
<td>Tablet touch triggered the IHL server sends a command to the media PC</td>
<td>IHL</td>
</tr>
<tr>
<td>4</td>
<td>00:11:00</td>
<td>Donald uses the tablet to check on the chalet and recognizes that the temperature is just 12°C. Is the heating broken? BUTLER should have started heating the chalet up.</td>
<td>Presenter takes the tablet and uses it to switch the TV to the energy visualisation screen showing the energy consumption of the chalet and the local temperature at the chalets premises.</td>
<td>A push on the flash client running on the tablet sends the command to switch the screen to the IHL server which forwards it to the media PC and further to the flash client which finally switches to an energy visualisation view. The server fetches the current temperature from the temperature sensor attached to the Orly gateway, transforms it into a visualisation command and sends it to update the temperature value to the media PC which updates the flash client rendering to the TV.</td>
<td>IHL, ST-I</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>00:12:00</td>
<td>He turns on the heating manually and gets a notification that alternative energy costs much now and is asked for action. Tablet presents the possibilities to switch on and off certain loads. Among them is also the heating. The presenter uses the tablet to switch on the heating manually. Immediately after this action, notifications are shown on the TV and the tablet to ask him if he really wants to turn it on now. [Here we present the Ericsson demo movie on the beamer to give an impression on what was happening in the background] He answers with “no – turn it on automatically when energy is cheaper” to prevent the heating.</td>
<td>A push on a button on the flash client running on the tablet sends the command to switch on the heating in the chalet to the IHL server. The IHL server uses the Ericsson cloud service to get some information on the current state of the alternative energy production. The cloud service answers and the IHL server produces the commands to the tablet and the media PC (TV) to fade in a message box including the text to be shown. The answer from the tablet reaches the IHL server which produces an acknowledgement.</td>
<td>IHL, ERC</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-------</td>
<td>---------------------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 00:18:00 | **By the way,** Donald is curious about the real energy consumption of his home heater (*). Using his smartphone (android), he points the mobile camera at the electronic items around him and sees the current watts consumption of the heater superimposed to the live camera view of his smartphone. The consumption is too high (shown by the sad “energy face”), then Donald decides to switch it off.  
Presenter points  
Smartphone camera (landscape position) at the heater and soon later, the item model/brand and icon type, the theoretical energy consumption (from the manual) and the real energy consumption appears on the mobile screen overlaid to the reality.  
It is also shown:  
• the status on/off icon  
• button that points to the item pdf user manual, if available.  
When the item is switched off, the real energy consumption goes to zero and the happy “energy face” is then shown.  
**TII’s AR Client recognizes** the heater and sends a request for the real consumption to the IHL server which sends back the value of the Smartplug on which the heater is plugged in. |
| 00:23:00 | Donald decides to watch the news magazine. His wife enters the living room. She wants to look at a movie she recorded yesterday. Donald presses a button on his phone and Daisies movie starts in the living room.  
When he enters the sleeping room, the news show continues at the right point.  
The news show starts on the same TV screen where the energy screen was on before.  
When Daisy enters and after Donald pressed a button on the phone, the news show stops and the movie starts.  
**[Walk to the 2nd booth, a picture shows the sleeping room]**  
**[A poster explains the “SmartHome Follow Me”-PoC setup and a picture shows the living room]**  
When Donald enters a certain area near a second screen, the news show continues there.  
**The output source of the TV screen is changed to switch from the IHL server to the (first) Utrema box. The recorded news show is played from this box.**  
After an smartphone button press (or using the remote from Utrema) the recorded movie starts  
The movie is reloaded at the right position on box 2 and shown on TV 2. |
| 00:28:00 | Daisies smartphone reminds her of checking her blood.  
She stops the movie  
**[Walk to the 3rd booth, a poster explains the “SmartHealth”-PoC setup]**  
The movie stops.  
**PoC as described by KUL.** |
| 00:30:00 | Donald decides to watch the news magazine. His wife enters the living room. She wants to look at a movie she recorded yesterday. Donald presses a button on his phone and Daisies movie starts in the living room.  
When he enters the sleeping room, the news show continues at the right point.  
The news show starts on the same TV screen where the energy screen was on before.  
When Daisy enters and after Donald pressed a button on the phone, the news show stops and the movie starts.  
**[Walk to the 2nd booth, a picture shows the sleeping room]**  
**[A poster explains the “SmartHome Follow Me”-PoC setup and a picture shows the living room]**  
When Donald enters a certain area near a second screen, the news show continues there.  
**The output source of the TV screen is changed to switch from the IHL server to the (first) Utrema box. The recorded news show is played from this box.**  
After an smartphone button press (or using the remote from Utrema) the recorded movie starts  
The movie is reloaded at the right position on box 2 and shown on TV 2.  
**CEA** |
| 00:30:00 | Daisies smartphone reminds her of checking her blood.  
She stops the movie  
**[Walk to the 3rd booth, a poster explains the “SmartHealth”-PoC setup]**  
The movie stops.  
**PoC as described by KUL.** |
| 00:30:00 | Daisies smartphone reminds her of checking her blood.  
She stops the movie  
**[Walk to the 3rd booth, a poster explains the “SmartHealth”-PoC setup]**  
The movie stops.  
**PoC as described by KUL.** |
for a moment. A few moments later she sees the actual amount of sugar in her blood. She also takes a look at the measurement history of the last week and the data of her step counter (fit bit). The BUTLER App suggests more sports and fewer sweets.

| 9 | 00:35:00 | Daisy gets another notification from BUTLER. Moon boots on sale at xyz-Store. It is one of those spark deal offers where you can register as a customer and get notified if they have your article. It is a very good offer! Those are exactly the sort of boots she wanted to have and they are on sale. She could use them well in the mountains. | [Walk to the 4rd booth, a poster explains the “SmartShopping”-PoC setup] Please also have a look at the “Open Questions” at the end of the document. | PoC as mentioned by CasC. | CasC |

| 10 | 00:38:00 | Finding a parking lot at this time is a nightmare. There is a free parking lot. So she immediately reserves it. She utilizes her NFC-enabled mobile to pay for the usage of the reserved parking space. | [On 4rd booth there is also a poster which explains the “SmartCity”-PoC setup]. [A movie is presented on the beamer which shows the SmartCity solution]. Please also have a look at the “Open Questions” at the end of the document. | PoC as mentioned by TST. | TST |

<p>| 11 | 00:45:00 | During the night, the heating turns on and the tablet shows that. A small electric heater starts running at the “Chalet-booth”. On the tablet a message is shown that the heating has turned on. Tablet triggers the IHL server which sends a command to the Orly gateway to turn on the smart plug. The Orly gateway does so and sends an | | IHL, ST-I |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 00:46:00</td>
<td>The system reminds Donald again that the old electric heating system is very inefficient and a nasty waste of energy. It context-sensitively calculates what he could save by replacing it.</td>
<td>The tablet shows a notification message showing the current load. It indicates what could be saved when replacing the heating. It also gives a proposal for replacement and hints on where to get more information.</td>
</tr>
<tr>
<td>13 00:48:00</td>
<td>When leaving the home for their holidays the next morning, the house automatically switches to the holiday mode.</td>
<td>[Walk away from the current boot to the 5th booth] [A poster explains the &quot;ZigPos&quot;-PoC setup]. [A picture shows the Chalet]. The presenter moves away from the booth and the home automatically switches off the TV screens and some other relevant loads of the home.</td>
</tr>
<tr>
<td>14 00:50:00</td>
<td>Donald and Daisy have spent out the day skiing and now they’re ready to take the bus to go back to the bottom of the mountain (the road is closed for normal car)</td>
<td>There are the 3 roll-up poster hiding the anchors. In front of the posters there is a table with the toy-bus with actuator. Led screen is on top of the middle posters, while the iPad can be held by the bus driver. There are three persons (i.e. three tags): driver, Mr Donald and Mrs Daisy.</td>
</tr>
</tbody>
</table>
"Door opening" and state turns into 2 [door open, lights on -- when at least one person is in or nearby (if other than driver, driver has to accept)]. Then the driver steps in, and status turns to 3. "Ready to leave" [door closed, lights on -- when driver and everybody else are in].

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:55:00</td>
<td>On Monday morning, Donald’s tablet suddenly buzzes. Someone stands at the door of his home back in the city. Donald uses the app on the tablet to look who this could be. The front door is lit (BUTLER turned on the lights) and the postman stands there.</td>
</tr>
<tr>
<td>01:00:00</td>
<td>Donald shortly opens the door and lets him enter the home with the packet. A minute later, he sees the postman leaving the house and BUTLER notifies “door locked” again. The presenter presses a button on the tablet which indicates that the door has been opened. At the same time a smart plug turns shortly on and off driving some kind of actor.</td>
</tr>
<tr>
<td>01:05:00</td>
<td>[End of the story] The Quing solution from Swisscom is also installed at booth 1.</td>
</tr>
</tbody>
</table>

### Table 13 - PoC-Review flow from different views

#### 7.3. Exemplary interactions and components

This exemplary use case will describe a typical interaction the administrator of a group of devices already registered in the BUTLER platforms, creates an information offering from the data offered by some of the devices the administrator is entitled to manage.

The following functional entities are considered:

- **Marketplace Web Front-End.** It is one of the elements of the BUTLER Data Marketplace Functional Component, deployed on a Smart Server instance. It provides the search tools for third party developers to discover relevant information offerings.

- **Marketplace Back-End.** It is one of the elements of the BUTLER Data Marketplace Functional Component, deployed on a Smart Server instance. It is responsible for translating the description of the information offerings purchased by third party developers into the right permissions and
configuration so that they become available for domain-specific applications developed by said third-party developers.

- **Data Sources Repository.** It is one of the elements of the Resource Directory Functional Component, supported by a Geodetic Database. It is deployed on a Smart Server instance. It stores the information about the resources available in the BUTLER platform, the virtual entities and the information offerings defined by the device administrators.

- **Device Owner Web Front-End.** It is one of the elements of the Smart Object and Entity Management Functional Component. It provides the map-based interface for the device administrator to manage devices, virtual entities and information offerings. It is deployed on a Smart Server instance.

- **Device Owner Back-End.** It is one of the elements of the Smart Object and Entity Management Functional Component. It takes care of managing the information about data sources. It is deployed on a Smart Server instance.

- **Adaptors.** They are used as interfaces towards the actual devices, taking care of protocol adaption, and data model transformation. They are deployed on a Smart Server instance.

- **Scalable Real-Time Event Processing.** This is the main element of the Stream Processing Functional Component. It distributes in real-time incoming information from devices to the clients subscribed to said information. It is deployed on a Smart Server instance.

- **NoSQL Storage.** Mass-scale storage for caching information coming from devices. It is deployed on a Smart Server instance.

- **Push Server.** Request-response based interface towards domain-specific applications. It is deployed on a Smart Server instance.

- **Pull Server.** Pub-sub based interface towards domain-specific applications. It is deployed on a Smart Server instance.

The exemplary use case mentioned above will have the following features (see use cases in Smart Exposition of Device Data):

- **Actors:**
  - Device Owner. Device Owner is the administrator of a group of devices already deployed and registered in the BUTLER platform.

- **Description:**
  - Device Owner accesses the BUTLER Administration Portal and creates different virtual entities representing physical entities, associates some of the devices s/he manages to said entities, creates information offerings and assigns tags and prices to said offerings.

- **Normal Flow:**
  - See description below the sequence diagram

- **Preconditions:**
  - Device Owner is registered in the BUTLER Administration Portal and has necessary credentials to get authenticated.
  - A number of devices have been deployed and registered in the BUTLER platform. The resources they expose have been also registered.
  - Said devices have been associated to the Device Owner profile.

- **Postconditions:**
  - The information offerings created by the Device Owner are available for purchase by third-party developers.

The use case normal flow is described in the figures below:
The flow comprises the following steps:

1. Once authenticated, the user accesses the web-based interface of the Smart Object and Device Management portal and asks for associated devices through a specific option in the web front-end.

2. The query is passed back to the back end, along with the user ID, available as part of the user authentication procedure.

3. The Data Sources repository is queried for the devices and resources already associated to the user.
   a. If the resources and objects are not yet geo-localized, a query to the Smart Object Register could be needed.
   b. The devices and resources associated to the user are represented by the Web Front-End on a map. A list of not geo-located devices and resources is also shown.

4. The user creates a polygon to describe a new entity. S/he also introduces a description of the entity and some tags associated to the entity.

5. Next, the user uses the graphical tool provided by the front-end to associate resources to entities and request these definitions to be stored.

6. The insertion operation is triggered from the web front-end. Such an operation includes the definition of the entity, the associated devices and or resources and the user identifier.

7. The actual insertion is performed using the geodetic features of the Data Sources Repository.

8. Next, the user creates an information offering through the map-based web front-end. S/he chooses the entities or individual devices/resources an offering should include along with other features of the offering (associated tags and price).

9. The insertion operation is triggered from the web front-end. Such an operation includes the definition of the information offering, the associated entities or devices and the tags, price and user identifier.

10. The actual insertion is performed using the geodetic features of the Data Sources Repository.
7.4. Implementation

According to the horizontal approach, the PoC applications are implemented by reusing BUTLER platform building blocks that are made available to developers.

In the following we provide a list and a description of such building blocks, considered as the minimal set to be ready before end of Year 2 to provide a minimal horizontality for PoC implementation. We provide also the current timeline for the planning of implementation of such platforms building blocks within WP4.

7.4.1. SmartServer platform components description

The following is the list of SmartServer platforms components that will be available to developers to be used in the PoC. For each component its’ specified if the component is expected to be available locally or remotely on the cloud and the partner that is responsible to provide the component.

- **UserProfile SmartServer.** This component will be used by PoC applications to register a new user in the system and to retrieve user profile data
  - **Partner Responsible:** TIL
  - **Availability:** CLOUD

- **Authorization SmartServer.** This component will handle all the authorization functionalities to make sure that a PoC mobile application used by a specific authorized BUTLER user will be authorized to invoke APIs provide by other SmartServers or other SmartObjet/Gateways
  - **Partner Responsible:** GEMALTO
  - **Availability:** CLOUD

- **ResourceDirectory SmartServer.** A directory server of all resources that have been registered in the BUTLER systems and that can be looked up by PoC applications
  - **Partner Responsible:** CEA
  - **Availability:** CLOUD

- **DDX (CEP) SmartServer.** This cloud server is able to provide a directory of sensors and their associations to users. The CEP engine is responsible to process events coming from different sources and, according to defined rules, generate events and actions based on the processed events
  - **Partner Responsible:** ERC
  - **Availability:** CLOUD

- **ContextManager SmartServer.** A server that is able to collect all context data about users or devices, and provide to interested applications both raw context data and higher level elaborated context
  - **Partner Responsible:** TIL
  - **Availability:** CLOUD

- **EnergyData SmartServer.** A server able to provide data about energy consumption in the current environment. Such data is provided both historically and in real time. Several clients can use the data to provide energy related information to the final user
  - **Partner Responsible:** iHL
  - **Availability:** CLOUD

- **UserBehavior SmartServer.** This server, which is available both locally and remotely, is able to collect all data that is useful to predict user behavior, process this data according to algorithms and return behavioral information and prediction about a specified user to PoC applications
  - **Partner Responsible:** KUL
  - **Availability:** CLOUD/LOCAL
• **LocationManager SmartServer.** This server will integrate several localization algorithms to provide the best possible location estimate of an entity according to the localization data received from sensor networks or user devices
  o **Partner Responsible:** ISMB
  o **Availability:** LOCAL

• **Multimedia SmartServer.** A local server which is used by PoC applications to control the play of multimedia data on different Screen SmartObjects that are available in the environment. The server is able to transfer one multimedia session from one device to another
  o **Partner Responsible:** CEA and MAYA
  o **Availability:** LOCAL

7.4.2. SmartServer platform implementation timeline

The following diagrams illustrated the current planned timeline that guides the development within WP4 of the various platform components that are needed by the PoC applications. As of M18, development of components has started and will be refined according to the finalization of the BUTLER architecture and specification of component interactions as defined in WP3. Components and their APIs will also be checked against PoC requirements. A first version of documentation of the APIs provided by components will be made available on a BUTLER project API documentation repository, so that PoC application developers will start collecting information about the APIs signatures. Implemented components are then planned to be deployed in M22. The last part of the implementation effort in WP4 until M24 will be spent in supporting applications developers in using the components API, making required refinements of the implementation and doing some general test of the functionalities provided. Finally components are expected to be used in the realization of horizontal PoC in M24.

![Figure 47 - Implementation, integration and testing planning for BUTLER platform components to be used in M24 PoC](image)

7.4.3. Integration of Algorithms in Software and Hardware

At the first year of the project, we have extracted system requirements from the vertical use cases. These requirements are currently been revisited in order to identify the horizontal platform requirements that will guide us to construct our first horizontal architecture by finding out the common requirements identified at the vertical cases.

WP4 is currently implementing/updating the platforms developments on top of that architecture. While the task 5.1 is planning the integration of the WP2’s technical achievements - in terms of localisation mechanisms, security protocols, context and behaviour modelling and mining techniques - into those WP4 platforms, task 5.2 is planning the integration of those platforms in the network (sensor networks,
mobile networks and IP networks). Task 5.3 will perform the overall integration and perform the proofs of concepts in order to test the requirements and validate the platforms (see Figure 46).

The 2nd year trials will provide us an important feedback in terms of performance, feasibility and dependability of the developed platforms. The third year of the project will start by taking into account the test results and the lessons learnt in order to refine and update its architecture to better realize the targeted horizontality. The components that do not conform to the requirements will be improved or replaced if necessary. The refinement will be done at the very beginning of the 3rd year in order to dedicate an important part of the last year to develop the final horizontal platform and assure the success of the final trials of the project.

7.4.4. Integration of the Platforms in the Network

The main goal of the WP5 is to integrate the technical achievements of the project into the developed BUTLER platforms and demonstrate key concepts of the BUTLER project via concrete use cases deployed on BUTLER platforms from 5 target application domains, namely smartMobility/Transport, smartHealth/Wellness, smartHome/Office, smartShopping and smartCity. Task 5.2 is targeted to integrate the elements of the BUTLER system into a pervasive network. The integration will attempt to define which network technologies will be used, hide from the user the fact that he is using several network technologies, provide a given QoS despite the user mobility and radio technology used. The task is mainly focused in integration of the tested and functioning smartMobile platform with the tested and functioning SmartServer platform to test system level interfaces and functionalities offered by the network composed of the individual Smart elements server, Mobile and Object. In particular, testing aspects of communication, security/privacy, location and data collection from the device. Integration and test of the SmartObject platform with the SmartServer platform to test collection of data flows coming from SmartObjects and sensors into the context management components of the SmartServer platform.

This task takes the major inputs from WP1 communication requirements, WP3 communication architecture and WP4 BUTLER platforms. After the selection of algorithms and network technologies, T5.2 analyses specific hardware and software constraints and the network technologies for the implementation of the algorithm and integration of the network platform. Then the task moves towards integration of the algorithm and the network platform using state of the art technologies. The task has started with the analysis and definition of network technologies to be used in the BUTLER-Platform. Required gateway functionality to the underlying sensor- and actor networks is identified. Existing PoC scenarios have been analyzed and options for network access technologies have been evaluated. With the collaboration from T1.3, T3.1, T4.1-3, T5.1 and T5.3, partially integrated demonstrations is planned to be shown from the initial results of the technical achievements obtained in WP2, WP3 and WP4 as a first horizontal field trial and the first pervasive BUTLER system by end of second year. The task finally leads to the Integration of smartMobile, smartObject/Gateway and smartServer platforms with advances in localization/context-acquisition, behavior models and security mechanisms onto the IoT.

Following is the work plan for the second year of T5.1

- M12-M18: Analyse the platforms developed in WP4 along with the hardware and software constraints and selection of technologies for the integration.
- M16-M20: Preparation of the integration of selected technologies in a common network platform.
- M20-M24: Integration and test of the platforms in the network
8. Final Trials (year 3)

Final trials within BUTLER project aim to technically validate the developed horizontal IoT platform in regard of applications from Smart Home, Smart Health, Smart City, Smart Transport and Smart Shopping domains as well as to identify the socio-economic impact of IoT technologies.

8.1. Objective and metrics of success

Based on the objectives and metrics of success of vertical field trials described in section 6.1 and keeping in mind the need of horizontal BUTLER platform technical validation across different applications, the BUTLER consortium has updated and extended the initial list from section 6.1. A final list of validation targets has been defined in regard to the BUTLER objectives of horizontality and context-awareness (Table 1).

<table>
<thead>
<tr>
<th>Validation target</th>
<th>Values</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical feasibility</td>
<td>Feasible now</td>
<td>Field Trial aims to validate if the proposed IoT solution, service or application can be technically implemented using a state-of-the-art technology set today or within the next years to come.</td>
</tr>
<tr>
<td></td>
<td>Feasible in less than 3 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feasible in more than 3 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not feasible until 2020</td>
<td></td>
</tr>
<tr>
<td>Horizontal technology integration</td>
<td>Open for integration</td>
<td>Field Trial aims to validate if the proposed IoT solution, service or application is ready for integration into the BUTLER IoT platform including data formats and communication protocols.</td>
</tr>
<tr>
<td></td>
<td>Open data formats only</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard communication protocols only</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integration hardly possible</td>
<td></td>
</tr>
<tr>
<td>Context-awareness</td>
<td>Highly aware – Current not yet saved in profile information and information from dynamic (updated by user and system) user profiles is used</td>
<td>Field Trial aims to validate if and how the proposed IoT solution, service or application leverages geo-temporal and other information about user and its environment (health, behavioural, physical, virtual, etc.).</td>
</tr>
<tr>
<td></td>
<td>Aware - Information from dynamic (updated by user and system) user profiles is used</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limited aware - Information from static (updated by user only) user profiles is used</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not aware – No additional information used</td>
<td></td>
</tr>
<tr>
<td>Deployment efforts</td>
<td>Low – Remote automatic</td>
<td>Field Trial aims to validate if the proposed IoT solution, service or application can be easily deployed.</td>
</tr>
<tr>
<td></td>
<td>Feasible – Remote semiautomatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Considerable – Onsite semiautomatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High – Onsite manual</td>
<td></td>
</tr>
<tr>
<td>Maintenance efforts</td>
<td>Low – Remote automatic</td>
<td>Field Trial aims to validate if the proposed IoT solution, service or application can be easily maintained.</td>
</tr>
<tr>
<td></td>
<td>Feasible – Remote semiautomatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Considerable – Onsite semiautomatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High – Onsite manual</td>
<td></td>
</tr>
<tr>
<td>Scalability</td>
<td>&gt; 1’000’000 connected nodes</td>
<td>Field Trial aims to validate if the proposed IoT solution, service or application can be easily maintained.</td>
</tr>
</tbody>
</table>
287901 BUTLER Project deliverable

| 100’000 – 1’000’000 connected nodes | application can be scaled to a large amount of nodes |
| 10’000 – 100’000 connected nodes | |
| 1’000 – 10’000 connected nodes | |
| < 1’000 connected nodes | |

| User experience / comfort / perception | User-friendly, simple, secure, reliable, privacy-driven | Field Trial aims to validate if the proposed IoT solution, service or application attracts with a well-designed user experience |
| User-affine - Any three properties | |
| Limited - Any two properties | |
| Very limited - Any property | |

| User acceptance | High – Daily usage | Field Trial aims to validate if the proposed IoT solution, service or application is widely accepted |
| Considerable – Weekly usage | |
| Borderline – Monthly usage | |
| Low – Less than monthly usage | |

Table 14 - Vertical Field Trial objectives or validation targets

In order to adequately measure the progress towards the objectives defined above, the BUTLER consortium has further come up with the following trial metrics (Table 15).

<table>
<thead>
<tr>
<th>Metric</th>
<th>Values</th>
<th>Relation to target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical performance</strong></td>
<td>Timing processing delays</td>
<td>Delivers measurements for all validation targets</td>
</tr>
<tr>
<td>Average time between technical problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System stability over daily, weekly, monthly, annual periods</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Trial duration</strong></td>
<td>Longer than 12 months</td>
<td>Delivers measurements for maintenance and user acceptance targets</td>
</tr>
<tr>
<td>6 – 12 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 - 6 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - 3 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shorter than 1 month</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dissemination impact</strong></td>
<td>High – at least 75% would recommend to others</td>
<td>Delivers measurements for user perception and user acceptance targets</td>
</tr>
<tr>
<td>Considerable – at least 50% would recommend to others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borderline – at least 25% would recommend to others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low – less than 25% would recommend to others</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Types of end-users</strong></td>
<td>Categories According to section 4.3.2 of this document: Public visitors of portable BUTLER demonstrations</td>
<td>Delivers measurements for user perception and user acceptance targets</td>
</tr>
<tr>
<td>Visitors of fixed public sites of BUTLER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participators of BUTLER online / offline questionnaires and interviews</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-testers firstly using prototypes of BUTLER components</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early adopters of BUTLER-related products</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of involved users</strong></td>
<td>&gt;1’000 users</td>
<td>Delivers measurements for all validation targets</td>
</tr>
<tr>
<td>500 – 1’000 users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 – 500 users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 - 100 users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10 users</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Moreover, the BUTLER consortium recognizes the need to synchronize the final trials with the common project objectives. For this reason the following aspects receive particular attention during the final trial definition, development, setup, execution and evaluation.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial scenario</td>
<td>Trial scenario within BUTLER is based on previously defined user (Deliverable 1.1) and system requirements (Task 1.2). The scenario consists of a set of use cases that are technically implemented, deployed, executed and actually tested by real human users.</td>
</tr>
<tr>
<td>Relevance to BUTLER horizontal storyline</td>
<td>Final trial scenario must be a part of the common horizontal storyline expressing a smart life vision of a typical day in the life of a family in the year 2020.</td>
</tr>
<tr>
<td>Disseminated messages</td>
<td>The field trials aim not only to technically prove the BUTLER platforms and technology sets but shall also raise the public awareness on the advantages and risks across different IoT applications.</td>
</tr>
<tr>
<td>Security concerns</td>
<td>BUTLER project gathers and analyses usage and profiling data before, during and after the field trial execution process. That is why the consortium follows the privacy, ethics and security strategy described in the section 4.4 of this document.</td>
</tr>
<tr>
<td>Potential exploitation after the project end</td>
<td>BUTLER project field trials create an important material for understanding the potential of IoT solutions through technological performance evaluation, user-experience validation and socio-economic impact study. All these aspects have to be considered and used for the final exploitation plan (D6.3).</td>
</tr>
<tr>
<td>Open scientific challenges</td>
<td>BUTLER project enabling technologies described in section 4.2.1 and used in the field trials still contain a number of scientific challenges. The final field trials will help to identify the most relevant of them for practical use.</td>
</tr>
</tbody>
</table>

### Table 16 - BUTLER Aspects to be considered within field trials

Final field trial will enable the final evaluation of the platform through the monitoring of defined above metrics. According to the project Quality plan D7.4 each trial will be screened by an independent not involved in the trial, except of the well-justified cases when the independent monitoring might not be feasible.

The following next deliverables will use the parts of the defined and observed metrics:
- D1.3 Final input on socio economic impact
- D6.3 Final exploitation plan
- D2.5 Future scientific challenges

Finally, D5.2 “Qualities and performance of the platform” will compile, summarize and make available the observed metrics over all BUTLER trials in full detail.

### 8.2. Trial selection process

The Field Trial described in section 6.3 will serve as a basis for the final project field trial. Some of the initiative developed over the second year will be ported to make use of the BUTLER platform. The choice
of which initiative to pursue on the BUTLER platform will be made based on their potential for horizontality, and for interesting feedback collection and the feasibility of a deployment of the BUTLER platform in each particular case. Hence, based on the field trials list described in the section 6.3, BUTLER consortium has made the following estimations for the selection process of IoT trials within months 24 – 36.

<table>
<thead>
<tr>
<th>Field Trial</th>
<th>Horizontality</th>
<th>BUTLER Platform</th>
<th>Feedback impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Awareness</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Energy Forecasting</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Office Information</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Inactivity recognition</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Activity measurement &amp; classification</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Multimedia</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Home Security</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Train Staff Assistance</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Public Transportation</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Parking Monitoring</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Parking Reservation</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Table 17 – Field trial selection estimations

8.2.1. Additional Trial Opportunities

In addition to this first list of trials that can be already quite clearly scheduled, the BUTLER project is working on additional opportunities to expand our IoT Trial initiative. These trials will involve not only the project member, but external participants. In most of these trials, the project will provide access to the BUTLER platform and knowledge, while the external/new partner will organize the trial in itself, integrate its own technological components, involve end users, and provide feedbacks. Depending on the specific scenarios and opportunities, some partners will also participate directly in the organization/running of the trial.

This choice to broaden the project trial initiative is justified by several motivations:

- **Confronting the project IoT vision with a broader community:** Involving external organizations in the setup of the project trials will provide a new, independent and fresh view on the scenarios and use cases defined by the project. These new use cases might generate additional requirements for a horizontal IoT Platform and will enable the project to evaluate the relevance and extensibility of the BUTLER platform.

- **External technical validation of the project:** Providing the BUTLER platform to organizations external to the project will generate additional feedbacks on the technical qualities of the project. This will not only generate interesting feedbacks how partners external to the project integrated their technologies and develop applications over the BUTLER platform but also should enable the project to evaluate the ease of use and acceptability of the platform for external developers. Thus the project will be able to validate and improve the platform in itself but also the related documentation and teaching material.

- **Extended user feedbacks:** As presented above in this document, the involvement of end-users and stakeholders is considered by the BUTLER project to be a way to collect crucial feedbacks on several aspects of the project (interest and acceptance of IoT, Ethics issues, technical readiness of solutions...). The involvement of external organizations in the field trial is therefore important for the project to maximize the reach of the project and the diversity of the feedback collected, if possible in a maximum number of locations in the European Union.
• **Dissemination and exploitation:** Of course the involvement of external partner in the project is in itself a dissemination opportunity. This may also present some interesting exploitation and impact opportunities as the external partners may be interesting by pursuing the collaboration outside of the scope of the project, or at least will provide a feedback on the identified business plans and exploitation opportunities of the project.

The following opportunities are currently targeted by the project:

8.2.1.1. BUTLER Open Call

**Open call process**

As scheduled in the project description of work, the BUTLER project has launched an open competitive call to add an additional partner to the project consortium. The new partner will be responsible for the setup of a field trial based on the BUTLER platform. The call announcement is presented below:

**Project acronym:** BUTLER  
**Project grant agreement number:** 287901  
**Project full name:** uBiquitous, secUre inTernet-of-things with Location and contExt-awaRene

The BUTLER project currently active in the Seventh Framework programme of the European Community for research, technological development and demonstration activities contributing to the creation of the European research area and to innovation (2007-2013) requires the participation of a new partner to carry out certain tasks within the project. Please note that the Seventh Framework programme offers part-funding not full-funding of research activities.

We have a vacancy in our consortium for a partner established in an EU Member State or FP7 Associated State, and having comprehensive expertise in the integration of Internet of Things technologies and conduct of end user trials.

The tasks involve the participation to the setup of a cross domain (horizontal) field trial based on the prototype of the BUTLER platform. The new partner will have to:

- Implement a cross domain “Smart Life” field trial. The domains we are looking for include: health, home/office, transportation and shopping
- Provide access to end users and have the ability and experience of conducting end user trials
- Participate to the technology integration and software industrialization of BUTLER’s platform into a consistent and reliable field trial

One partner will be selected for funding in this competitive call, which will be preferably a SME or an organization demonstrating plans for sustainable exploitation of BUTLER project achievements.

**Deadline:** The call closes on April 13th 17th 2013 at 17h00 (Brussels time)  
**Expected duration of participation in project:** June 2013 to September 2014  
**Total EC funding available for new partners is up to 120 000 €**  
**Call identifier:** BUTLER open call  
**Language in which proposal should be submitted:** English  
**Web address for further information (full call text/proposal guidelines):** [http://www.iot-BUTLER.eu/events/21/open-call](http://www.iot-BUTLER.eu/events/21/open-call)  
**Email address for further information:** contact@iot-BUTLER.eu

As specified in the European Commission Guidance Note, the call was published in an international journal (IEEE Communications magazine) and in three national newspapers (Les Echos in France, Süddeutsche Zeitung in Germany, and l’Echo in Belgium).
The Call was also forwarded and published in numerous IoT relevant mailing lists (including IERC Mailing list March 2013); the websites EUROSFAIRE² & FinES³ also published the Call. The call information, along with more detailed description of the project expectation has been published on the project website⁴ and a Frequent Asked Question⁵ section has been set up to publish openly the questions and answers of potential candidate.

In total, 30 eligible proposals have been received, coming from 11 countries (8 EU member states), most of them (67%) coming from the Industry, but also research centre (20%) and universities (13%).

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² http://www.eurosfaire.prd.fr/7pc/
³ http://www.fines-cluster.eu/fines/jm/
⁴ http://www.iot-butler.eu/events/21/open-call
⁵ http://www.iot-butler.eu/events/open-call-f-a-q
The evaluation recommendations state that each proposal should be evaluated by at least 2 independent experts. 2 months before the call deadline, the coordinator started to invite evaluators to be part of the evaluation team. To evaluate the 30 proposals received the coordinator selected 6 evaluators who would work in duo, each duo having 10 proposals to evaluate. The six chosen evaluators were selected for their expertise in relation with the call (users’ involvement, transversal issues related to data privacy and security, interoperability) and liaison capacity within IERC.

The ranking of the evaluation is presented in the figure below:

![Figure 52 - Open Call proposal ranking](image)

The best ranking proposal, by company Tecnalia, was presented to the general assembly of the project and by vote; the general assembly accepted the choice of the evaluators, opening the process for the new company inclusion in the consortium (currently in progress).

To initiate rapidly our cooperation and introduce the new partner to the consortium, the selected company was invited to a BUTLER Synchronization meeting (focused on the finalization of the BUTLER architecture) in Madrid in May 2013.

**Selected company**

TECNALIA (http://www.tecnalia.com) is the leading private research and technology entity in Spain and the fifth largest in Europe, employing 1,500 people (164 PhDs). TECNALIA operates in all the fields of today’s and tomorrow’s industry: Industry and Transport, ICT, Sustainable Development, Innovation Systems and Health. TECNALIA is very active in the 7FP (2007-2013), involved in 209 projects, and the coordinator of 46 of these.

Key features that turns TECNALIA into a powerful agent in co-operative endeavours are: its **private nature**; the focus on **Applied Research**; the fact of being a centre of **international excellence** (international R+D contracts, foreign researchers, and international accompaniment of local industries, licenses, IP, etc.); the **impact on local industry** (R+D and Innovation projects with companies, spin-offs, training, E+C services); its **openness** to other organizations or networks keen to interact and co-generate knowledge and the fact that it has become a centre that attracts people who want to develop their creativity.
Selected proposal

This project proposes the implementation of a cross domain “Smart Life” field trial covering several Vertical Use Cases (smart home, smart health and smart transport) based on the prototype of the BUTLER platform. The main aim is to conduct extensive end user trials based on the deployment of different services already developed by Tecnalia on top of the BUTLER existing platform. The portfolio of IoT services and components that Tecnalia can offer includes behavior monitoring (through sensor fusion), emotion monitoring (using a smartphone and heart rate sensor), multimodal medication management system (using NFC technology and smartphones or PDAs), TV-based telecare services, video-conference based services, mobile assistant to use public transport and a mobile fall detection solution. This range of complementary systems and services can be applied to several vertical BUTLER scenarios, such as smart health, smart home and smart transport, in order to be used as proof of concepts and assessment of the BUTLER architecture.

The proposed end-user trials will involve both testing in controlled environments and long term testing in real sites so that the testing has a higher impact by increasing the number of final end users. Tecnalia wide expertise and experience in conducting user tests in similar pilot projects already carried out guarantees the required access to end users and the ability of conducting end-user trials for the BUTLER project. The involvement of Tecnalia in numerous EU projects in the health domain has allowed us to set up collaborations with a wide network of relationships with end-users and associations working with specific population sectors.

Finally, Tecnalia can provide its expertise in the software industrialization of BUTLER’s platform. We have experience in the incubation of new SMEs and in the creation of spin-offs. We will analyse potential opportunities with the results of the BUTLER architecture applied to the proposed field trials. In particular, knowledge gained from the analyses of the test beds concerning interoperability with BUTLER platform and other specific equipment for elderly and disabled people will be of great value.

Additional opportunities

Given the number and quality of the proposal received, the BUTLER project is considering keeping contact with some of the proposers for inclusion in the external member group to enable them to access to the BUTLER platform and possibly organize additional trials. One of the proposals is especially interesting, coming from the Institute for Information Industry of Taiwan as it could lead to international cooperation.

8.2.1.2. External Member Group

Project BUTLER is strongly positioned as an open project, not working in isolation. BUTLER is not developing a new environment. It is mostly integrating existing components and modules into a comprehensive system providing additional features usable in a horizontal context. For these reasons there is a strong interest from the project perspective to build liaisons with external projects and initiatives so to further demonstrate:

- Extensibility through the integration of addition components and modules (technology interoperability)
- Extensibility over the domains covered (horizontality)

A number of actions have already been launched in that direction and will be pursued within the 2nd phase of the project.

External Members Groups

The project EMG is the first recipient for collaboration. During first year of the project, a technology support group has been created and MoU with companies such as Interdigital, NEC, iControl discussed and signed. Among the proposed directions for cooperation is the inclusion within the EMG of a trial support group. Initial contacts have been established with white ware support companies (Liebherr) and Smart Transport (Bosch - Electrical Charging equipment).

IERC Cluster projects

BUTLER and iCORE projects are two IP projects from the IERC cluster, progressing in parallel. While iCore does not target regarding field trials involving users (show case of project results are expected to be done though demonstration activities), discussions between projects occurred whenever co-location of
projects’ meetings is feasible. During the last discussion, taking place in Delft in February 2013, the opportunity to link projects’ platforms has been discussed. While principles have been agreed, details will be set when projects architecture will have matured, in summer 2013. Cooperation with other IERC projects for trials will be discussed in June 2013, during the IoT week, during a session proposed by project BUTLER and related to platforms for horizontal applications.

**FI-PPP**

Phase 2 projects from the FI-PPP, built over the FIWARE platform, may provide some opportunities in the third year of the project. BUTLER intends to make use of some of the generic enablers proposed by the FIWARE project, in particular in relation to context management. FIWARE GE will be publicly released in July 2013 but preliminary contacts will be established.

### 8.2.2. Tentative scenario for a final trial

In addition to the continuation of the second year trial, and to the additional trial opportunities presented above, the BUTLER project is working on a tentative scenario for a larger, horizontal experimentation, described below, that could form either a third year proof of concept or field trial, and might even be continued as exploitation of the project, involving most of the project partners and the full BUTLER technological platform.

The tentative horizontal scenario describes the platform for the exposition and consumption of real time data. Main actors are Jean-Luc (IT administrator) and Deanna (Developer). Horizontal storyline created by Ericsson for BUTLER.

**Jean-Luc** is 35 years old, works as IT Administrator. He handles the IT infrastructure in the South Campus of the Technical University of Farpoint. The University is interested in publishing the real time data flows generated by their devices to allow external developers and organizations to build novelty applications that could help to the University to improve their processes, get new revenues and to have available innovative services.

**Deanna** is 19 years old; she is an enterprising student at the Campus South of the Farpoint University. She is passionate about pursuing new business models and more specifically she is interested in those that use real time information on mobile environments. Deanna realizes that services based on said real time data could be useful for several companies and therefore she could make a benefit by creating new services fed by real-time data from the sensors deployed in the South Campus.

#### 8.2.2.1. Smart Exposition of Device Data

**8.2.2.1.1. Motivating story line**

The Technical University of Farpoint is experiencing financial difficulties. In an attempt to overcome the situation, the management staff of the South Campus has decided to deploy a large number of sensors and expose the information they are gathering so that any third party developer can use such information to create new services. Therefore, several temperature, presence, noise and dust sensors have been installed in the university premises in the South Campus. Additionally, the university administration is a true believer in open innovation and thinks that opening their data and resources to third parties will translate in a larger number of better services for its students, researchers and teaching staff.

According to the guidelines provided by the management staff, Jean-Luc, the IT administrator in the South Campus, has created different data offering comprising each of them different sets of real-time sensor information with different qualities and prices. Said data offerings are offered through the BUTLER Marketplace so that any third party developer can discover suitable data offerings and purchase them for subsequently use in their services.

Later, Geordi, an enterprising student, realizes that services based on said data could be useful for several companies and therefore he could make a benefit by creating new services fed by real-time data coming from the sensors deployed in the South Campus. After contacting several firms, he makes an agreement with the ones in charge of campus security and cleaning service to create new apps fitting
their requirements. Next, he purchases the appropriate data offerings in the BUTLER Marketplace, retrieves necessary credentials, API details and endpoints and sets out to develop the applications that suit the needs of his customers.

The application for the security staff analyzes all the data coming from temperature sensors in order to determine if a fire has started. The risk of fire in the server room is high. Before they had access to the newly developed application this could lead to disastrous consequences. However, it is now possible for them to detect and put out a fire almost instantly. They also benefit from the presence sensors that are deployed around the area. From 10 pm to 8 am, if any movement is detected in a spot where the guards are not currently present, they are notified immediately.

The cleaning service company can also improve their performance by using the application created by Geordi. The dust that gathers in the AC system can end up causing damage. Previously, it was only possible to detect an excess of dust when the AC started to malfunction. A thorough and expensive maintenance operation was then necessary. Now they are notified whenever the dust amount reaches a certain threshold. By carrying out a simple cleaning operation, the dust quantity can be brought down to an acceptable level again.

8.2.2.1.2. The actors

<table>
<thead>
<tr>
<th>Users/Groups</th>
<th>Roles</th>
<th>Descriptions</th>
</tr>
</thead>
</table>
| Jean-Luc     | Device Owner  | Age: 45  
Gender: Male  
Occupation: IT Administrator  
Other: he handles the IT infrastructure in the South Campus of the Technical University of Farpoint. |
| Geordi       | Developer     | Age: 19  
Gender: Male  
Occupation: student  
Marital status: single  
Hobbies / interests: entrepreneur and amateur developer of mobile apps. |

8.2.2.1.3. The use case description

<table>
<thead>
<tr>
<th>Topic</th>
<th>No. UC</th>
<th>User Story</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration and management of data sources</td>
<td>SmartExposition_UC_1</td>
<td>Create a new entity</td>
</tr>
<tr>
<td></td>
<td>SmartExposition_UC_2</td>
<td>Associate devices to entities</td>
</tr>
<tr>
<td></td>
<td>SmartExposition_UC_3</td>
<td>Massively upload device descriptions</td>
</tr>
<tr>
<td></td>
<td>SmartExposition_UC_4</td>
<td>Create a data offering</td>
</tr>
<tr>
<td>Discovery and purchase of data sources</td>
<td>SmartExposition_UC_5</td>
<td>Discovery of data sources</td>
</tr>
</tbody>
</table>

8.2.2.1.4. Create a new entity

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>SmartExposition_UC_1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Create a new entity</td>
</tr>
<tr>
<td>Primary Actor(s)</td>
<td>Jean-Luc – IT administrator of the Technical University of Farpoint South Campus</td>
</tr>
</tbody>
</table>
Jean-Luc registers on a map the entities representing relevant physical entities.

Jean-Luc, on behalf of the university administration, has a main reason to create entities:
- Individual (device-based) data sources may not fit well the needs of customers wishing to purchase real-time data coming from devices. Therefore, a less-granular option is needed when discovering and purchasing data sources. Entities group different data sources and, if well defined, make more sense for a developer interested in creating new services that individual data sources.
- By creating entities the university administration can organize better their devices and have control over their devices and entities.

Jean-Luc has registered to the BUTLER administrator service as administrator.

A hierarchy of new created entities is available. Through the Graph View control it is possible for Jean-Luc to verify how the different entities are represented as ‘children’ of the ‘South Campus’ entity.

Jean-Luc is commissioned by the university administration to start the process of exposition of data sources

1. Jean-Luc registers the campus as a new entity over a map of the area.
2. Next, he fills in its name and chooses a color for its area and he draws the area the campus takes up on the map.
3. Since the South Campus is made up of different schools and with the purpose of improving the management in the future he creates two sub-entities, one for each school.
4. Because both of them belong to the same campus, he adds the virtual entity 'South Campus' entity as their parent, later on this entity will be integrated within the Farpoint virtual entity.

Alternative 1:
1. Instead of using the map-based interface, Jean-Luc uses the Graph View control to arrange the relationships between entities.

8.2.2.1.5. Associate device to entities

Jean-Luc has registered to the BUTLER administrator service as administrator. Actual devices have been deployed and registered in the BUTLER platform. The description of the devices available in the platform includes, at least, location of the device (so that they are visible on the map), type of magnitude, and units. It may also include information about how frequently the data is being provided by the device.
### Main Success Scenario

1. When registered to the BUTLER administration service, Jean-Luc sees over the map the devices already available in the BUTLER platform but yet not linked to any entity.
2. Next, Jean-Luc chooses the device or set of devices he has got in his location. For every device, he sets it with all its respective info.
3. Finally, he associates devices to entities through the map-based interface. A same device can get associated to several entities.

### Alternative Flows

**Alternative 1**

1. The devices are not available in the map-based interface but as a list of devices with no location information assigned yet.
2. Jean-Luc is able to manually create a representation of the device on the map and pick-up from the list which device with no location information it has to be assigned to.

---

### 8.2.2.1.6 Massively upload device descriptions

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>SmartExposition_UC_3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Massively upload device descriptions</td>
</tr>
<tr>
<td>Primary Actor(s)</td>
<td>Jean-Luc – IT administrator of the Technical University of Farpoint South Campus</td>
</tr>
<tr>
<td>Secondary Actor(s)</td>
<td>None</td>
</tr>
<tr>
<td>Context of Use / Short Description</td>
<td>Following Jean-Luc, other departments share their device information with him, using XML files. Jean-Luc just drags and drops them on to the map. The contents of the file are processed and added to the platform. After this use case has been run, SmartExposition_UC_2 can be carried out.</td>
</tr>
<tr>
<td>Actor Motivations (Needs)</td>
<td>Although manual management of devices is a valid option, batch management of devices is definitely easier than performing it on a case-by-case basis.</td>
</tr>
<tr>
<td>Preconditions</td>
<td>Jean-Luc has registered to the BUTLER administrator service as administrator. Actual devices have been deployed and registered in the BUTLER platform. The description of the devices available in the platform includes, at least, location of the device (so that they are visible on the map), type of magnitude, and units. It may also include information about how frequently the data is being provided by the device. The description of all the devices has been recorded in an XML-based file.</td>
</tr>
<tr>
<td>Postcondition (Result)</td>
<td>Devices are visible in the map-based interface.</td>
</tr>
<tr>
<td>Trigger</td>
<td>Other university departments in the South Campus have decided to start sharing the information coming from their devices.</td>
</tr>
</tbody>
</table>
| Main Success Scenario | 1. When registered to the BUTLER administration service, Jean-Luc accesses the map-based interface.
2. Next, he opens the file explorer tool and pick up an XLM file his colleagues has sent to him.
3. Jean-Luc drags and drops the file.
4. All the devices described in the file appear in the map-based interface. |
### 8.2.2.1.7. Create a data offering

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>SmartExposition_UC_4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Create a data offering</td>
</tr>
<tr>
<td>Primary Actor(s)</td>
<td>Jean-Luc – IT administrator of the Technical University of Farpoint South Campus</td>
</tr>
<tr>
<td>Secondary Actor(s)</td>
<td>None</td>
</tr>
<tr>
<td>Context of Use / Short Description</td>
<td>Jean-Luc decides which data sources are exposed to developers and the way it is done. Exposition can be done taking entities or generic groupings of data sources as exposition units. Each data offering will comprise different data sources, with different qualities and different prices.</td>
</tr>
</tbody>
</table>
| Actor Motivations (Needs) | Jean-Luc, on behalf of the university administration, has a main reason to create data offerings:  
  - Providing a simple way to developers to discover and pick up relevant data sources based on devices. That was, it is possible to efficiently manage subscriptions so that a reduced set of conditions have to be enforced when exposing data. |
| Preconditions | Jean-Luc has registered to the BUTLER administrator service as administrator. Actual devices have been deployed and registered in the BUTLER platform. Entities have been created grouping different devices. |
| Postcondition (Result) | Data offerings are available in the BUTLER Market Place |
| Trigger | Other university departments in the South Campus have decided to start sharing the information coming from their devices. |

#### Main Success Scenario
1. When registered to the BUTLER administration service, Jean-Luc accesses the map-based interface.  
2. Next, he selects the Data Offering Creation tool. He is asked to choose the entities he wished to provide as a single data offering.  
3. He introduces tags describing the offering and a price.  
4. He can also tune the quality of the data sources (for instance, lowering the frequency of data delivery).  

#### Alternative Flows
- **Alternative 1:**  
  1. Instead of grouping entities, the user creates arbitrary data offerings by picking up individual devices

- **Alternative 2:**  
  1. The Data Offering Creation tool allows the user to search by tag or type of device. Using the search capability, Jean-Luc is able to create data offerings comprising data sources from devices of the same type or feature (as described by tags)  
  2. If all the devices comprising the offering share the same tag(s) such a tag is ‘inherited’ by the data offering.

### 8.2.2.1.8. Discovery of data sources

<table>
<thead>
<tr>
<th>Use Case ID</th>
<th>SmartExposition_UC_5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Discovery of data sources</td>
</tr>
<tr>
<td>Primary Actor(s)</td>
<td>Geordi – A student and mobile app developer wishing to use data sources from Technical University of Farpoint South Campus to create advantageous BUTLER</td>
</tr>
</tbody>
</table>
services for his customers

<table>
<thead>
<tr>
<th>Secondary Actor(s)</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context of Use / Short Description</td>
<td>Geordi accesses the BUTLER Market Place to find the data sources he need for creating two services: one focused on security and other on dust detection.</td>
</tr>
<tr>
<td>Actor Motivations (Needs)</td>
<td>Geordi wishes to get an extra revenue by creating services he can sell through popular application stores or directly to interested customers.</td>
</tr>
<tr>
<td>Preconditions</td>
<td>Geordi has registered to the BUTLER Market Place. He has also provided payment means and chosen the payment procedures.</td>
</tr>
<tr>
<td>Postcondition (Result)</td>
<td>The purchased data sources are available for use in Geordi’s applications.</td>
</tr>
<tr>
<td>Trigger</td>
<td>Geordi has envisioned a couple of services that someone would be willing to pay for.</td>
</tr>
</tbody>
</table>

**Main Success Scenario**

1. Geordi gets authenticated and enters the Data Finder tool.
2. He provides searching parameters: area he is interested in, tags (‘fire’, ‘dust’) and the price he will pay at most.
3. Among all the available data offerings, he chooses the ones that provide information about the Technical University of Farpoint South Campus.
4. He chooses a pay per use option and accepts payment.
5. He receives a jar file including the credentials his applications will need for accessing data sources, end points, API details as well as any necessary documentation

**Alternative Flows**

8.2.2.2. Horizontal storyline

**Story:** The Technical University of Farpoint is experiencing financial difficulties. In an attempt to overcome the situation, the management staff of the South Campus has decided to deploy a large number of sensors and expose the information they are gathering so that any third party developer can use such information to create new services. Therefore, several temperature, presence, noise and dust sensors have been installed in the university premises at the South Campus. Additionally, the university administration is a true believer in open innovation and thinks that opening their data and resources to third parties will translate in a larger number of better services for its students, researchers and teaching staff.

According to the guidelines provided by the management staff, Jean-Luc, the IT administrator in the South Campus, has created different data offering comprising each of them different sets of real-time sensor information with different qualities and prices. Said data offerings are offered through the BUTLER Marketplace so that any third party developer can discover suitable data offerings and purchase them for subsequently use in their services.

Later, Deanna, an enterprising student, realizes that services based on said data could be useful for several companies and therefore she could make a benefit by creating new services fed by real-time data from the sensors deployed in the South Campus. After contacting several firms, she makes an agreement with the contractors in charge of campus security and cleaning service to create new apps fitting their requirements. Next, she purchases the appropriate data offerings in the BUTLER Marketplace, retrieves necessary credentials, API details and end-points, and sets out to develop the applications that suit the needs of his customers.

The application for the security staff analyzes all the data coming from temperature sensors in order to determine if a fire has started. The risk of fire in the server room is high. Before they had access to the newly developed application this could lead to disastrous consequences. However, it is now possible for them to detect and put out a fire almost instantly. They also benefit from the presence sensors that are
deployed around the area. From 10 pm to 8 am, if any movement is detected in a spot where the guards are not currently present, they are notified immediately.

The cleaning service company can also improve their performance by using the application created by Deanna. The dust that gathers in the AC system can end up causing damage. Previously, it was only possible to detect an excess of dust when the AC started to malfunction. A thorough and expensive maintenance operation was then necessary. Now they are notified whenever the dust amount reaches a certain threshold. By carrying out a simple cleaning operation, the dust quantity can be brought down to an acceptable level again.

8.2.2.3. Storyline presentation script

Two people will play the role of the IT Administrator (Jean-Luc) and Deanna (developer). One person from the audience will use the developed application and will play the role of final user.

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Story</th>
<th>Audience View</th>
<th>System View</th>
<th>Resp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>00:00:00</td>
<td>[Welcome the audience and shortly introduce the PoC- Review. Present the personas and the scenario setup.]</td>
<td>3 slides presenting the scenario setup on the beamer wall.</td>
<td>PC and Beamer showing PowerPoint slides</td>
<td>ERC</td>
</tr>
<tr>
<td>2</td>
<td>00:05:00</td>
<td>[One person playing the role of Jean-Luc] Jean-Luc, IT Administrator, is at his office and defines using the device owner web tool the entities, sub-entities and related devices that are located in the campus sur.</td>
<td>[Walk to the 1st booth, a poster explains the current organization of the campus sur and the problem that the management staff wants to solve by exposing real time information to third parties] IT administrator enters in the device owner web page, creates entities, make the links among them and register devices. Once this step is finished the IT administrator has defined the organization and has ready the entities and devices to expose the information.</td>
<td>Media PC running a web browser showing the Device Owner Web page</td>
<td>ERC</td>
</tr>
<tr>
<td>3</td>
<td>00:15:00</td>
<td>[One person playing the role of Jean-Luc] Once the IT Administrator has defined entities and related devices, in this step he will define the packages that later on will be offered in the market</td>
<td>The IT administrator defines entities and devices that will be exposed in the market place and publish them into the marketplace.</td>
<td>Media PC running a web browser showing the Device Owner Web page</td>
<td>ERC</td>
</tr>
<tr>
<td>Time</td>
<td>Activity Description</td>
<td>Place Description</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>4:00</td>
<td>Deanna enters into the market place and look for entities and devices located in the campus</td>
<td>Media PC running a web browser showing the Device Owner Web page</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>place that she wants to use in her real time application</td>
<td></td>
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</tr>
<tr>
<td>5:00</td>
<td>Deanna builds an application based on the APIs provided by the real time data exposition platform. And somebody in the audience checks that is working properly</td>
<td>Mobile device with the application running and view of some of the physical sensors providing the real time information.</td>
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<tr>
<td>6:00</td>
<td>End</td>
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</tr>
</tbody>
</table>

Table 18 - PoC-Review flow from different views
9. References


Annex A  List of Requirements

The following requirements have been identified in deliverable 1.1 and are reminded here:

Global Non-Functional Requirements

<table>
<thead>
<tr>
<th>Requirement ID</th>
<th>Description</th>
<th>Rationale</th>
<th>Use Case ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global_NFR_1</td>
<td>Users must be identified to use the system</td>
<td>Different topics like access control, rights management, privacy management require the users to be identified and authenticated in all the locations / settings in which BUTLER might be active, e.g. homes, restaurants and shops, transportation devices, public places</td>
<td>SmartCity_UC_2, SmartCity_UC_6, SmartCity_UC_8, SmartCity_UC_9, SmartCity_UC_10, SmartCity_UC_11, SmartCity_UC_15, SmartHealth_UC_9, SmartHealth_UC_10, SmartHome_UC_4, SmartHome_UC_9, SmartHome_UC_13, SmartHome_UC_20, SmartTransportation_UC_3, SmartTransportation_UC_4, SmartTransportation_UC_7</td>
</tr>
<tr>
<td>Global_NFR_2</td>
<td>The consumer’s authentication must be quick and simple.</td>
<td>Difficult authentication will not be suitable for usage for example in real shops or in any of the other situations / locations where a user must be authenticated.</td>
<td>SmartShopping_UC_2</td>
</tr>
<tr>
<td>Global_NFR_3</td>
<td>The system shall provide the means for the identification of the object associated with a user</td>
<td>For example in the SmartTransport environment: Guaranteeing that a given car is the one being driven by the user is a key functionality</td>
<td>SmartTransportation_UC_8</td>
</tr>
<tr>
<td>Global_NFR_4</td>
<td>The system shall identify and localize users / actors in a certain area</td>
<td>outdoor as well as indoor localization system should be provided in order to detect the accurate location for example of the volunteers on request</td>
<td>SmartTransportation_UC_10, SmartCity_UC_15</td>
</tr>
<tr>
<td>Global_NFR_5</td>
<td>The system shall respect the privacy of users in all respects, for example: - when detecting a crowd, information about individual users shall not be gathered or accessed - preferences a user has selected are protected - services (such as alarms) a user subscribes to - queries a user puts to the system - user profiles (containing sensitive information)</td>
<td>Privacy control is one of the most important acceptance criteria for BUTLER.</td>
<td>SmartCity_UC_6, SmartCity_UC_7, SmartCity_UC_8, SmartCity_UC_9, SmartCity_UC_12, SmartCity_UC_15, SmartHealth_UC_3, SmartHome_UC_8, SmartHome_UC_9, SmartTransportation_UC_8</td>
</tr>
</tbody>
</table>
and even non sensitive personal data) are protected - when monitoring a users behaviour the data gathered needs to be protected

<table>
<thead>
<tr>
<th>Global_NFR_6</th>
<th>The system shall take into account place &amp; end-user privacy preferences, i.e. the user can decide - which data to share - when (in which situations) data will be shared - with whom data will be shared - which data the system can access - where (across which area) the data will be shared or accessible - whether shared data should be available anonymized or with personal information Privacy control is one of the most important acceptance criteria for BUTLER. But in order for BUTLER to perform its &quot;magic&quot; a certain amount of data sharing between users is necessary and encouraged. So this data sharing must always be fully under the control of the user.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global_NFR_7</td>
<td>The system must be able to control individual objects, such as e.g. - specific streetlamps (switching them on and off) - water valves and actuators (opening and closing them) In order to efficiently monitor and control resources used and to react to critical situations, the system needs to be able to control objects.</td>
</tr>
<tr>
<td>Global_NFR_8</td>
<td>The system must be able to monitor individual objects, such as e.g. - specific streetlamps - water valves and actuators - vehicles and their occupants In order to do this, certain information about the objects must be known to the system e.g. - physical location of an object - status of the object (like full/empty, on/off, open/closed) - relation of the object to other objects or users In order to control objects, the system needs to be able to monitor them first. The system also needs to be able to monitor services being executed on or with an object, such as e.g. assistance given to a vehicle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BUTLER</th>
<th>Project deliverable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SmartCity_UC_15, SmartHealth_UC_6, SmartHealth_UC_3, SmartHealth_UC_8, SmartHome_UC_8, SmartHome_UC_15, SmartShopping_UC_1, SmartShopping_UC_2, SmartShopping_UC_3, SmartShopping_UC_4, SmartShopping_UC_5, SmartShopping_UC_6, SmartShopping_UC_7, SmartShopping_UC_8, SmartTransportation_UC_5, SmartTransportation_UC_6</td>
</tr>
<tr>
<td></td>
<td>SmartCity_UC_5, SmartCity_UC_7</td>
</tr>
<tr>
<td></td>
<td>SmartCity_UC_5, SmartCity_UC_7, SmartTransportation_UC_2, SmartTransportation_UC_10</td>
</tr>
<tr>
<td>Global_NFR_9</td>
<td>The system must be able to predict the overall demand with a precision of 5% at least one day in advance</td>
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</tr>
<tr>
<td>Global_NFR_10</td>
<td>Service shall be able to install service’s ticketing application on user’s device.</td>
</tr>
<tr>
<td>Global_NFR_11</td>
<td>Service shall be able to check user device capability according required device features for application</td>
</tr>
<tr>
<td>Global_NFR_12</td>
<td>Service shall be able to register a ticket on user’s device service application.</td>
</tr>
<tr>
<td>Global_NFR_13</td>
<td>The system shall provide the users with several user interfaces, according to the individual needs and preferences of a user or the situation the user is in. Possible types of user interface are: - graphical user interfaces over all kind of devices (smart phones, tablet PCs, video screens, virtual reality glasses, touch screens etc.) - geographical representations of data like map representations) - audio interfaces, both for alarms/notifications and for interaction Please note: This list is not complete!</td>
</tr>
<tr>
<td>Global_NFR_14</td>
<td>Interfaces shall be tailored to the specific needs of different user roles. For example the system shall provide - specific administration interfaces - interfaces for representing data - interfaces for</td>
</tr>
</tbody>
</table>
| Global_NFR_15 | monitoring objects  
- interfaces to enter user preferences or for users registering with a service | SmartCity_UC_16,  
SmartCity_UC_7,  
SmartHealth_UC_9,  
SmartHealth_UC_10,  
SmartHome_UC_13,  
SmartHome_UC_20 |
|----------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Global_NFR_16 | A dedicated interface should allow a user to create and manage end-user profiles. This includes access credential, privacy preference, look and feel, etc... | Some specific privileges should be granted for example to the owner of a place to define access control & privacy rules as well as to manage place embedded sensors. | SmartCity_UC_6,  
SmartCity_UC_8,  
SmartCity_UC_9,  
SmartCity_UC_15,  
SmartHealth_UC_1,  
SmartTransportation_UC_10,  
SmartTransportation_UC_8 |
| Global_NFR_17 | The system contains a role management, where  
- different users can have different roles  
- roles can be shared by users or groups of users  
- a user can have a different role with regard to different services within the system  
- access to certain services can be restricted according to the roles a user has | the system should have different levels for different person for example a doctor is able to see everything, a friend only restricted view etc. | SmartHealth_UC_1,  
SmartTransportation_UC_10 |
| Global_NFR_18 | The system shall be able to administrate different user levels | From unpacking to the start of the new service and a visible (and wished) user feedback | SmartHome_UC_25 |
| Global_NFR_19 | Detecting and setting up a new device or service should not take more than 5 minutes and needs to be easy to do. | The maximum time the system should take to answer a question, notify a user, communicate with a visitor should be predefinable as well as minimum times the system will wait for an answer by the user | SmartHome_UC_21,  
SmartHome_UC_22 |
| Global_NFR_20 | The system shall quickly react to new inputs or be able to verify information or interact with the customer. The allowed performance may depend on the situation | The system must be able to quickly compute alternate routes and advertise the user promptly after new inputs | SmartCity_UC_11,  
SmartCity_UC_12,  
SmartCity_UC_17,  
SmartCity_UC_2,  
SmartCity_UC_10,  
SmartTransportation_UC_3,  
SmartTransportation_UC_4,  
SmartHome_UC_7,  
SmartHealth_UC_10,  
SmartHealth_UC_9,  
SmartHealth_UC_10,  
SmartHome_UC_13,  
SmartHome_UC_20 |
<table>
<thead>
<tr>
<th>Global_NFR_21</th>
<th>The system shall allow the user to personalize his/her user profile</th>
<th>The users will personalize their profile in order to specify their preferences. Based on the nature of the user, this personalization can be different for different users.</th>
<th>SmartCity_UC_1, SmartCity_UC_3, SmartCity_UC_4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global_NFR_22</td>
<td>The system shall enable the owner to set/create the applications proposed within his place.</td>
<td>It’s up to the owner to decide which application are relevant for his place. Locally-wised applications chosen by the owner himself would improve the experience of the place.</td>
<td>SmartCity_UC_16</td>
</tr>
<tr>
<td>Global_NFR_23</td>
<td>The system must be able to be provided with rules and reasoning components, in order to - detect abnormal situations - suggest alternative routes - provide health advice</td>
<td>The system must be able to detect an energy-inefficiency or a non-comfortable situation</td>
<td>SmartCity_UC_5</td>
</tr>
<tr>
<td>Global_NFR_24</td>
<td>The system shall be able to deliver reports or notifications to users or groups of users</td>
<td>On detecting problematic or illegal situations, the system will have to be able to notify the correct authorities</td>
<td>SmartCity_UC_1, SmartCity_UC_3, SmartCity_UC_4, SmartTransportation_UC_7</td>
</tr>
<tr>
<td>Global_NFR_25</td>
<td>The system is able to prioritize and customize the notification delivery</td>
<td>The system must be non-intrusive to obtain maximum acceptance with users</td>
<td>SmartHome_UC_11, SmartHome_UC_12</td>
</tr>
<tr>
<td>Global_NFR_26</td>
<td>Safety and security: one must be sure that the devices are not harmed by turning them off/on</td>
<td>Safety and security</td>
<td>SmartHome_UC_7</td>
</tr>
<tr>
<td>Global_NFR_27</td>
<td>The availability of the system shall be easily identifiable within a place thanks to a physical indicator.</td>
<td>As the provided service is triggered on user demand, this one must be aware of the system availability in order to launch the corresponding mobile application. Typically physical or digital signs should equip the place to indicate.</td>
<td>SmartTransportation_UC_1, SmartTransportation_UC_5, SmartTransportation_UC_6</td>
</tr>
</tbody>
</table>
Global System Constraints

<table>
<thead>
<tr>
<th>Requirement ID</th>
<th>Description</th>
<th>Rationale</th>
<th>Use Case ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global_C_1</td>
<td>The system shall be able to access - historical - up-to-date - forecasted information for a given area, for example data about: - meteorological phenomenon - pollution levels - carbon concentrations - water levels and water reserves - water consumption - electricity consumption - crop prices - traffic density - vehicle movements etc. Data can be related to a specific sensor location (e.g. within a home), but also cover a wider area (like a geographic region or a city district)</td>
<td>1) Historical as well as up to date information is used by BUTLER to forecast for example - future pollution levels or pollen concentration - demand on water or electric resources - advisability to fasten or slow down ripening of crops - opening up or closing down additional lanes for traffic etc. 2) External forecast data e.g. weather forecasts might be used to determine optimal watering schemes for crops. 3) Actual Data may also be needed for monitoring purposes, e.g. to detect water leaks, over-consumption of resources or other potentially dangerous situations</td>
<td>SmartCity_UC_6, SmartCity_UC_7, SmartCity_UC_8, SmartCity_UC_9, SmartHome_UC_3, SmartTransportation_UC_4, SmartTransportation_UC_8</td>
</tr>
<tr>
<td>Global_C_2</td>
<td>The system shall perform computation intensive tasks in the cloud to save energy on the terminal device</td>
<td>To offer the service on smartphones, computation tasks must be done ahead</td>
<td>SmartTransportation_UC_4</td>
</tr>
<tr>
<td>Global_C_3</td>
<td>A place must be tied to a bounded physical area, this is e.g. true for - restaurants, clubs, hotels etc. - parking places - street locations and places etc.</td>
<td>Off-site people must know the geographical situation of the place and people on/in the location have to be aware about the ability of the place to capture elements of ambiance or occupancy</td>
<td>SmartCity_UC_1, SmartCity_UC_2, SmartCity_UC_3, SmartCity_UC_4, SmartCity_UC_15</td>
</tr>
<tr>
<td>Global_C_4</td>
<td>The smart place is bound to a physical area</td>
<td>The system should not allow people to remotely enter in a place. Frontiers of the smart place are technologically defined according the local radio coverage of the place</td>
<td>SmartCity_UC_16</td>
</tr>
<tr>
<td>Global_C_5</td>
<td>The system must be able to communicate with - remote parts of the system (like sensors, cameras, microphones, screens etc.) - Other systems for</td>
<td>The system should be as flexible as possible with regard to communication, for example the user should not have to be physically connected to the system, and there must be means to access the system remotely.</td>
<td>SmartCity_UC_1, SmartCity_UC_3, SmartCity_UC_4, SmartCity_UC_16, SmartCity_UC_2, SmartCity_UC_10, SmartCity_UC_11</td>
</tr>
</tbody>
</table>
example to collect data, raise alarms etc. - human recipients (registered and not registered users, administrators, control personnel etc.)
For the communication both wired and wireless technologies can be used, subject to specific needs and availability.
Example from SmartCity: Sensor nodes deployed in a parking space will be often using wireless technologies to communicate with a gateway which will be often using both wired and wireless technologies.
It is possible that a given communication will be executed in parallel via different mediums depending e.g. on the recipient or the location of the recipient. Example from Smart Transportation: Alarms about a traffic situation may be transmitted via wireless to authorities further away and through car to car communication to other users close by.

<table>
<thead>
<tr>
<th>Global_C_6</th>
<th>All communication shall be secured</th>
<th>SmartCity_UC_13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global_C_7</td>
<td>The places should be equipped with network infrastructure elements that provide sufficient capabilities to allow for example real-time video streaming</td>
<td>A CCTV network or at least one camera should be deployed within the place (here the platform) to allow people to remotely check the situation. SmartTransportation_UC_5, SmartTransportation_UC_6</td>
</tr>
<tr>
<td>Global_C_8</td>
<td>The system needs to be able to aggregate and correlate data from different sources to gain the correct information.</td>
<td>For example the detection of a crowd is a difficult task that would benefit from the aggregation of several sources of information like usage of GSM antennas or streaming from the city cameras SmartCity_UC_12</td>
</tr>
<tr>
<td>Global_C_9</td>
<td>The system must have an intuitive user interface</td>
<td></td>
</tr>
<tr>
<td>Global_C_10</td>
<td>It must be possible for non-registered users to make use of selected</td>
<td>Except under certain circumstances, non-registered users may use a parking space SmartCity_UC_1, SmartCity_UC_3, SmartCity_UC_4</td>
</tr>
<tr>
<td>Global_C_11</td>
<td>resources that are managed by the system.</td>
<td>The registered users in the system must be allowed additional functionalities not available to non-registered users.</td>
</tr>
<tr>
<td>Global_C_12</td>
<td>registered users</td>
<td></td>
</tr>
<tr>
<td>Global_C_13</td>
<td>Control of ticket shall not require user device with charged battery.</td>
<td>The device should be usable in all circumstances.</td>
</tr>
<tr>
<td>Global_C_14</td>
<td>Data shall be secured at all times within the system, i.e.</td>
<td>Users must be sure that only accepted data are sent to the services and that such data are not corrupted or tampered with. The system also needs to make sure, that users do not cheat while entering data into the system.</td>
</tr>
<tr>
<td>Global_C_15</td>
<td>Updating user devices with service specific application shall be secure</td>
<td>The device shall not be updated with corrupted application.</td>
</tr>
<tr>
<td>Global_C_16</td>
<td>The system must</td>
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<tr>
<td>Global_C_17</td>
<td>incorporate one or more platforms to allow secure payments. This payment should be compliant with SEPA (Single Euro Payments Area)</td>
<td>Each type of crop shall need different types of watering</td>
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<tr>
<td>Global_C_18</td>
<td>The system must allow initial configuration of different data sets per user and service, for example: - different watering schemes for different crops - training exercises for different health conditions and age groups - adding new products to a product database or packaging to the waste database</td>
<td>System must be minimally invasive for end-user</td>
</tr>
<tr>
<td>Global_C_19</td>
<td>System must use cheap ($0.01 \text{ - } 0.5 \text{ Euro}$) RFID or wireless sensors to detect which items were forgotten</td>
<td>The system must use cheap ($0.01 \text{ - } 0.5 \text{ Euro}$) RFID or wireless sensors to detect which items were forgotten</td>
</tr>
<tr>
<td>Global_C_20</td>
<td>Information about package materials shall be provided by trustworthy entities</td>
<td>Trustworthy stakeholders are important</td>
</tr>
<tr>
<td>Global_C_21</td>
<td>The system must be energy efficient</td>
<td>The system must be able to monitor and communicate with its users requiring as little energy as possible to create a positive return on investment</td>
</tr>
</tbody>
</table>
Annex B  Compliance of BUTLER trials to the proposed architecture

This table is planned to be used to assess the compliance of the field trials with the BUTLER architecture.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Functional Component</th>
<th>Used by the domain-specific application</th>
<th>Degree of use</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Communications</td>
<td>Network Monitoring</td>
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<tr>
<td></td>
<td>Device Discovery</td>
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<tr>
<td></td>
<td>Device Directory</td>
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<tr>
<td></td>
<td>Device Authentication</td>
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<tr>
<td></td>
<td>IoT Protocol Adaptors</td>
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<tr>
<td></td>
<td>User Directory</td>
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<tr>
<td></td>
<td>Device Authorization</td>
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<tr>
<td></td>
<td>User Connectivity manager</td>
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<td></td>
<td>Server Directory</td>
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<tr>
<td></td>
<td>Server Connectivity Manager</td>
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<tr>
<td></td>
<td>Server Authentication</td>
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<td></td>
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<tr>
<td>Data / Context</td>
<td>Persistent Storage</td>
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<tr>
<td>Processing</td>
<td>Complex &amp; Simple Event Processing &amp; Notification</td>
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<td>Context Broker</td>
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<td>Context Data Collector</td>
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<tr>
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<td>Persistent Storage</td>
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<td>User Profile Management</td>
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<td>Location Manager</td>
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<td>Behavior Capture</td>
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<td>Behavior Information Provider</td>
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<td>Device Actuator</td>
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<td>Resource Access</td>
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<td>Context Configuration</td>
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<td>Resource Management</td>
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<td>Entity Management</td>
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<td>Services</td>
<td>Raw Resource Exposition</td>
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<td></td>
<td>Context Exposition</td>
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<td>Behaviour Exposition</td>
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<td>User Profile Exposition</td>
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<td>User Authentication and Identity Management</td>
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<td>Authorization Service</td>
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<td>Monitoring Service</td>
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Each column must be filled up according to the following criteria:

- **Functional Component**: Each functional component defined in the BUTLER architecture.
- **Used by the domain-specific application (YES/NO)**: Whether the functional component is actually used or not.
- **Degree of use**: This is a qualitative criterion that must show, according to the trial responsible, to which extent the functionalities being provided by the functional component are being used.
- **Comments**: Any further information that explains or clarifies the rest of values applied in the every column.

When needed, N/A (Not Applicable) can be used.
Annex C  Ethics, Privacy and Data Security process

C.1  Project Awareness to Ethics and Privacy Issues

This section answers the questions listed in the “Data protection and privacy ethical guidelines”, version 5, edited by the European Commission on 18th September 2009.

- **What kind of human participants/data are involved within the research?**

Participants involved in BUTLER trials will be either workers from the project consortium organisations or volunteers invited to participate in special test sessions. Data capture will take place during timely and geographically bounded areas. Informed consent will be collected from participants, priori engaging them in the experiment.

Informed consent is the process by which a participant will be fully informed about the research in which he/she is going to participate. It originates from the legal and ethical right the participant has to direct what happens to his / her body and personal data and from the ethical duty of the investigator to involve the participant in research. Seeking the consent of an individual to participate in research reflects the right of an individual to self-determination and also his/her fundamental right to be free from bodily interference whether physical or psychological and to protect his / her personal data. These are ethical principles recognised by Law as legal rights. A distinction between three informed consent elements is possible: the information given, the capacity to understand it and the voluntariness of any decision taken.

In order to involve a human being as a participant in research, the investigator will obtain the legally effective informed consent of the participant or the participant's legally authorized representative. All investigators within BUTLER will seek such consent only under circumstances that provide the prospective participant or the representative sufficient opportunity to consider whether or not to participate and that minimize the possibility of coercion or undue influence.

The information given to the participant or the representative will be in language understandable to the participant or the representative. No informed consent, whether oral or written, may include any exculpatory language through which the participant or the representative is made to waive or appear to waive any of the participant's legal rights, or releases or appears to release the investigator, the sponsor, the institution or its agents from liability for negligence.

- **Are all sensitive data that are planned to be collected really focused on the research question and is relevant for the foreseeable research?**

Only data required to progress on the project objectives will be collected.

- **For how long will the collected data be used?**

Collected data will be used for the duration of the experiment and in any case will not be used for a period longer than the BUTLER project duration.

- **For how long will the collected data be stored and when will it be irreversibly destroyed?**

Collected data will be stored for the duration of the experiment and in any case will not be used for a period longer than the BUTLER project duration.

- **Do the applicants have the necessary legal permission to obtain and process the data?**

Most of the BUTLER partners are already running experiments, within their normal business, involving collection of human being related data and have set-up processes within their organization to comply with European and national ethical regulation.

In addition BUTLER will pay special attention to any ethical rules and regulations, stemming from national laws and directives that would require additional targeted ethical interventions for specific pilot sites. BUTLER will ensure compliance with both EU directives and national directives (at the countries where pilots will be performed).

- **How will the collected personal data be securely accessed?**
The protection of the privacy of participants is a responsibility of all people involved in research with human participants. Privacy means that the participant can control the access to personal information; he/she decides who has access to the collected data in the future.

Due to the principle of autonomy the participants have to be asked for their agreement (informed consent) before private information can be collected. It should be also ensured that all the persons involved in research work, understand and respect the requirement for confidentiality. The participants should be informed about the confidentiality policy that is used in the research.

The privacy plays a role at different levels:

- Hints to or specific personal information of any participant in publications
- It should be prevented to reveal the identity of participants in research deliberately or inadvertently, without the expressed permission of the participants.
- Dissemination of data among partners
- Access to data method of access, data formats, method of archiving (electronic and paper), including data handling, data analyses, and research communications. Offer restricted access to privacy sensitive information within the organization of the partner.
- Protection of the privacy within the organization of volunteers (employers, etc.) throughout the whole process like, communications, data exchange, presentation of findings, etc.

A question currently under debate among behavioural scientists is whether a consent form stating that personal data will not be shared precludes sharing of data even if identifying characteristics are removed. The removal of identifying information from data gathered on an individual may not be enough since identities can be reconstructed from disparate data sources.

There are solutions to the challenge of maintaining confidentiality including substituting numerical identifiers for names, aggregating data so that the performance of individuals is not obtainable, encryption or layering data so that researchers who need identifying information can obtain it only after signing a legal document that requires honouring the confidentiality of individuals. Researchers who do not need identifying information can have free access to aggregated data.

- **How will the data be securely stored: data structure and format?**

As already mentioned, protection of confidentiality implies informing the participants about what may be done with their data (i.e. data sharing). As databases are developed, confidentiality will become increasingly hard to maintain. Simple stripping of the participants name and its replacement with a code is no guarantee of complete confidentiality.

In addition, all stored information will be made available only to authorized users through special secure access management mechanisms, therefore, avoiding jeopardizing personal privacy when the project’s results will be commercially exploited. It should be underlined at that stage that development and integration of pervasive security is among the key challenges addressed by BUTLER.

Questionnaires developed to capture users feedback will be handled in the strictest confidence – the results will be entered immediately into a database from where each set of results will be given an automatic number and the personal details omitted. The questionnaires themselves will be kept in a folder, which is kept in a lockable drawer. The questionnaires will be destroyed at the end of the project.

Data will be encoded, and anonymized using numerical codes. During the pilot stages, the correspondence with the users list will be saved into a local database, which will be encrypted

- **How will the data be securely stored: location & hardware?**

The name of the persons and any kind of identification data will appear on the consent forms, of which one copy (possibly in electronic format) is kept by the project leader and the other one by the person participating to the experiment. All recordings will then be anonymized by assigning a numerical code to each user (local database), and stored accordingly (e.g. Subject 1, Subject 2, etc.). All data will also be anonymized in internal reports, internal communications and external publications.
Data will be stored in servers hosted in professional data-centers with secure access (physical and network) control.

- **How will data transfer be monitored?**

The participants have to be able to control the dissemination of the collected data. The investigator is not allowed to circulate information without anonymization. This means that only relevant attributes, i.e. gender, age, etc. are retained. Another possibility is to keep the identity of the participants, but only with prior consent of those.

Transfer of data within the consortium is defined within the consortium agreement. Anonymization will be used to protect the user’s identity within data transfer taking place in BUTLER. Moreover, ensuring protection of data being transferred is integral part of the security processes being developed within BUTLER.

Researcher and database developer should always consider – when designing studies, before passing information to others, and before publishing information - whether data contain combinations of such information that might lead to identification of individuals or very small groups. How much of this potentially identifying information can be safely included in data that is assumed to be unidentifiable can only be judged on a case-by-case basis taking into account the sample size, the ways in which results will be published and used.

**C.2 Commonly understandable written description of the project**

The following description of the project, its objective, and planned progress is to be distributed to all the project field trial and proof of concepts participants, to ensure their correct understanding of their participation to the project.

**What is the Internet of Things?**

Imagine a world where everyday objects can sense what is happening around them, act on their environment, react autonomously and communicate with each other’s and with us. This once futuristic vision is more and more possible thanks to the progress of the Information and Communication Technologies. The implication on our lives will be tremendous as these new “Smart”-Objects will be able to help us to save time, reduce human mistakes, optimize the energy, and increase our ability to better interact with our environment.

The connection of Objects in an “Internet of Things” will open many possibilities, for example enabling us to better avoid traffic jams and find parking places, advising us to bring specific medications when we’re travelling to a place where we might encounter allergic pollens, or letting us know when we should water the plant; reminding us that we are out of milk when passing by the grocery store or enabling our home appliances to talk to each other’s to better use water and electricity, and in many other situations.

As with all new technology, these new opportunities also come with potential for misuses and dangers but this is also part of our researches.

**What is the BUTLER Project?**

The BUTLER project is a European Union co-funded research project on the topic of the Internet of Things. The goal of the project is to develop and experiment a technological platform that could enable the Internet of Things. The specificity of the BUTLER project is to try to target several application domains with the same platform: “Smart”-Transports, “Smart”-Health, “Smart”-Shopping, “Smart”-Home and “Smart”-Cities.

The main challenges that the project addresses are:
- How to handle the very diverse, varying and large quantities of data that such “Smart”-Objects could gather and make sense of it?
- How to ensure the security of these new communications and respect the privacy of the end users?
- How can this “Internet of Things” be used to optimize the way we collectively act?
The BUTLER project started in September 2011 and will continue until September 2014. At the end of the project we expect to have a better understanding on how it can change the way we live our lives and how this new “Internet of Things” can be pushed further.

What is the goal of this experiment?

The experiment in which you are invited to take part is what we call a “BUTLER Field Trial”, it involve the deployment and use of technologies developed in the project along a scenario inspired by this vision of a “Smart-Life, where objects are able to help us. The goal of this “Field Trial” is to help us get out of the lab and experiment with the technology in nearly “real” conditions and more importantly to get your feedback on this experiment, scenario and the “Internet of Things”.

C.3 Regulations followed by the project to ensure data privacy

<table>
<thead>
<tr>
<th>partner</th>
<th>Current situation</th>
<th>BUTLER data</th>
<th>Required actions</th>
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<tr>
<td>Inno AG</td>
<td>Inno runs online survey from servers hosted in secured datacenters. Surveys are anonymised using numerical tokens. Whenever necessary, authorizations are asked to the national regulators.</td>
<td>Possibly user surveys to collect experiments participants with feedback on their experience.</td>
<td>Inno will apply its standardized internal methodology for private data processing. Handling of data transfer to partners will be done in line with agreement set in the consortium agreement.</td>
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<tr>
<td>Ericsson España S.A.</td>
<td>In our data analytics processes, Ericsson will either work with data coming from anonymous sources (group of people, devices, etc), or with individual end-user disintegrate data (i.e. data not associated to personal identification).</td>
<td>No inform consent will be needed to process data.</td>
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<tr>
<td>Telecom Italia S.p.A.</td>
<td>For sensitive context data collected in the Lab, user’s inform consent to share all data with other testbed users is obtained by opt-in web page. This procedure is compliant with national law n. 196/2003</td>
<td>User device position; device Id, settings and status; favorite places; contacts; calendar; social network profile</td>
<td>Users involved in BUTLER experiments will have to accept to share all their context data with other testbed users using the opt-in web page</td>
</tr>
<tr>
<td>GEMALTO</td>
<td>Follow French regulation (Loi informatique et libertés) whenever private date is being used.</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Commissariat à l’énergie atomique et aux énergies alternatives</td>
<td>Follow French regulation (Loi informatique et libertés) whenever private date is being used.</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Oulun yliopisto.</td>
<td>UOULU does not collect data form user of any system of any kind.</td>
<td>UOULU will NOT collect data form user of any system of any kind.</td>
<td>No action required. UOULU will not be involved in field trials or future commercial exploitation. It’s work on issues such as behavior modeling will be performed at a theoretical level, using simulated (computer-generated) data only.</td>
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© BUTLER – Page 154/166
<table>
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<tr>
<th>FBConsulting S.a.r.l.</th>
<th>Istituto Superiore Mario Boella Sulle Tecnologie Dell’informazione E Delle Telecomunicazioni</th>
<th>BUTLER</th>
<th>Project deliverable</th>
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<tbody>
<tr>
<td>Not applicable</td>
<td>User consent for personal data collection is obtained through explicit permission requests by the applications or by filling in proper privacy consent forms. Where appropriate, the information collection procedure offers the possibility for selective personal data disclosure. Unnecessary collection and use of personal data is avoided, and collected data is not kept for longer than necessary for the purposes for which the data are collected. ISMB commits to respect all Italian legal rules regarding this matter and consistent with European Directive 95/46/EC.</td>
<td>Not applicable</td>
<td>Before carrying out any experiments about positioning or tracking modules requiring processing of personal and/or sensitive data, a user consent process will be executed where every participant will signify his agreement to personal data relating to him being collected and processed. The user consent process will detail how the data may be stored for future use, shared with other parties or services, and/or whether the data is processed/used locally (e.g. on a user owned device) or remotely (e.g. statistical research for the elicitation of common group behavior). Collected information will only be shared as part of the testbed to third parties authorized to process the data after removing personal identifiers and/or applying powerful de-identification procedures such as k-anonymization.</td>
</tr>
<tr>
<td>Hochschule Luzern, CEESAR-iHomeLab</td>
<td>The iHomeLab visitors are informed about the fact of gathering their personal data. The personal data of the iHomeLab visitors are anonymised before internal usage. The personal data of the iHomeLab visitors are not provided to third parties and are only used for statistical and analytic purposes. The personal data are legally protected by the Federal Act on Data Protection (DPA) of 19 June 1992 (Status as of 1 January 2011). All employees of iHomeLab are subject to the Official Secrecy (“Amtsgeheimnis”) and must treat all data confidential as stipulated in the Public Sector Employment Act of the</td>
<td>Type of personal data being collected are: First Name, Last Name, E-Mail, Employer, Corresponding Address, Age, Gender Personal data collected during BUTLER field trial experiments of Smart Home, Smart Office, Smart HealthCare, Smart Transport, Smart Shopping and Smart City will be exclusively used for the research purposes. The interviews, surveys and other feedback gathering methods has to conform the Federal Constitution of the Swiss Confederation of 18 April 1999 (Status as of 1 January 2011) including ethical norms on racism, gendering, aging, physical and mental impairment issues.</td>
<td>Periodical review of the data security and research methods.</td>
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<td>BUTLER</td>
<td>Project deliverable</td>
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<td><strong>Canton of Lucerne of 26. Juni 2001</strong> (Status as of 1 January 2011) (&quot;Gesetz über das öffentlich-rechtliche Arbeitsverhältnis&quot;).</td>
<td>We have to inform trial users about what data will be used for which reason and the trial user has to agree in written form. All employees and project partners accessing such data have to sign a NDA based on Swiss data protection and privacy law. All project personal accessing personal data needs to sign a NDA. Trial users have to agree on the usage of personal data in written form. The project will become part of ISO 27001 processes at Swisscom and will be audited on a regular basis.</td>
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| **Swisscom Ltd.** | Personal Data is basically not accessible to any employee or external person, and is under the protection of Swiss data security and privacy law. (Bundesgesetz über den Datenschutz (DSG;SR235.1)
According to DSG,SR235.1 Swisscom has dedicated person assigned taking care about enforcement of DSG,SR 235.1 within Swisscom along ISO 27001 processes. Swisscom is ISO 27001 certified. |
| **STMicroelectronics S.r.l.** | **ST will participate to the field trials as a provider of embedded systems (hardware and low-level software) and will not deal with the management of user data collection, analysis and use** |
| **University of Luxembourg** | UL does not plan to collect data but to use the data collected by other partners from the BUTLER consortium, in order to define the security layers within the BUTLER architecture. UL's use of the data collected will follow the Luxembourg law of August, 2, 2002 (http://www.cnpd.public.lu/fr/devoirs/index.html) and the ethical requirements defined by the National Commission for Data Protection for the use of private data. |
| **K.U.Leuven** | Information will be collected to enable situational awareness and contextual human behavior recognition. This information may include personal data. User consent for personal data collection is obtained through explicit permission requests by the applications. Where appropriate, the information collection |
| **University of Luxembourg** | Any contextual information that will contribute on investigation of appropriate security solutions for different networks with a special focus on a flexible and modular security support. |
| **K.U.Leuven** | Any contextual information that can be used to characterize the situation of an entity. An entity can be a person, time, place or object that is relevant to the interaction between a user and an application and/or service that is considered relevant for the characterization of common human behavior. |
| **K.U.Leuven** | Before carrying out any experiments requiring processing of personal and/or sensitive data, a user consent process has to be executed in which every participant must signify his agreement to personal data relating to him being collected and processed. The user consent process will detail how the data may be stored for future use, shared |
| Tecnologías Servicios Telemáticos y Sistemas S.A. | Not applicable | Not applicable | Will review with SmartSantander project the co |
| Jacobs University | Jacobs University does not collect data form user of any system of any kind. | Jacobs University will NOT collect data form user of any system of any kind. | No action required. Jacobs University will not be involved in field trials or future commercial exploitation. It’s work on issues such as behavior modeling will be performed at a theoretical level, using simulated (computer-generated) data only. |
| ZigPos | Personal data collection is obtained through explicit permission requests along with the information about the fact. The personal data are anonymized before internal usage. Unnecessary collection and use of personal data is avoided and collected data is not kept for longer than necessary for the purposes for which the data are collected. All the employees are subject to the official confidentiality for the collected data. The personal data are legally protected by the German Bundesdatenschutzgesetz (BDSG), a Federal Data Protection Act. | ZIGPOS will participate to the field trials for Smart Transport that involves user surveys to collect experiments participants with feedback on their experience. The interviews, surveys and other feedback gathering methods has to conform the Federal Data Protection Act. | ZIGPOS will apply its standardized internal methodology for private data processing. Handling of data transfer to partners will be done in line with agreement set in the consortium agreement. The employees working on the BUTLER projects will sign a non-disclosure agreement identifying the sensitive data and guaranteeing that the data received from the other project partners will not be communicated to third parties without their prior agreement. |
| **Maya** | Maya does not collect customer personal data of any form. | Personal data may be collected during BUTLER field trials. Maya will follow the French regulation (Loi Informatique et Libertés) regarding personal data, in particular users will be informed that such data may be collected for a period of time, and will have the right to ask for update or deletion of these data at any time. | User involved in BUTLER field trials will have to accept in written to share all their context data, and will be informed that personal data may be collected during trial post-processing, under the terms of the corresponding regulation. |
Annex D  Letter of consent signed by field trial participants

D.1  Letter of consent signed by field trial participants

LETTER OF CONSENT

I ____________________________ (Print Name) would like to confirm that I accepts to participate in the BUTLER Field trial under the framework of the BUTLER project that will take place in ____________________________.

I understand that if I have any questions arising from the Information Sheet or explanation already given to me I can ask the researcher before I decide whether to join in. I will be given a copy of this Consent Form to keep and refer to at any time.

I understand that if I decide at any time during the research that I no longer wish to participate in this project, I can notify the researchers involved and withdraw from it immediately without giving any reason. Furthermore, I understand that I will be able to withdraw my data up to three weeks after the date of interview. I understand that my eventual withdrawal from the trial would have no negative consequences whatsoever for me.

I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be treated in accordance with the terms of Data Protection Laws and according to the Ethics Policy of the BUTLER project.

I consent to the recording of videos of my gestures that will be gathered in the context of the evaluation of “Web-cam gesture switch/tracker” and their storage in an BUTLER-not public-research repository. I approve that fact that will be used solely for research purposes in the context of the project and will not be public.

Contact details of the participant:
• Name (in capitals):
• Organization
• Gender:
• Age:
• Nationality:
• E-mail:
• Telephone:

I ____________________________ (Print Name) agree that the research project has been explained to me to my satisfaction and I agree to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves.

Signed: ____________________________ Date: ________________ Location: ____________________________

D.2  Complaint procedure information

The following description is to be distributed to all trial participants to present their right to form a complaint regarding their privacy, data, and the way the trial was organized.
As a participant to a BUTLER Field Trial your feedback, positive or negative is always welcome and appreciated. The Field Trial Organizer should provide you with ways to express yourself and provide any feedback that seems relevant to you.

However if this not sufficient, and / or if:
  • You feel that you were denied the opportunity to provide your feedback in a full and adequate way
  • You have concerns about the way your private data has been treated by the Field Trial Organizer
  • You have concerns about the safety of the trial
  • You have complaints about the way the trial was organized and the way you have been involved

You can place a formal complaint by following the procedure described below:

1) Fill the following Trial Complaint Form, in 3 copy

2) Address one form to the Field Trial organizer

3) Address one form to the BUTLER Project Project Coordinator

Inno TSD
To Mr Franck Le Gall
Place Joseph Bermond - Ophira 1
06902 Sophia-Antipolis
France
contact@iot-BUTLER.eu

4) Keep one copy for yourself.

5) You should be contacted rapidly by the project to evaluate your complaints.

In case no amiable agreement can be reached, the BUTLER Project is governed by the laws and regulations of the European Union (including Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data) and governed by Belgian law regarding the resolution of conflicts.
D.3 Complaint form

COMPLAINT FORM

I ________________________________ (Print Name) would like to complaint about my participation in the BUTLER Field trial under the framework of the BUTLER project that took place in ________________ (place) on __________________________ (date)

Detail your complaint hereafter:

The following form should be provided to you in three copies by the BUTLER Field Trial organizer, along with the details regarding the complaint procedure.
Annex E  Questionnaire form on fixed and portable BUTLER sites

If you were about to buy an Internet of Things application like the one you’ve seen / used today, what would be the **most important criteria for selecting a vendor / company** to buy from.

Please select your three most important criteria, giving a 1 to the most important, a 2 to your second and a 3 to your third important one.

- I would buy this wherever I get the best price
- I would buy this from whomever offers me the best service and support, if anything should go wrong
- I would buy this from a company who has specialist know how / expertise in the field the application addresses (for example: Health applications from a doctor, Transport application from a transport operator)
- I would buy this from a company I can trust with my personal data
- Something else (please specify what that would be)

If you were to use an Internet of Things application like the one you’ve seen / used today, what would be **important to you in daily use** . Please tick all that apply

- I would like a community of other users to exchange tips and get help
- I expect to be able to contact the vendor easily in case I have a problem
- I want to decide exactly what the application does and be able to control it at all times
- I don’t want any extra work because of this application. It should just run.
- I want to know exactly what data is being collected and what it is used for
- I do not want to notice the application and the devices, they should be as hidden as possible
- Other, please specify:

Some **socio-demographic data** to help us evaluating the answers:

1.  Age (select one answer)
   - Under 20
   - 20 – 30
   - 30 -50
   - 50 – 65
   - Over 65

2.  Gender (select one answer)
   - Male
   - Female

3.  Please answer the following two questions on the size of your household:
   - Number of persons in total (adults and children):
   - Number of children / persons under age 18
     - Younger than 6 years old:
     - Between 6 – 12:
     - Over 12:
4. How would you describe your working Situation (select the one that best applies)
   - Full time work (> 30 hours / week)
   - Part time work
   - Retired
   - In education
   - Others

5. Please indicate your highest level of education (select the one that best applies)
   - No formal school graduation
   - Graduated from school
   - Apprenticeship
   - Graduate Degree
   - Postgraduate Degree

6. How would you best describe your living situation (select the one that best applies)
   - Rural area
   - Suburban
   - Urban
Annex F  Questionnaire form on SmartParking Field Trial

SmartParking Field Trial
SURVEY

1. Your Gender:
   - Male
   - Female

2. Your Age:
   - Under 18
   - 18-24
   - 25-34
   - 35-44
   - 45-54
   - 55-64
   - 65 or above

3. Do you have a disability?
   - Yes
   - No
   - Prefer not to answer

4. Do you agree that it was easy to understand the content and technical language of the presentation?
   - Strongly agree
   - Somewhat agree
   - Neutral agree
   - Disagree

5. Do you agree that it was easy to get the idea of the SmartParking service?
   - Strongly agree
   - Somewhat agree
   - Neutral agree
   - Disagree

6. Would you like to attend another presentation from the BUTLER project in the future?
   - Yes

7. Compared to the alternative products and services available on the market, how do you estimate the SmartParking services:
   - Much better
   - Somewhat better
   - About the same
   - Worse
   - Much worse
   - Don't have other experience to compare with

8. Based on your recent experience, will you subscribe to the SmartParking service in the future?
   - Definitely
   - Probably
   - Probably not
   - Definitely not
   - Not sure

9. If no, why not?

10. What is the most convenient way for you to subscribe to this kind of service?
    - Mail order
    - Internet
    - Phone
    - Kiosk
    - Other
11. Would you recommend trying the SmartParking service to your friends or affiliates?
   - Definitely
   - Probably
   - Probably not
   - Definitely not
   - Not sure

12. Did you experience any problems using any parking service in any city?
   - Yes, quite often
   - Yes, but rarely
   - No, I don’t remember

13. If you did, what kind of problems?

14. Now please think about the features and benefits of the SmartParking service itself. How satisfied are you:
   - Very poor
   - Somewhat unsatisfactory
   - About average
   - Very satisfactory
   - Superior

15. Would you please take a minute to describe why you are not satisfied with the product?

16. What could we undertake to increase your level of satisfaction with the SmartParking service?

17. Please submit your contact email in case you have any additional questions and would like us to contact you:

18. Do you have any final comments or suggestions to help us improve?
THANK YOU FOR YOUR FEEDBACK
For additional info, please visit us in www.iot-BUTLER.eu