IoT-A (257251)

Internet of Things Architecture

IoT-A

Project Deliverable D6.1 - Requirements List

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Executive Summary

Because the Internet of Things Architecture (IoT-A) project aims to develop a socially and business relevant architecture reference model for heterogeneous entities, it is necessary that in addition to developer know-how, external inputs are acquired to shape the architecture design. The problem of acquiring external input was addressed by contacting stakeholders, who are individuals and companies with an interest in or concerns about the realization of the architecture. The stakeholder input was acquired input via questionnaires and the completion of a workshop held in Paris on October 28th 2010. The present report provides a list of requirements extracted from the stakeholder workshop materials. Future work will involve disseminating these requirements, which will serve as inputs in designing the architecture reference model and developing validation models for the architecture.

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1. Introduction

Contributors: Edward Ho

1.1 Background

The objective of the IoT-A project is to provide an architectural reference model for the interoperability of IoT systems, outlining principles and guidelines for the technical design of its protocols, interfaces and algorithms. The "things" in IoT systems refer to real-world entities such as machines, with sensor and/or actuator capabilities. Thus IoT-A aims to provide the architecture that would let these heterogeneous entities exchange information and interact with one another, within the context of being socially and business relevant.

IoT-A will use an experimental paradigm, that combines top down reasoning about architectural principles and design guidelines with simulation and prototyping work to explore the technical consequences of architectural design choices and to validate the architecture's use to society and business.

To explain the context of this report, it is first necessary to explain how the above overall objective is broken down into concrete work within the IoT-A project. The work in the IoT-A project is divided into work packages (WP) which cover different areas in the spectrum of work. The results of this report are relevant to the following work packages:

1. **WP1:** An architectural reference model for Internet of Things will be developed

2. **WP7:** The developed IoT-A architecture shall be implemented and validated by developing a prototype to be used in a Proof-of-Concept use case, which aims to show IoT-A's relevance to society and business

3. **WP6**, for which this deliverable belongs to, acts as bridge between WP1 and WP7. Thus, the work involved in WP6 is twofold, and illustrated in the following Figure.

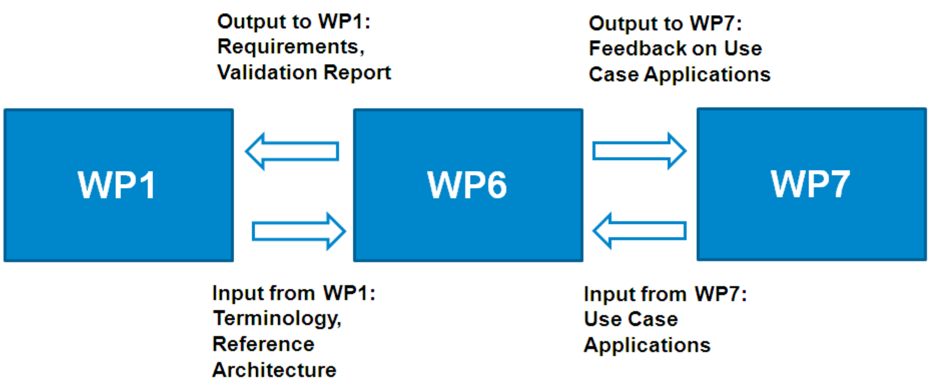


Figure 1: Relation of Work Package 6 (WP6) to the other Work Packages (WP)

The development of the aforementioned architectural reference model (WP1) shall be facilitated by collecting functional as well as non-functional requirements from a very diverse set of actors, which include external stakeholders - this interaction and requirements collection work falls within WP6. The results of this requirements collection and analysis shall be transferred to WP1 designers to help refine the architecture reference model. This work package will also be responsible for validating the reference model against the collected requirements, providing input into the design of the prototypes in WP7.

This document, "D6.1 Requirements List", documents the process and the resulting requirements coming from the first major interaction between partners and stakeholders at the first Stakeholder Workshop (SW1). It provides the first initial results from the workshop in the form of ordered requirements sorted by stakeholders, extracted from their business scenarios which they had explained to the IoT-A partners. In future work, these requirements shall be further analyzed and generalized and abstracted in order to provide inputs to WP1, and these requirements will also be further refined from future stakeholder workshops and the forthcoming validation results of WP7.

1.2 Overview of Document

The present document is structured as follows:

1. **Definition of Terms -** This section defines the terminologies which are used in WP6 in the requirements engineering process. The terms used in this document are defined to minimize ambiguity and misunderstanding.

2. **Description of Methodology and** Tools **-** In this section, a brief overview of the techniques and approaches for requirements elicitation are discussed and presented. The methods chosen for the deliverable are explained.

3. **Application of the Methodology and Process Undertaken in** D6.1 - This section describes how the requirements in this document were gathered. Reference is made to methodologies described in Section 3. The relationship between the work completed in this deliverable with respect to other WP is presented.

4. **Requirements List** - This section provides the first initial results from the workshop in the form of ordered requirements sorted by stakeholders, extracted from the business scenarios they had narrated to the IoT-A partners.

5. **Annex** - a summary of each use case given by the stakeholders is presented here. Since this document deals with requirements, the use case is therefore provided in summary form to give context to the reader.

The reader should also be aware of a complementing document, "D6.6 A Report on Stakeholder Opinions", which also covers the results of SW1, but eschews any content on requirements in favour of focusing on documenting the workshop itself and on the stakeholder's business opinions.

2. Definition of Terms

Contributors: Alain Pastor, Ralf Kernchen

An unambiguous understanding of the terminology among the stakeholders and partners is needed for effective requirements engineering. This section defines the terminologies which are used in WP6 in the requirements engineering process.

2.1 List of Generic Terms, WP Independent

The following is a list of terms in the requirements engineering process which are general and can be applied in the different work packages of the IoT-A project.

- **Stakeholder** [17]: A stakeholder in a software architecture is a person, group, or entity with an interest in or concerns about the realization of the architecture.

- **Architecture concerns** [17]: A concern about an architecture is a requirement, an objective, an intention, or an aspiration a stakeholder has for that architecture.

- **Scenarios** (in the sense of user's stories in a visionary future): A scenario is a concrete story about use. Scenarios are a vocabulary for understanding people's needs, envisioning new activities and technologies, designing effective systems and software, and drawing general lessons from systems as they are developed and used [15]. Instead of designing software by listing requirements, functions, and code modules, scenarios are visions how life could look like with a fully functional IoT. Different scenarios span a wide space of applications and are too diverse to materialize them in the IoT-A project with a reasonable effort. Therefore, each scenario is broken down into a subset of use cases, which are a tangible realization of scenario. The use cases show a general applicability of the architecture and focus on different aspects. The details of the use cases will be defined and validated in cooperation with the stakeholder group.

- **Actor** [12]: An actor specifies a role played by a user or any other system that interacts with the subject (e.g., by exchanging signals and data), but which is external to the subject. Actors may represent roles played by human users, external hardware, or other subjects. Note that an actor does not necessarily represent a specific physical entity but merely a particular facet (i.e., "role") of some entity that is relevant to the specification of its associated use cases. Thus, a single physical instance may play the role of several different actors and, conversely, a given actor may be played by multiple different instances.

- **Use Cases** [12][16]: Use cases are a means for specifying required usages of a system. Typically, they are used to capture the requirements of a system, that is, what a system is supposed to do. The key concepts associated with use cases are the *subject, actors*, and the *use cases*.

    - The subject is the system under consideration to which the use cases apply.

    - The users and any other systems that may interact with the subject are represented as actors. Actors always model entities that are outside the system.

- The required behavior of the subject is specified by one or more use cases, which are defined according to the needs of actors. Strictly speaking, the term “use case” refers to a use case type. An instance of a use case refers to an occurrence of the emergent behavior that conforms to the corresponding use case type. use cases treat the system as a black box, and the interactions with the system, including system responses, are perceived as from outside the system

A (System-) use case shall describe what the actor achieves interacting with the system. For this reason it is recommended that a (System-) use case description begins with a verb (e.g., create voucher, select payments, exclude payment, cancel voucher). Use cases should not be confused with the functionalities, features, requirements of the system under consideration. A use case may be related to one or more functionalities, requirements. A functionality or requirement may be related to one or more use cases.

- **Requirement** (also called story card in XP [13][14]): A requirement describes a property of a system in conjunction with (if applicable) a measure to determine whether the developed system covers the property and achieves the requirement. Requirements are typically placed into these categories:

  - **Functional requirements** are the fundamental or essential subject matter of the system. They describe what the system has to do or what processing actions it must take. They characterize the externally visible behavior of a system by defining the functional interactions between the system and its environment.

  - **Non-functional requirements** are the externally visible properties that the system’s functions must have. They characterize the quality properties of an architecture such as performance, security, scalability or usability.

  - **Design constraints** impose restrictions on how the system must be designed.

A given requirement, in addition to falling within one of the above categories, can also be *tagged* with the following designations (i.e. labelled into further sub-categories):

- *Exterior requirements* are derived from stakeholder use cases and will be refined into a set of general requirements. They are coarse-granular thus not covering any technical details and belong to the exterior view.

- *Interior requirements* belong to the interior view (between project partners, for example) and are technical in scope.

- *Business or Domain level requirements* provide a value towards the business domain (ex. retail, health). This designation is use for the development of WP7 proof-of-concept use cases (which focuses on specific business domains, such as retail) and also for WP1's domain modelling work.

- *Architecture design constraints* impose restriction on how the reference architecture must be designed.

- *General process requirements* define principles on the design and implementation of the system for the project partners, how to perform a certain design or implementation activity. The general process requirements can be derived from the Exterior Requirements.

- *Application use cases requirements* are requirements dedicated to a specific application.
- *System level requirements* are requirements toward designing the IoT.

2.2 List of Terms, D6.1 Specific

The following is a list of terms in the requirements engineering process which are specific only to this deliverable. The generic terms mentioned previously are used in other work packages while the terms listed here are used only in D6.1.

- **Stakeholder Business Scenario**: A scenario that is gathered from a stakeholder during the first stakeholder workshop, SW1. It describes what business process, application, or set of applications that can be enabled by the architecture.
- **Stakeholder use case**: A use case that is gathered from a stakeholder during SW1.
- **Stakeholder Requirement**: A requirement that is obtained or derived from the stakeholder in SW1.

2.3 Relationship Between Terminology

The relationship between the WP-independent terms and the terms used in WP6 and D6.1 as well as the topology of how are they defined also is depicted in the following figure:

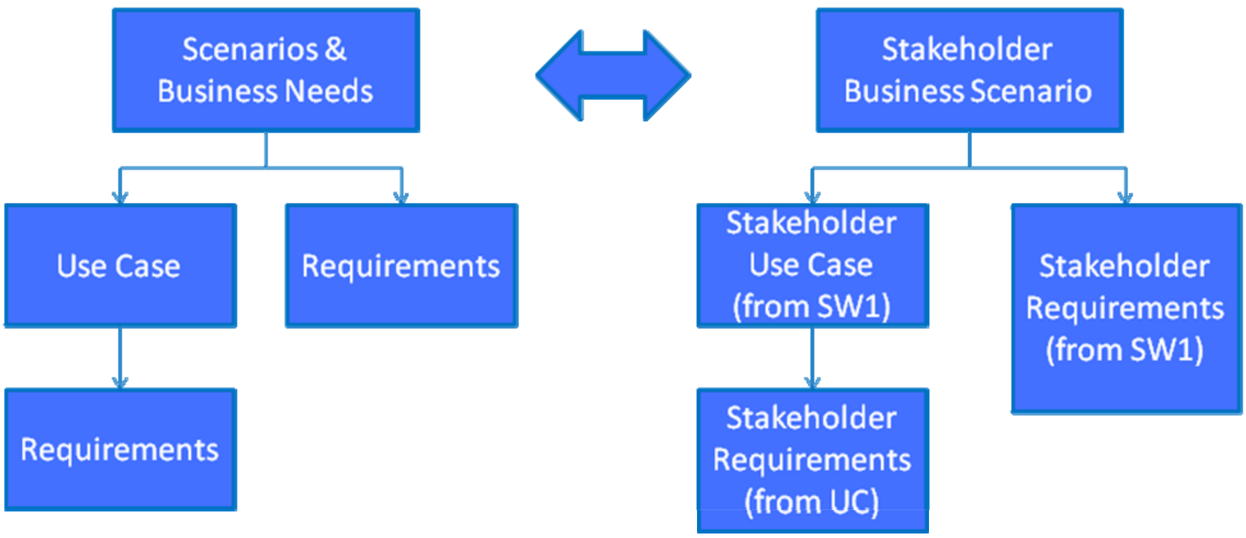


Figure 2: The relationship between the general terms (left) and the terms specific to D6.1 (right)

Referring to Figure 2, a scenario consists of a collection of use cases and requirements, both of which define specific usages and properties of the scenario. Within each use case, one can also extract requirements, which form the core of this deliverable.

Specific to this deliverable and to the first stakeholder workshop, a Stakeholder Business Scenario (as defined and used in this deliverable) is an example of a "scenario & business need". The

Stakeholder use cases and Requirements are specific examples from the categories "use case" and "requirements".

Using this structure, in other work packages partners can define their own categories of use cases and requirements according to their needs.

3. Description of Methodology and Tools

Contributors: Sonja Meyer, Edward Ho

In this section, a brief overview of the techniques and approaches for requirements elicitation and management are discussed and presented. The methods chosen for the deliverable are explained.

3.1 Methodology

The requirements methodologies fall into two area. One deals with how the requirements are managed over time, as the situation of the project changes. The other methodology area deals with how to structure and organize the requirements themselves. The requirements are structured as per the Volere template [11] and the change management system is described as follows.

3.1.1 Overview on Requirements Change Management Methods

In general, a portfolio of different methodologies is used together for the requirements process depending on the chosen software development method. In this sections we will discuss some existing approaches for the software development process, such as the waterfall model [1], the Agile Alliance model [2] and the spiral model [5]. An important relationship regarding the discussion of methods is the connection between the chosen software development approach, which will be used for the development of the IoT reference architecture and the associated change management; the method used for requirements management in IoT-A must be as flexible as the architecture development methods.

A description of common change management methodologies are as follows:

- **The Waterfall Model**: The waterfall model describes the software development process as a sequential, linear and predictable process. It begins with a complete analysis of the requirements from the user perspective and is followed by design, development, and organized shipment. If a phase is completed, it is not possible to return to a previous phase of the process. This means within the IoT-A project a change of the initial requirements set or only a change of the priority of a requirement would not be supported. The main advantage of the waterfall model is that it provides a kind of stability [3]. Nevertheless, experience has shown that this software development model is applicable in a stable environment which is less affected by market dynamics. In a changing environment, as in the IoT-A research project, the waterfall model doesn't provide the possibility to react in a constantly changing market situation [4].

  Innovations of these early methods brought a variety of publications, such as the ones of Boehm [5], who is known for his spiral model and other developments such as the V-model. In the 90s the new software management approach called" Agile Movement" [6] was published [7], influenced by the development of object-oriented programming and Internet technologies.

- The **Spiral Model** combines aspects of iterative prototyping in stages with the design sequences of the waterfall method. The general steps can be defined as follows:

- In the beginning, the system requirements are defined in as much detail as possible by contacting external and internal stakeholders

- A preliminary design is created for the new system, based on analyzing alternatives and reviewing works in the state-of-the-art

- A first prototype of the new system is constructed from the preliminary design.

- The first prototype is then tested, evaluated and validated. This data can then be used to revise the requirements already gathered, and also provide inputs for the next iteration of the prototype

- A second prototype is constructed based on the aforementioned validation, and also the gathering of any new requirements

Schematically, this can be shown in Figure 3 as an iterative spiral that loops through different design iterations. The spiral model contains several design & requirement gathering stages, whose development influences the future iterations of work.

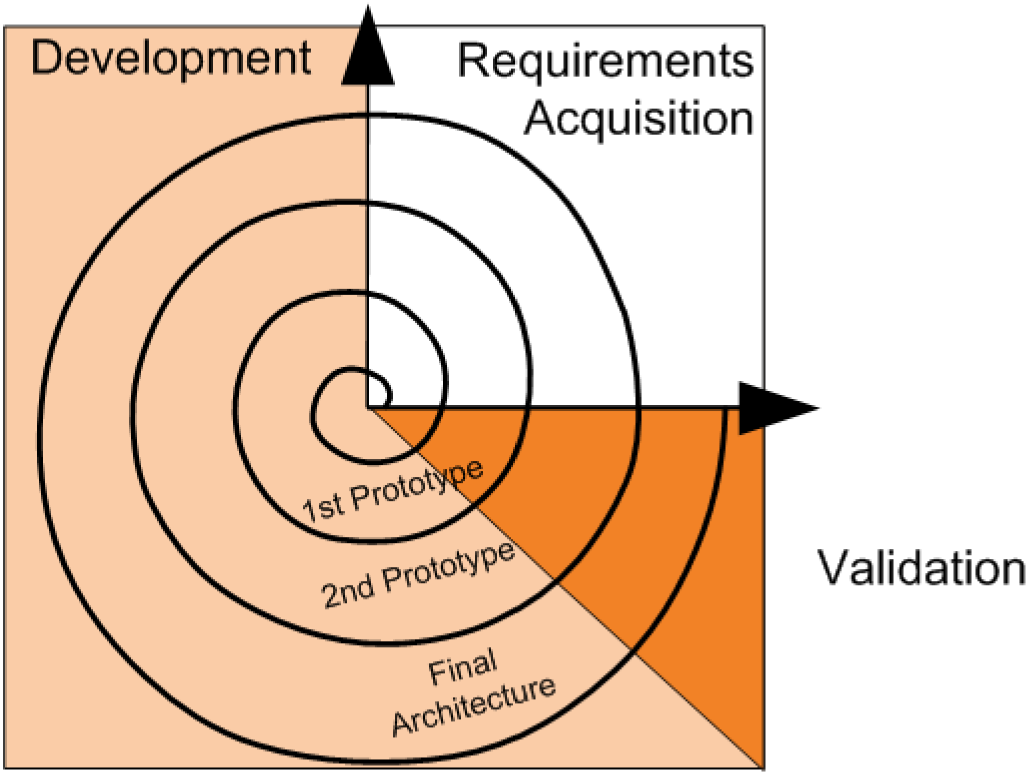


Figure 3: Schematic of the Spiral Model

- **Agile software development** aims to make the software development process more flexible than traditional process models do. This approach focuses on achieving the objectives to address technical and organizational problems within the development process. The agile software development follows the agile manifesto of 2001, which is based on particular values rather than a framed methodology:

"Individuals and interactions …over processes and tools

Working software	*…over*	*comprehensive documentation*
Customer collaboration	*…over*	*contract negotiation*
Responding to change	*…over*	*following a plan*

That is, while there is value in the items on the right, we value the items on the left more.“ [2]

Applying this model to requirements gathering, the requirements are formulated at the beginning and the project starts immediately with the development of key features. The solution is therefore incrementally and iteratively built up. Thus, it is possible to always keep the overview and to control the project. Since the most important requirements are developed first, a basic version of the architecture can be presented after a short development time. The amount of requirements grows over the project time.

The agile principle is a guiding principle for agile work. The transition between agile principles and methods is fluid.

3.1.2 Methods Chosen for IoT-A

3.1.2.1 Chosen Method for Requirements Change Management

As part of WP6 and IoT-A, a software development method combining aspects from agile principles and the Spiral method was chosen. The waterfall method's rigidity makes it inappropriate for IoT-A; during the project requirements will evolve, and new ones added to the collection. This could be caused by a changing research situation in the area of Internet of Things, which requires the flexible adaption of the project.

With regard to the requirements change process the following general considerations were made, which are covered by agile principles and the spiral model (see Figure 3):

- All requirements are stored in a set of lists in the software tool Requirements Aid (Reqaid). The entire requirements list will be reviewed at regular intervals. A corresponding functional time interval will be defined within the project. As per the agile methods, any new requirements which arise from the stakeholders can be added and implemented quickly - an advantage to meet the needs of stakeholders.

- The requirements list remains constant over a certain time period, in which development takes place. For instance, this "requirements freeze" is needed for the development process of the Future Internet Layer of WP 2. In this way a stable development process can be realized for the involved developers.

- Then, at regular intervals, a review and a final validation of the requirements list is needed including internal and external project stakeholders. Depending on these results the priority of certain requirements can be adapted and thus influence the remaining process. Therefore both requirements and the development process are iteratively updated, as per the spiral model.

This process ensures that all features are primarily developed, that are most beneficial for the solution. Requirements are defined on the internal and external stakeholder side during the project and iteratively updated over the design cycle.

3.1.2.2 Chosen Method for Structuring Requirements

Below we briefly explain the IoT-A requirements methodology. One of the goals of Task 6.1 is to define an initial set of requirements. Here we follow an approach that was already used in the research projects Aletheia [8] and Smart Products [9]. Based on domain dependent scenarios we define a set of application-specific use cases. These use cases consist of a set of requirements, the goal of this deliverable. The following figure shows the general requirements structure.

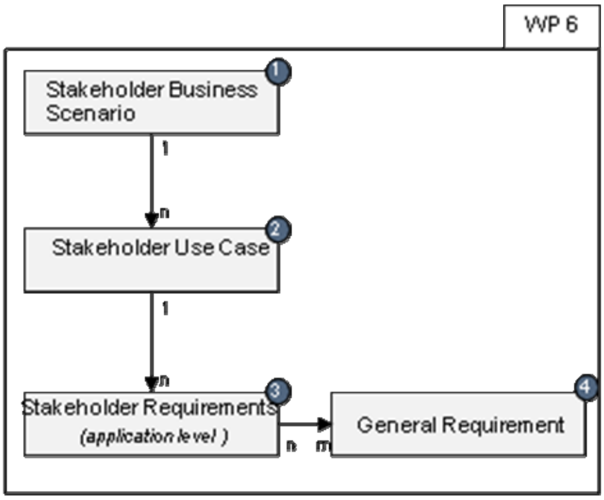


Figure 4: General Requirements Process - One or more use cases are part of a domain-specific application scenario. For each use case, several application-specific requirements can be derived.

In future WP6 work, these application-level requirements need to be analyzed and generalized to obtain cross-domain requirements on the IoT-A level, which will serve as an input for WP1 and WP7 of the project. For WP1, the analysis of the generalized requirements would help provide details for designing the reference architecture. For WP7, the analysis of the generalized requirements would assist in the development of the proof-of-concept use cases in the areas of Retail/Logistics and the Health/Home-domain.

The analysis work is outside the scope of this deliverable.

3.2 Tool Support

In this section we give a brief introduction to the functionality of the tool Reqaid. This requirements tool is an application that has been developed and used in the project Aletheia [8]. Moreover, it is currently successfully used in the EU project Smart Products [9].

The IoT-A consortium decided to use Reqaid as a tool for documenting the requirements, as it supports the specifically defined requirements process. In particular Reqaid supports the following functions:

- Version Control: Requirements and use cases can be changed as often as desired by persons of the project through the whole project cycle. Reqaid has an automatic version control to ensure that no data loss occurs after modifications.

- Access Rights: Access rights ensure which user groups can view or change certain information such as use cases and requirements.

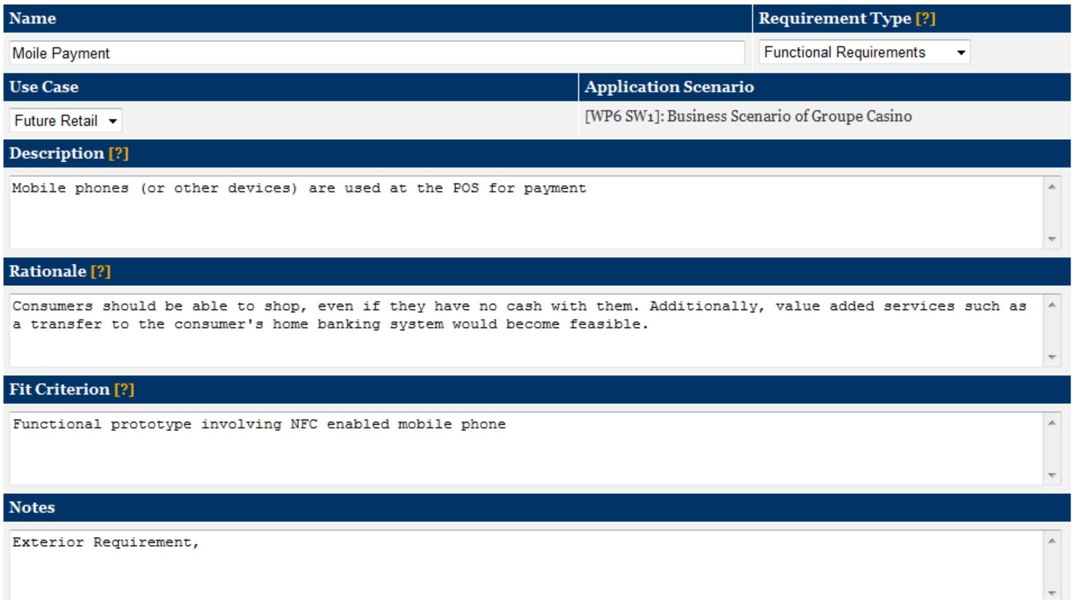
- Intuitive User Interface: To enable all partners of the project consortium to access the requirements process, Reqaid offers an intuitive user interface. The intuitive navigation structure allows partners to quickly access the desired information.

- Easy Web Based Access: Reqaid can be easily accessed using a web browser. This supports the formation of virtual teams across different countries and across organizational boundaries, and also minimal additional software infrastructure.

- Low Maintenance Cost: By using Reqaid already in the projects Aletheia and Smart Products, early software bugs have been already eliminated. Minimal adjustment and maintenance costs are expected.

In this section we explain how the terms "scenario", "use case" and "requirement" of IoT-A can be represented into Reqaid. Reqaid has already been set up and customized to serve during the project period as a single central platform for documenting all use cases and requirements. The input and display fields contained in Reqaid have been developed for the use case format based on Cockburn [10] and for the requirements based on the industry-accepted Volere template defined by Robertson [11]. The authorization is performed over the Internet using a Web browser by logging in with user name and password.

After the successful login, the user reaches the central entry page of the tool that displays a list of all scenarios. Within each scenario, the scenario description, the list of associated use cases and the list of associated requirements are displayed. One level down to each use case the appropriate use case description, the associated user group and its requirements are specified and visualized. By entering a particular requirement, the user finds the details to each requirement. The following graphic shows a part of the different categories displayed within Reqaid based on the Volere Template [11].



Name	Requirement Type [?]
Moile Payment	Functional Requirements

Use Case	Application Scenario
Future Retail	[WP6 SW1]: Business Scenario of Groupe Casino

Description [?]

Mobile phones (or other devices) are used at the POS for payment

Rationale [?]

Consumers should be able to shop, even if they have no cash with them. Additionally, value added services such as a transfer to the consumer's home banking system would become feasible.

Fit Criterion [?]

Functional prototype involving NFC enabled mobile phone

Notes

Exterior Requirement,

Figure 5: Volere based Reqaid

An export function provides the easy information export into other tools such as Microsoft Word or Excel.

4. Application of the Methodology and Process Undertaken in D6.1

Contributors: Edward Ho, Alain Pastor, Alexander Salinas, Alessandro Bassi

This section describes how the requirements in this document were gathered. Reference is made to methodologies described in Section 3. The relationship between the work completed in this deliverable with respect to other WP is presented.

4.1 Introduction

The WP6 process, which applied the previously described requirement gathering methods, is illustrated schematically as follows. The process is iterative in nature and fits the so-called "spiral model", where preliminary work is initiated and the results are passed onto the next steps, looping back eventually to influence the next iteration of the work that was started.

Figure 6 shows the general relationship between the work in WP6 with WP1 and WP7, independent of a specific time in the project cycle.

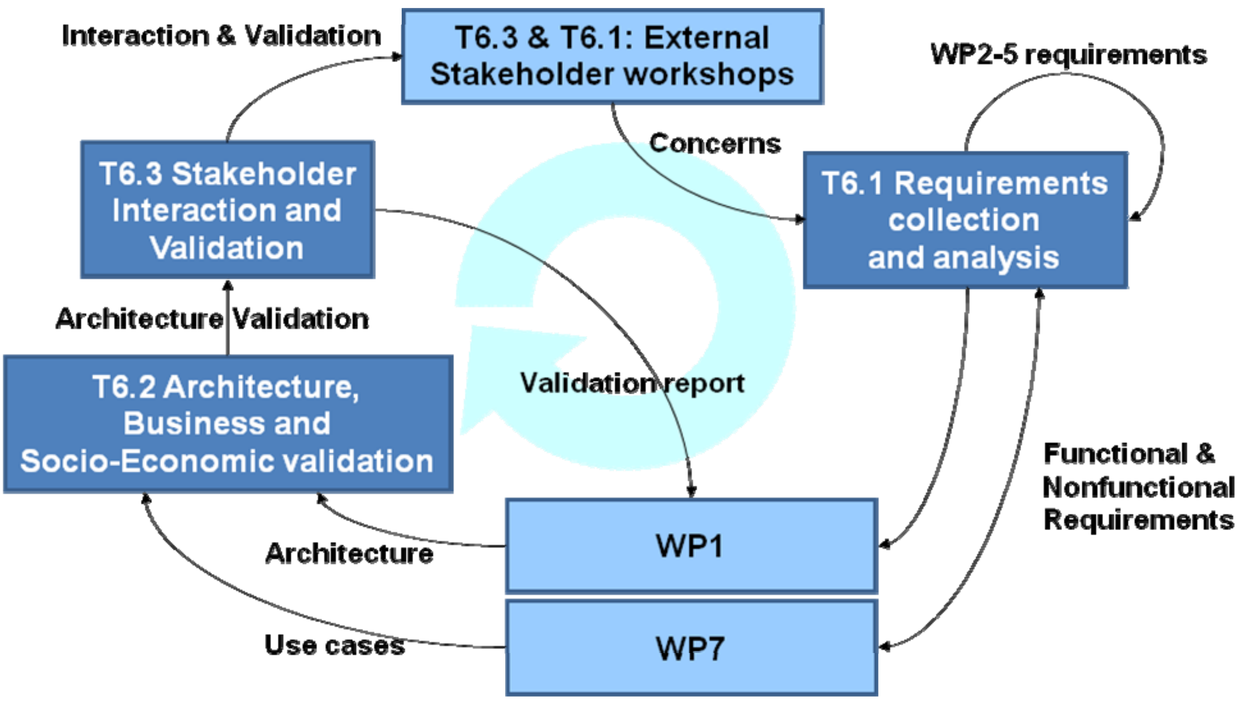


Figure 6: The process of WP6 with respect to WP7 and WP1

For the reader's reference, a brief description of the tasks referred to in Figure 6 are listed as follows:

- **T6.1 Requirements Collection and Analysis** - This task will focus on providing the requirements, and will do this in mainly two ways: one is through explicit partner engagement in the task, and the other through workshops with the group of external stakeholders. The latter activity is described more in depth in Task 6.3. The task will continuously revise the collected requirements

- **T6.2 Architecture, Business and Socio-Economic Validation** - The purpose of this task is to validate the designed architecture against technological requirements, the economic rationale of the target application areas, and legal/societal/political constraints. The required inputs for this task come from the architecture reference model (WP1), security and privacy considerations (WP4), gathered requirements (T6.1), and the developed proof-of-concept use cases (WP7).

- **T6.3 Stakeholder Interaction and Validation** - This task is responsible for maintaining contact with a set of external stakeholder organizations which can provide input to the requirements and help to validate the architectural reference model developed in WP1. Furthermore, this task is responsible for preparing, organizing and reporting from four workshops with the stakeholder group and to perform a set of interviews with individual stakeholders

Figure 6 and the overall WP6 process can be described as follows. Sequentially, the WP6 project process begins with the arrangement of the stakeholder workshop (T6.3 & T6.1). The results of the workshop are then analyzed (T6.1). The results of this analysis are passed onto the other work packages (such as WP2-5, which involve developing components of the IoT-A architecture). In particular, the requirements extracted in T6.1 influence the development of the proof-of-concept use cases in WP7, which are used to demonstrate the functionality and relevance of the architecture developed. The results of T6.1 are also used to influence the architecture development (WP1). This process is then iterated as new requirements are collected in future stakeholder workshops, and as the proof-of-concept use cases are evaluated.

The scope of D6.1 is a subset of this iterative process, encompassing activities from T6.1 and T6.3. Figure 7 shows the activities relevant to this deliverable (in white). The tasks not relevant to D6.1 have been grayed out.

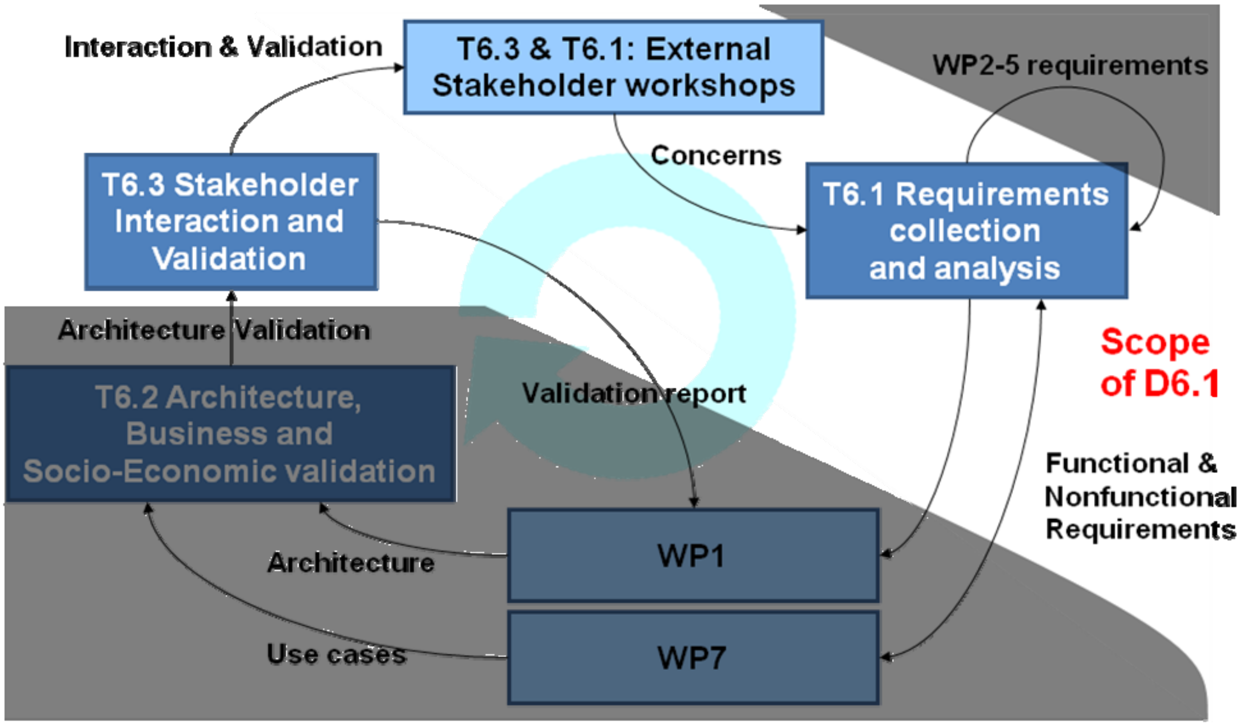


Figure 7: The process elements in WP6 which are relevant to D6.1. The activities outside the scope of this deliverable are in the grey shaded regions.

A breakdown of the tasks (T6.1 and T6.3 in Figure 8) relevant to D6.1 into substeps are shown in Figure 8.

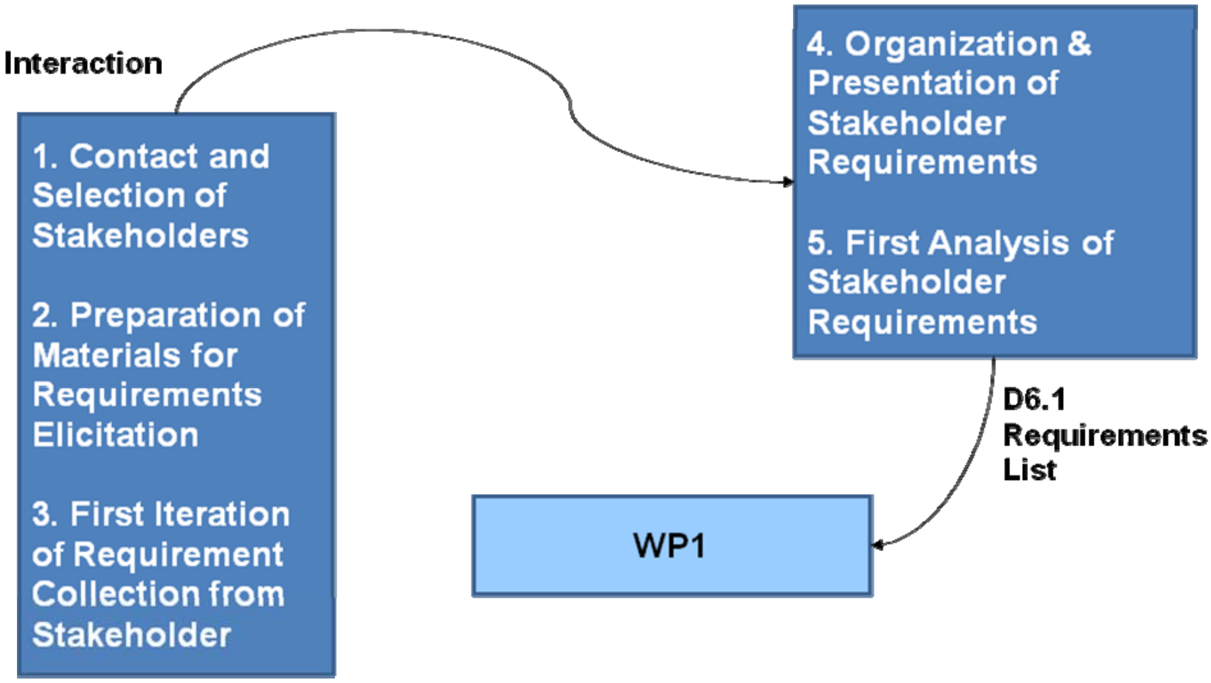


Figure 8: Breakdown of the methodology in D6.1

In list form, the substeps in the application of the methodology are:

1. Contact and Selection of Stakeholders
2. Preparation of Materials for Requirements Elicitation
3. First Iteration of Requirement Collection from the Stakeholder
4. Organization and Presentation of Stakeholder Requirements
5. First Analysis of Stakeholder Requirements
6. Future Steps and Outlook

These are elaborated upon in the following sections.

4.2 Contact and Selection of Stakeholders

From the conception of the IoT-A project, the partners took as a strategic decision not to include in the consortium any end-user organizations, since that would have steered the creative process towards a particular set of requirements, whereas the goal of IoT-A was to design a reference architectural model able to implement the Internet of Things in its entirety.

In order to be able to collect requirements from a large number of different application fields, it was then decided to implement a "Stakeholders Group", and to subsidize participation by reimbursing travel fees to meetings. Therefore, while not officially belonging to the project partners list, the Stakeholders are considered to be part of IoT-A's "extended family".

Based on other projects which have already used IoT technology, a number of application areas were then identified for stakeholder input for this project, namely: Logistics, Health Care, Technology Integrators, Retail, Automotive, Service Integrators and Telecom Operators. For each of these areas several companies and organizations were contacted; these organizations are well known in the IoT area, having spent a considerable amount of effort in designing IoT solutions for their challenges. Most of them replied positively to our requests, and we are happy to list them as belonging to the Stakeholders Group. The stakeholders are profiled as follows.

Technology Integrators:

Philippe Bereski (Alcatel Lucent Services) is a member of the IPv6 Task Force France and sat on the board of the G6 for 6 years. He has a long IT background, starting at Schlumberger in 1984 for 3 years and then at Digital Equipment Laboratories for 5 years more. He joined ALCATEL in 1994 and now works for Alcatel-Lucent Services Group whose business is focused on strategic industries. Strategic industries cover everything that is not underlying to the telecommunication operators, such as Energy, Transportation or Public Safety. He is the director of a laboratory dedicated to provide innovative solutions, filling the gap between standard Alcatel-Lucent products and the specific needs of strategic industries.

Thomas Jell (Siemens) is Director for the department Mobile Business, Embedded and Distributed Systems and Intelligent Labels (RFID) and Senior Principal Consultant at Siemens IT Solutions and Services (Munich, Princeton and Seattle). Siemens IT Solutions, represented by

Thomas Jell presented the current situation and the major issues in the healthcare arena from a technology integrator viewpoint. The healthcare model has been changing quite significantly since the 1990s. The point of care, for instance, has been moving away from hospital centric to more periphery centric systems, which is still an ongoing process. This of course requires suitably adapted ICT solutions fulfilling the specific requirements of such decentralized systems. For example, objects need to be located and information about objects needs to be made available for the respective caretakers – objects could e.g. be the medicine, the movable medical equipment, or artificial organs. It is clear that IoT-related technologies and solutions will play a major role in that context.

Standardization Authorities:

Patrick Guillemin (ETSI) ETSI, represented by Patrick Guillemin, produces globally-applicable standards for ICT (Information and Communications Technologies). ETSI is the home (standard body) of the GSM (Global System for Mobile Communications) and LTE (Long Term Evolution) standards. Furthermore ETSI is also active in areas directly related to standardization such as interoperability or technologies for communication in machine to machine (M2M) activities and therefore currently involved in a M2M committee regarding the IoT. Patrick is responsible within the ETSI Secretariat for the development, coordination and management of new standardization initiatives and proposes to link with ETSI RFID, M2M, IoT, Future Internet and ETSI TC CLOUD activities. He is the IoT standardization coordinator of IERC, the IoT European Research Cluster of the European Commission and actively participated in EU FP7 Projects related to RFID and the Internet of Things (CASAGRAS and GRIFS).

e-Health:

Christoph Thuemmler (Edinburgh Napier University) is currently member of the Institute of Applied eHealth at Edinburgh Napier University, in Edinburgh UK. The Institute has worked for about ten years on workflows and ergonomics at hospitals, particularly referring to the connectivity of entities to improve work processes in hospitals. Cristoph studied Medicine, Political Science and Educational Science at Heidelberg University where he earned his doctoral degree in Neurology. Among his interests are cloud computing, RFID and the Internet of Things in the context of eHealth. He has been involved in extensive knowledge transfer activities, especially in promoting the integration of life sciences, clinical practice and computing.

Logistics:

Markus Witte (Lufthansa Cargo) Lufthansa Cargo, represented by Markus Witte, is one of the leading cargo carriers in the world with a focus on airport-to-airport business. Besides its core business it also develops new industry and transport solutions in cooperation with customers including radio and localization technologies. Thus, there exists a common interest concerning the IoT in order to improve not only material flow systems or eProduction, but also global positioning, wireless communication and auto identification in the air freight logistics. Lufthansa Cargo currently works on other projects, (for example, a smart intelligent container), which are closely related to the IoT.

Retail:

Jean Prevost (Casino Groupe) The stakeholder Groupe Casino represented by Jean Prevost is one of the world's leading food retailers, which are active in multiple retail formats. Groupe

Casino's leading position in the market allows it to anticipate changing lifestyles and consumer practices. Jean Prevost, Director of Innovation of Groupe Casino is working on the store of tomorrow by understanding and envisioning the city of tomorrow. A main future aspect for the Groupe Casino is to discover the key contribution possibilities from the retail perspective. This includes understanding the consumer of tomorrow, which will change its shopping habits in the totally new use of the tomorrow's city. Groupe Casino expects particularly that the integration of IoT- technologies will enable the support of disabled people such as visually handicapped or blind.

Automotive:

Julien Mascolo (Centro Ricerche Fiat (C.R.F.)) represented by Julien Mascolo is an applied research centre, which was founded in 1978 as a common development center for innovation for companies Fiat Group, Fiat Group Automobiles, Ferrari, Maserati, Iveco, CNH, Fiat Powertrain Technologies and Magneti Marelli. Now an internationally recognized centre of excellence, CRF enhances the Fiat products through the development and transfer of innovative content. The principal objective is the development and application of innovative technologies which improve power plant performance, cutting engine and vehicle emissions and improving fuel economy. Further activities include the research and development of technologies for engines and components, green mobility, research for safe mobility, optics, telematics, new materials and micro-and production technology. C.R.F is interested in technologies that enable applications to improve the mobility with the help of vehicle diagnostics as well as lifecycle services.

Telecom Operator

Telefónica I+D represents the innovation company of the Telefónica Group. Founded in 1988, it contributes to the Group's competitiveness and modernity through technological innovation with the purpose to translate the innovative ideas, concepts and practices in order to develop advanced products and services within the core business of the Operator. It is the largest private R+D centre in Spain as regards activity and resources, and is the most active company in Europe in terms of European research projects in the ICT sector.

Telefónica I+D and Telefónica have a special interest within the M2M business in the forthcoming years through the creation of a specific Global M2M unit with more than 100 professionals worldwide working in the M2M business. However it is necessary to resolve the technological barriers that prevent IoT to be an everyday reality. IoT-A represents for Telefónica an important step, from a technical point of view, in overcoming the current limited state of the art. IoT-A will create the bases for the currently envisioned M2M services and also the technology for the future next generation of IoT services. All the tangible outcomes of the project will fuel the activity of the new Telefónica Business Unit.

Law

Eleni Kosta (ICRI) The Interdisciplinary Centre for Law & ICT (ICRI), represented by Eleni Kosta, is a research centre at the Faculty of Law of K.U.Leuven dedicated to advance and promote legal knowledge about the information society through research and teaching of the highest quality. ICRI is committed to contribute to a better and more efficient regulatory and policy framework for information & communication technologies (ICTs). Its research is focused on the design of innovative legal engineering techniques and is characterized by its intra- and interdisciplinary approach, constantly aspiring cross-fertilization between legal, technical, economic and socio-cultural perspectives.

Veterinary and Food Traceability

Francesco Tangorra (University of Milan) The Department of Veterinary Science and Technology for Food Safety of the University of Milan, represented by Francesco Tangorra, was established on 1 January 2001. It is part of the University's Faculty of Veterinary Medicine and is a teaching, research and consultancy institute concerned with veterinary science and technologies applied to food inspection, animal feeds, animal nutrition, veterinary toxicology and chemotherapy, domestic animal physiology, plant engineering for agriculture and livestock production, food chemistry, and other areas with the aim of ensuring the safety of food products of animal origin.

4.3 Preparation of Materials for Requirements Elicitation

The source of the requirements pertaining to D6.1 was from stakeholders. The requirements were collected in the following ways:

- **Questionnaires**: The questionnaire has been set up to gather information from the workshop participants before the start of the first stakeholder workshop. The main goal of this document was on the one hand to capture information about the understanding of the IoT between the participants and to identify their aspirations on the IoT. The questionnaire also aimed to examine the expected impact on their business sector and the society. Finally the stakeholders were faced with the technical aspects concerning the IoT and the technologies used in it. In order to ensure a high response rate, a limited amount of nine questions were presented to the participants. Regarding the structure of the questionnaire it is divided into three sections termed "nature and advantages of IoT", "IoT and your business" and "technical aspects" with each of the sections containing three questions associated to the section topic. The questionnaire text is stored in the partner's internal IoT-A portal.

- **Stakeholder presentations during the workshop**: One source of requirements material was from the stakeholder presentations conducted during morning of the workshop. Prior to the workshop, the stakeholders participating in the workshop were instructed by email to prepare a few slides presenting who they are, which organization they represented and what is their involvement in the IoT area. No further instructions were given. The briefing notes, including the schedule of the stakeholder workshop, can be found in the publicly available deliverable "D6.5 Briefing Notes".

- **Workshop exercise, stakeholder presentation of use cases:** In order to get structured data from the stakeholders, for which requirements can eventually be extracted, an exercise for the afternoon session of the workshop was planned. A use case template was generated in paper and computer file form, based on the The Open Group Architecture Framework (TOGAF) industry method [18]. The TOGAF method is a widely accepted standard for building enterprise architectures. During the workshop, stakeholders would be instructed to put their use cases and business scenarios into this template, and present them to the group. The raw data from the stakeholders, the use case template given to the stakeholders and the workshop exercise outline and plan are stored internally in the IoT-A portal.

4.4 First Iteration of Requirement Collection from the Stakeholder

The stakeholder workshop (SW1) was conducted on October 28th 2010 in Paris; seven stakeholders attended, described earlier in Section 4.2. The attendance list of all participants (stakeholders and partners) is stored in the IoT-A online portal for the internal partners; the Stakeholders who attended are listed below:

- **Philippe Bereski (Alcatel Lucent Services)**
- **Thomas Jell (Siemens)**
- **Patrick Guillemin (ETSI)**
- **Christoph Thuemmler (Edinburgh Napier University)**
- **Markus Witte (Lufthansa Cargo)**
- **Jean Prevost (Casino Gruppe)**
- **Julien Mascolo (Centro Ricerche Fiat (C.R.F.))**

The full agenda can be found in the publicly available deliverable "D6.5 Briefing Notes". In the morning, the stakeholders presented their backgrounds and aspirations.

- The stakeholders often presented their concerns and desired business scenarios. A set of minutes were taken from the presentations, for future analysis, and the general stakeholder opinion is documented in D6.6
- The set of workshop notes and minutes are stored internally on the IoT-A portal

In the afternoon, the business scenario / use case exercise (discussed in Section 4.3) was conducted, and the results were subsequently discussed

- Stakeholders were instructed to provide 3 use cases, and given 1 hour to generate all 3. Most stakeholders were able to generate 1-2 use cases.

Both audio and video were logged during the workshop and are also stored internally in the IoT-A portal.

4.5 Organization and Presentation of Stakeholder Requirements

The resulting workshop raw data from the different stakeholders was split between the partners for analysis and parsing into basic requirements. Weekly meetings were set up to discuss results and address future work. The raw data was sorted and stored in the online Requirements Engineering tool, Reqaid. This process and the associated requirements were then documented in the deliverable "D6.1 Requirements List".

4.6 First Analysis of Stakeholder Requirements

In order to work effectively with requirements, we need to capture a useful set and prioritize them to know where to focus our efforts for reaching the architecture goals and objectives.

We have derived those requirements from a number of different sources as explained in chapter 4.3.

Having identified a set of requirements, we need to prioritize them. With a large requirement set, it is easy to lose track of which ones are the most important ones to focus on. We focused our attention in several requirement characteristics that helped us to prioritize our requirements. In our experience, the two key criteria for requirements classification are: 1) the importance that our stakeholders attach to the requirement and 2) the likely risk that we consider the implementation of the requirement will involve. We have paid significant attention to requirements that the core group consider crucial and that are also risky to implement than to relatively straightforward requirements that stakeholders don't feel are that important (usually related to an application and not to the IoT itself). Requirements will also be ordered in terms of both priority and risk, so that we can focus our efforts on the high-priority, high-risk ones. Some requirements have overlapping and conflicting interests and opinions, and therefore, some must be discarded.

At this stage and for this deliverable, we will not prioritize or filter out the requirements based on the aforementioned criteria, simply because we need to involve the stakeholders to vote on which is the most important. This will be done during the second workshop dedicated to a first validation of the architecture and the refinement of the requirements.

4.7 Future Steps and Outlook

For the discussion of the future steps, the process diagram for WP6 with respect to WP1 and WP7 is presented again in Figure 9.

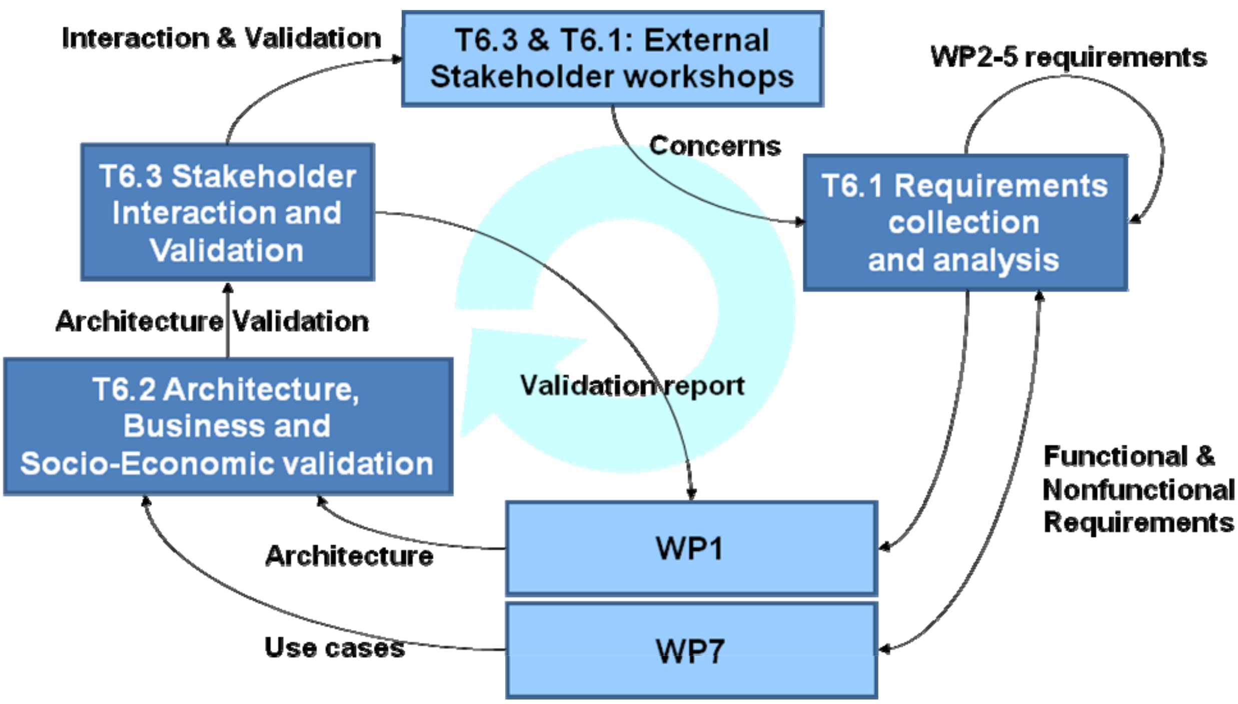


Figure 9: The process of WP6

Our stakeholders were a rich source of possible business scenarios and applications from which we have extracted a set of domain level requirements and application use case requirements. The future work can be described in the following steps:

1. Future analysis of the general requirements extracted from the SW1 results will be passed onto the other work packages as input (such as WP2-5, which involves developing

components of the IoT-A architecture).

2. The requirements extracted in SW1 will be further generalized by business domains in order to influence the development of the proof-of-concept use cases in WP7, which are used to demonstrate the functionality and relevance of the architecture developed.

3. The results of SW1 are further generalized to be independent of business domain, as well as to system level requirements. Both of these requirement types will be inputs to the architecture development (WP1). This process is then iterated as new requirements are collected in future stakeholder workshops, and as the proof-of-concept use cases are evaluated.

4. In parallel, the use cases and requirements obtained need to be validated from a technological, societal, economical, and legal perspective. This falls internally within the domain of WP6 and can be described by tasks 6.2 and 6.3, which also deals with the validation of the reference model. Therefore the validation process will also involve interactions with tasks 1.1 and 1.2 (architecture reference model), 4.4 (security and privacy), 6.1 (requirements), and 7.1 (use case definition), as described above.

    - The **technological validation** consists of an investigation of the structural as well as the content validity. In a **first step the structural validity** will be verified by checking to what extent the requirements from task 6.1 are covered by **the reference model**. The second step will concentrate on the reference architecture as a whole and review the overlapping regarding the original design goals.

    - The **business validation** provides a cost/benefit analysis of the use cases designed in WP7. In order to achiev**e** this, a quantitative as well as a qualitative analysis will be performed.

    - The **socio-economic validation** will focus on the security and privacy issues in the Internet of Things, comparing to what extent the architecture reference model is compliant to European legislation. The outputs from the validation process will be an initial validation on the reference model followed by the second validation report ending in a final validation report.

Figure 10 summarizes the flow of requirements in the future work, as per the aforementioned tasks.

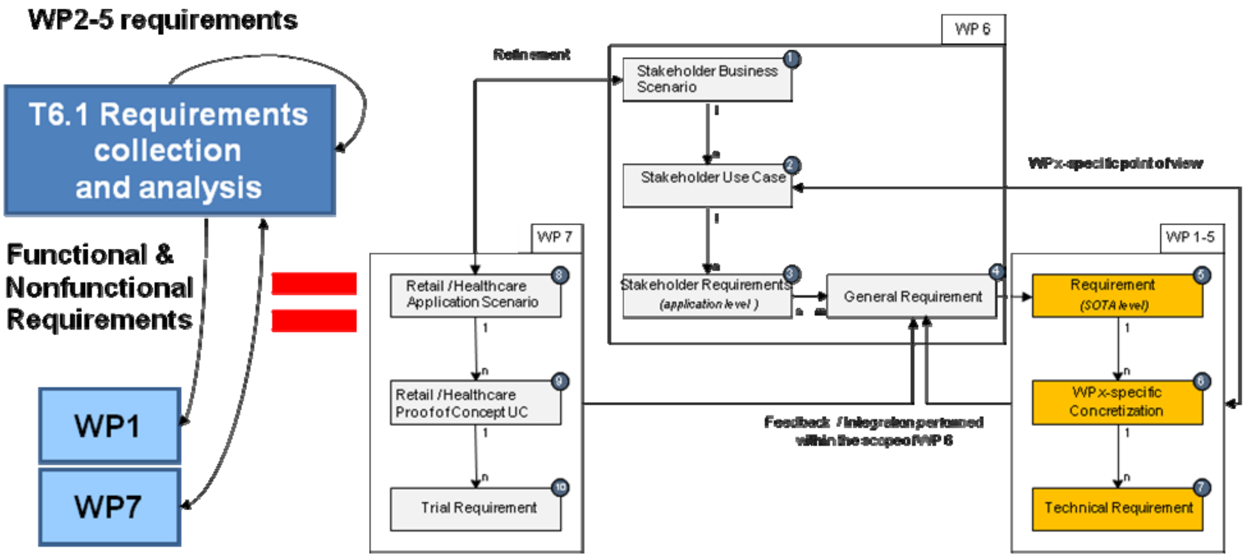


Figure 10: The flow of requirements from WP6 to the other WP

The left side of the diagram, shown previously, shows the flow of work between WP6 and WP1 and WP7. The right side of the diagram elaborates on the flow of requirements during these tasks between work packages, and how requirements are organized. As can be seen, the Stakeholder Requirements gathered in SW1 will be generalized into a set of business domain independent general requirements, which act as input to the other work packages.

5. Requirements List

Contributors: Ralf Kernchen, Alain Pastor, Sonja Meyer, Johannes Riedl, Alexander Salinas

This section presents the requirements extracted from the stakeholder use cases gathered during the first stakeholder workshop (SW1). The interested reader is referred to the Annex for a quick summary of the use cases from which these requirements are derived from. In addition to the use cases presented by the seven stakeholders at SW1, a set of requirements were also extracted from the speech of Gerald Santucci, who represented the interests of the EU Commission.

Note that at this stage and for this deliverable, we will not prioritize or filter out conflicting requirements, simply because we would need to involve the stakeholders to vote on which is the most important. This will be done during the second workshop dedicated to a first validation of the architecture and the refinement of the requirements. Further generalization of the requirements, so that they can serve as input to the other work packages in the project, falls within the scope of future work.

5.1 Requirements from Siemens, Lufthansa, Edinburgh Napier University (combined)

Requirements for the "Multidimensional Automated Trustworthy Seamless Distribution Monitoring" use case

Name	Requirement Type	Description	Rationale
WP6.SW1.LCSIENU .DISTMONITORING .DCONS.1	Design constraints	Easy and secure electronic access should be provided on all collected data for anything to the authorized bodies from any location.	A method for clarification whether the Cold/Hot Chain has been violated or not is required. To be able to do this, the detailed context information (e.g., temperature) of the things, which have been collected in some database need to be easily made available. This is for example of major importance to avoid any damage to the pharmaceutics during the transport and storage process.
WP6.SW1.LCSIENU .DISTMONITORING .DCONS.2	Design constraints	Smart systems should provide the basis for centralized or decentralized automated activities (control loops)	Today, due to sub-optimal processes, a lot of time and money is wasted. This situation could be improved a lot by tracking all the items/things, providing context data on them at any time and location, allowing for automated evaluation of the collected data and reacting immediately on a dangerous situation to protect

			against the breakdown of items.
WP6.SW1.LCSIENU.DISTMONITORING.FUNC.1	Functional Requirements	The context of all things/tags should be monitored continuously for a given time slot.	A method for clarification whether the Cold/Hot Chain has been violated or not is required. To be able to do this, the continuous context information (e.g., temperature) of the things needs to be collected. This is for example of major importance to avoid any damage to the pharmaceutics during the transport and storage process.
WP6.SW1.LCSIENU.DISTMONITORING.FUNC.2	Functional Requirements	Every time and from any location the active (i.e. triggered) collection of certain medical status information (e.g. temperature, location, date of expiry) should be possible.	When things need to be found in a certain area, an easy way to ask for its precise location helps to save time and money. Especially money is saved by such a localization function, since no longer a new piece of equipment (e.g. medical equipment) has to be bought, when the old component is not found any more / in time.
WP6.SW1.LCSIENU.DISTMONITORING.FUNC.3	Functional Requirements	Things should be easily integrated into (cloud) services. Smart Things should be able to easily use (cloud) services.	The costs for complex logistics and healthcare processes need to be kept on a low level. A modular setup of the applications and services is one important ingredient to achieve this. Therefore it should be very easy to integrate things together with their atomic services into other services, and it should be easy for things to use services provided by others.

5.2 Requirements from Alcatel-Lucent Services

Requirements for the "Safe Smart Cities" use case

Name	**Requirement Type**	**Description**	**Rationale**
WP6.SW1.ALU.SSC.DCONS.1	Design constraints	The system should provide an API	Smart communicating objects, would help writing complex city management system just like object programming has helped writing complex applications.

WP6.SW1.ALU.SSC.DCONS.2	Design constraints	The system shall support standard communications between objects	Standard communications between objects, from a communication channel point of view but also from a semantic point of view. (Standardization of object semantic is somehow similar to the standardization of MIB (Management Information Base) of telecommunication equipments).
WP6.SW1.ALU.SSC.DCONS.3	Design constraints	The system shall support standardization of object semantics	Standard communications between objects, from a communication channel point of view but also from a semantic point of view. (Standardization of object semantic is somehow similar to the standardization of MIB (Management Information Base) of telecommunication equipments).
WP6.SW1.ALU.SSC.FUNC.1	Functional Requirements	The system must allow queries for retrieving Things capabilities	My wish is to retrieve the capacity of a thing. Thus, I can plan a change maintenance of all my bulbs if they can said when they should be changed
WP6.SW1.ALU.SSC.FUNC.2	Functional Requirements	The system must allow Things to collaborate between them for reaching a defined goal	I would expect that the traffic lights collaborate for a goal
WP6.SW1.ALU.SSC.FUNC.3	Functional Requirements	The system should provide the semantics of an object	I would like to understand the semantics brought by the objects
WP6.SW1.ALU.SSC.FUNC.4	Functional Requirements	The system should let an actor to create the semantics of an object	I would like a way to create and exchange semantics between objects in order to design new applications
WP6.SW1.ALU.SSC.FUNC.5	Functional Requirements	The system may enable a set of objects to exchange their semantics	I would like a way to create and exchange semantics between objects in order to design new applications
WP6.SW1.ALU.SSC.FUNC.6	Functional Requirements	The system should propose means to design applications based on the semantics carried by the objects	I would like a way to create and exchange semantics between objects in order to design new applications
WP6.SW1.ALU.SSC.FUNC.7	Functional Requirements	Rules based on time, location, consumption or any kind of criteria should be attached to an object and should conduct the behavior of the object	A constraint programming approach with smart objects could help implementing some high level decision. For example, we can imagine the following from that time to that time, I wand a green wave on these street to ease the journey of this car id.

WP6.SW1.ALU.SSC.FUNC.8	Functional Requirements	The system must allow the composition and/or aggregation of several objects in order to set up a new one.	Objects can be aggregated into more complex object (ex: street is a collection of crossroads, traffic lights, CCTV cameras, speed meter, gates to buildings, parking meters...)
WP6.SW1.ALU.SSC.NFUNC.1	Nonfunctional Requirements	The system must ensure interoperability between objects or between applications build on top of the IoT Architecture.	As an example, CCTV system could inform traffic management of the length of the waiting queue at a crossroad. Having smart traffic lights receiving such input from the CCTV system could, could help changing the schedule of green/red light to optimize the traffic.

5.3 Requirements from ETSI

5.3.1 Requirements for the "eHealth" use case

Name	**Requirement Type**	**Description**	**Rationale**
WP6.SW1.ETSI.MVLVBS.FUNC.1	Functional Requirements	Non-interference with electro medical devices: The M2M system or parts of it should avoid interfering with the detection and measurement of very low voltage signals to be acquired and used by the M2M Application.	In order to achieve a reliable eHealth service the system must be interference-free
WP6.SW1.ETSI.MVLVBS.FUNC.2	Functional Requirements	Radio transmission activity indication: Depending on the type of M2M service, all the radio transmitting parts (e.g. GSM/GPRS) of the M2M Device (or Gateway) should provide a real-time indication of radio transmission activity to the application on the M2M Device/Gateway.	The application knows the current radio transmission activity of the M2M device
WP6.SW1.ETSI.MVLVBS.FUNC.3	Functional Requirements	Radio transmission activity control: Depending on the type of M2M service, all the radio transmitting parts (e.g. GSM/GPRS) of the M2M Device (or Gateway) should be instructed real-time by the application on the M2M Device/Gateway to suspend/resume the radio transmission activity.	The application can control the radio transmission

WP6.SW1.ETSI.PPSM.FUNC.1	Functional Requirements	The system should have a support for Patient-Initiated Communication (via Patients M2M Device)	Patients are able to initiate communication to the providers Electronic Medical Record (EMR) or health database application using the secure messaging tool for a variety of purposes. Examples include providing manually gathered information on existing self-monitoring and/or chronic care regiments.
WP6.SW1.ETSI.PPSM.FUNC.2	Functional Requirements	The system should have a support for Provider-Initiated Communication (via Providers M2M Application Server or Device)	Providers can initiate communication with the patients health monitoring device for a number of reasons. Examples of this include a provider querying the device for a reading or for configuring such a device.
WP6.SW1.ETSI.PPSM.FUNC.3	Functional Requirements	The device should have a support for Policy, Event or Schedule Based Communication	Under certain circumstances a Policy, Event or Schedule Based Communication is required
WP6.SW1.ETSI.PPSM.FUNC.4	Functional Requirements	The system should have a support for routing of data based on content	A system may be provided which is operable to determine a routing node for a data object. The system can comprise an identifier generator operable to generate an identifier for the data object on the basis of data content thereof, and a lookup engine operable to compare the identifier for the data object to a routing table to determine a routing node for the data element.
WP6.SW1.ETSI.PPSM.FUNC.5	Functional Requirements	Updates to Security Protocols: Current secure messaging suites such as PGP and TLS should provide a sufficient framework to handle trusted communication	There are regulations concerning the storage, transmission, or destruction of electronic health information. These regulations are inconsistent across different jurisdiction regions. Therefore, enhancements may be necessary for handling trusted communication.
WP6.SW1.ETSI.PPSM.FUNC.6	Functional Requirements	Portability of Connection: The M2M Device and the supporting system (and application) should provide the ability to connect to M2M Gateways (or equivalent components) in other locations and thereby establishing connectivity to the network and the recipients of data reports and/or messages.	The use of M2M Devices for monitoring health related information is not confined to the residence of the patient.

WP6.SW1.ETSI.PPSM.FUNC.7	Functional Requirements	Location Tracking: M2M Device and the supporting system (and application) should provide for the tracking and reporting of the patients location.	This information may be critical in emergency situations to provide location information to Emergency medical technician (EMT) or ambulance services, proximity to nearby hospitals, etc.
WP6.SW1.ETSI.PPSM.FUNC.8	Functional Requirements	The system should have a secure messaging capability between health devices or applications and between these systems and the user.	Because of privacy issues of patient data the devices should communicate in a secure way
WP6.SW1.ETSI.PPSM.FUNC.9	Design constraints	Device Maintenance: The system should have the ability for updating the software or performing other maintenance type procedures on the M2M Device. This presumes that the device should have the capability to support a type of over the air update using the devices access technology.	A centralized update is easy to perform and there is no need to update from user side
WP6.SW1.ETSI.RPM.FUNC.1	Functional Requirements	Device Initialization and Registration: RMD should be initialized and registrated to establish communication	The remote monitoring device is prepared for use and communication by the action of the patient or clinician. This may involve physically attaching or placing the device, registering the device, setting up the communications channels to M2M application entities, setting up the communications capabilities of the device and providing for secure communications.
WP6.SW1.ETSI.RPM.FUNC.10	Functional Requirements	The system should have a support for ordered message delivery based on prioritized service handling	Not every message has the same priority
WP6.SW1.ETSI.RPM.FUNC.11	Functional Requirements	The system should have a support for priority communication to time-sensitive health services	In case of time-sensitive services the system needs to assure that important services are prioritized

WP6.SW1.ETSI.RPM .FUNC.2	Functional Requirements	Device Communications - Remote Control and Configuration: The RMD system should support remote communication between a user (patient or provider) and an M2M Device and/or application	The remote monitoring device may be configured by via the M2M network by the M2M application entities. The configuration capability could span simple parametric changes, such as, reporting rates, event or alarm trigger levels, and dosing levels to downloading and securely restarting new operating SW.
WP6.SW1.ETSI.RPM .FUNC.3	Functional Requirements	Device Communications - Patient Telemetry (Data Retrieval and Delivery): The system should support communication from a RMD (or application on a RMD) to a Provider (or M2M service).	The remote monitoring device gathers patient measurements, data and or events. Data may be communicated each time the device gathers the data, accumulated measurements may be communicated periodically (e.g., hourly, daily), or data may be delivered upon request or upon certain events.
WP6.SW1.ETSI.RPM .FUNC.4	Functional Requirements	Integrity validation: The system should support integrity validation based on a trusted execution environment	In certain life-critical applications the device may be required to perform a secure start-up procedure that includes integrity checking.
WP6.SW1.ETSI.RPM .FUNC.5	Functional Requirements	The system should provide Alarm signaling to indicate initialization failure	Initialization failure could be indicated
WP6.SW1.ETSI.RPM .FUNC.6	Functional Requirements	The system should provide support for secure storage of sensitive data	Sensitive data of patients must be kept secure in order to assure trust between the patients and to allow access to certain people
WP6.SW1.ETSI.RPM .FUNC.7	Functional Requirements	The system should have a support for secure communication via a secure protocol	In order to guarantee a secure communication secure protocols should be integrated in the M2M network
WP6.SW1.ETSI.RPM .FUNC.8	Functional Requirements	The system should have a support for time critical message handling and delivery	In case of emergency the RMD has to send or receive time critical messages
WP6.SW1.ETSI.RPM .FUNC.9	Functional Requirements	The system should have a support for secure time synchronization	Services which depend on a precise time need a guarantee that the devices they are communicating to have the right time.
WP6.SW1.ETSI.VIC. NFUNC.1	Nonfunctional Requirements	High reliability and low latency should be required to ensure effective and quick communication between vehicle and traffic information service; premium (paid) service might require QoS and SLA agreements.	Communication blackouts are not accepted from client side and particularly if they are paying for premium services

5.3.2 Requirements for the "Automotive Applications in M2M capable networks " use case

Name	Requirement Type	Description	Rationale
WP6.SW1.ETSI.EVC.FUNC.1	Functional Requirements	Interoperability: The electric vehicle and the charge station must be compatible.	To charge the electric vehicle it has to be compatible to the charge station
WP6.SW1.ETSI.FMTT.FUNC.1	Functional Requirements	Autonomous communication establishment: Devices should have a autonomously communication with the Server via the telecom network either at regular intervals, prescheduled times, or based on some event such as crossing a geographic threshold	High value assets need to be tracked in order to avoid theft and also to know where they are currently located
WP6.SW1.ETSI.FMTT.FUNC.2	Functional Requirements	Bi-directionally information exchange: Information should be exchanged bi-directionally between the M2M Devices (vehicles) and the M2M Server (Fleet Management Server), as well as between the external location infrastructure and the M2M Devices	Both the M2M server and the M2M device must be able to provide information about the current state
WP6.SW1.ETSI.FMTT.FUNC.1	Functional Requirements	Autonomous communication establishment: Devices should have a autonomously communication with the Server via the telecom network either at regular intervals, prescheduled times, or based on some event such as crossing a geographic threshold	High value assets need to be tracked in order to avoid theft and also to know where they are currently located
WP6.SW1.ETSI.FMTT.FUNC.2	Functional Requirements	Bi-directionally information exchange: Information should be exchanged bi-directionally between the M2M Devices (vehicles) and the M2M Server (Fleet Management Server), as well as between the external location infrastructure and the M2M Devices	Both the M2M server and the M2M device must be able to provide information about the current state

5.4 Requirements from Centro Ricerche Fiat

5.4.1 Requirements for the "Collaborative City" use case

Name	Requirement Type	Description	Rationale
WP6.SW1.CRF.COL CITY.FUNC.1	Functional Requirements	Service Provisioning: Public sector city services should be provided within different communities.	Citizens want to have new services
WP6.SW1.CRF.COL CITY.FUNC.2	Functional Requirements	Goal orientated Collaboration: A collaboration concept should be provided to reach a common goal	Citizens want to use new collaborative technologies supporting them to reach common goals
WP6.SW1.CRF.COL CITY.FUNC.3	Functional Requirements	Mobility Support: Since mobility is an important aspect in the city life collaborative cities should support mobility	Citizens want to access all areas of a city
WP6.SW1.CRF.COL CITY.FUNC.4	Functional Requirements	Pollution Reduction Support: The Collaborative City should support the pollution reduction in cities like heating and transportation	Citizens want to life in a clean city
WP6.SW1.CRF.COL CITY.FUNC.5	Functional Requirements	Smart Products: The Collaborative city should enable citizens using smart products regarding their individual needs	Citizens want to use features of smart products
WP6.SW1.CRF.COL CITY.FUNC.6	Functional Requirements	System Interoperability: Different smart system IOT systems should be interoperable with one another.	Citizens doesn't want to use several city systems
WP6.SW1.CRF.COL CITY.FUNC.7	Functional Requirements	Privacy Protection: Persons using smart city systems should be treated anonymously.	Citizens want to protect their private data
WP6.SW1.CRF.COL CITY.FUNC.8	Functional Requirements	Standard Smart City System: One standard smart city system should be available.	Citizens don't want to use different systems
WP6.SW1.CRF.COL CITY.FUNC.9	Functional Requirements	Accuracy of Smart City Service: The services of smart city systems should be accurately.	Citizens want to use a reliable service

5.4.2 Requirements for the "Electric Vehicles Lifecycle Services" use case

Name	Requirement Type	Description	Rationale

WP6.SW1.CRF.EVLS.FUNC.1	Functional Requirements	Avoid Blackouts: The energy in a flexible energy consumption environment should always be available.	Road users and energy providers want to avoid shortages/ blackouts
WP6.SW1.CRF.EVLS.FUNC.2	Functional Requirements	Increase of renewable energy use: The amount of renewable energy use should be increased.	Road users want to use green energy
WP6.SW1.CRF.EVLS.FUNC.3	Functional Requirements	Service Lifecycle: A service lifecycle should improve the mobility.	Road users want to use one service over a service life cycle
WP6.SW1.CRF.EVLS.FUNC.4	Functional Requirements	Interaction between heterogeneous components: vehicles, components, infrastructure and remote servers should interact between one another.	Road users want to use one system instead of several different systems
WP6.SW1.CRF.EVLS.FUNC.5	Functional Requirements	External and heterogeneous resource integration: external data and resources should be integrated into electric vehicle lifecycle services.	Road users don't want to provide information that is already available
WP6.SW1.CRF.EVLS.FUNC.6	Functional Requirements	Safe infrastructure interaction: The vehicle infrastructure and vulnerable road users should interact safely with one another.	Road users want to have a safe system

5.5 Requirements from Groupe Casino

Requirements for the "Future Retail" use case

Name	**Requirement Type**	**Description**	**Rationale**
WP6.SW1.GC.FR.FUNC.1	Functional Requirements	Mobile Payment: Mobile phones (or other devices) should be used at the POS for payment	Consumers should be able to shop, even if they have no cash with them. Additionally, value added services such as a transfer to the consumer's home banking system would become feasible.
WP6.SW1.GC.FR.FUNC.2	Functional Requirements	RFID tag provision on goods: RFID tags should be placed on consumer products as an item level, instead of at a handling unit level only	Item level RFID would allow for product identification, T&T, inventory management, reception and management, Product information in the store/at home (nutrition, cross products), Automatic Payment, Antitheft system, Automatic replenishment when sell by date or disposed in bin
WP6.SW1.GC.FR.FUNC.3	Functional Requirements	Assistive environment: For certain user groups such as blind people the environment	Blind people should be able to participate

		should provide sufficient cues and assistance in order to let them get along in the store, this includes the adaptation of information for contrast/ light etc.	
WP6.SW1.GC.FR.FUNC.4	Functional Requirements	Self-explanatory Products: By using the mobile phone as an interface to product related services, the products should tell with what you can drink them with or if your son is allergic to the product or all kinds of other valuable information	The mobile phone of the consumer can and should be used for interacting with product centric services
WP6.SW1.GC.FR.FUNC.5	Functional Requirements	Mobile Shopping Assistant: The mobile phone of the consumer should provide means to access both user profiles and value added services such as a navigation system to find the appropriate store/ location in the store for a given product recommendation	The mobile phone of the consumer can and should be used for assisting the user in all purchase relevant aspects
WP6.SW1.GC.FR.FUNC.1	Functional Requirements	Mobile Payment: Mobile phones (or other devices) should be used at the POS for payment	Consumers should be able to shop, even if they have no cash with them. Additionally, value added services such as a transfer to the consumer's home banking system would become feasible.
WP6.SW1.GC.FR.FUNC.2	Functional Requirements	RFID tag provision on goods: RFID tags should be placed on consumer products as an item level, instead of at a handling unit level only	Item level RFID would allow for product identification, T&T, inventory management, reception and management, Product information in the store/at home (nutrition, cross products), Automatic Payment, Antitheft system, Automatic replenishment when sell by date or disposed in bin
WP6.SW1.GC.FR.FUNC.3	Functional Requirements	Assistive environment: For certain user groups such as blind people the environment should provide sufficient cues and assistance in order to let them get along in the store, this includes the adaptation of information for contrast/ light etc.	Blind people should be able to participate
WP6.SW1.GC.FR.FUNC.4	Functional Requirements	Self-explanatory Products: By using the mobile phone as an interface to product related services, the products should tell with what you can drink them with or if your son is allergic to the product or all kinds of other valuable information	The mobile phone of the consumer can and should be used for interacting with product centric services

WP6.SW1.GC.FR.FUNC.5	Functional Requirements	Mobile Shopping Assistant: The mobile phone of the consumer should provide means to access both user profiles and value added services such as a navigation system to find the appropriate store/ location in the store for a given product recommendation	The mobile phone of the consumer can and should be used for assisting the user in all purchase relevant aspects
WP6.SW1.GC.FR.FUNC.1	Functional Requirements	Mobile Payment: Mobile phones (or other devices) should be used at the POS for payment	Consumers should be able to shop, even if they have no cash with them. Additionally, value added services such as a transfer to the consumer's home banking system would become feasible.
WP6.SW1.GC.FR.FUNC.2	Functional Requirements	RFID tag provision on goods: RFID tags should be placed on consumer products as an item level, instead of at a handling unit level only	Item level RFID would allow for product identification, T&T, inventory management, reception and management, Product information in the store/at home (nutrition, cross products), Automatic Payment, Antitheft system, Automatic replenishment when sell by date or disposed in bin
WP6.SW1.GC.FR.FUNC.3	Functional Requirements	Assistive environment: For certain user groups such as blind people the environment should provide sufficient cues and assistance in order to let them get along in the store, this includes the adaptation of information for contrast/ light etc.	Blind people should be able to participate

5.6 Requirements from the EU Commission

Name	**Requirement Type**	**Description**	**Rationale**
WP6.SW1.EU.APP.FUNC.1	Functional Requirements	IoT-A must be able to provide the framework that will set the technological requirements and options to further develop applications based on IoT	The problem is to provide a framework, a set of scenarios where these applications could be developed in harmony, in an interoperable way and in a way that responses to the real needs of organization and people.
WP6.SW1.EU.FI.NFUNC.1	Nonfunctional Requirements	IoT-A shall contribute to the overall scheme of the Future Internet	Internet of Things is part of the Future Internet

WP6.SW1.EU.FI.NFUNC.2	Nonfunctional Requirements	IoT-A shall bring some answer to the Internet evolution	How the Internet will evolve?
WP6.SW1.EU.GOV.NFUNC.1	Nonfunctional Requirements	IoT-A shall identify the principles that conduct a governance for the Internet of Things	The work of IoT-A on resolution infrastructure will allow to provide some principles, some elements that will be useful to define that IoT governance.
WP6.SW1.EU.INTEROP.FUNC.1	Functional Requirements	IoT-A shall innovate in the definition of what an object is and in the relations we have with objects	The notion of object is something which will change and our relationship to these objects will also change. Because it will change, it will also change the way we apprehend our life, work and entertainment, everything we do and even the meaning of life.
WP6.SW1.EU.INTEROP.FUNC.2	Functional Requirements	IoT-A shall handle semantic interoperability	I believe that IoT-A will do a lot to clarify for IoT the notion of semantic interoperability
WP6.SW1.EU.INTEROP.NFUNC.1	Nonfunctional Requirements	IoT-A must enable the realization of an interoperable IoT avoiding the emergence of Intranet of Things	We want to have not silos but real cross-sectors IoT
WP6.SW1.EU.NA.FUNC.1	Functional Requirements	IoT-A must provide a novel resolution infrastructure regarding the naming, addressing and assignment of objects in an interoperable manner	IoT-A will play a role in terms of providing a kind of novel resolution infrastructure. We need to understand how best IoT could be served by scheme regarding the naming of objects, the addressing and assigning problems.
WP6.SW1.EU.PRIV.NFUNC.1	Nonfunctional Requirements	IoT-A must provide a reference model that will ensure the privacy in the IoT	IoT-A will have a role to play to say what are the options and requirements for privacy and security in the IoT
WP6.SW1.EU.REF.NFUNC.1	Nonfunctional Requirements	IoT-A must design and validate a reference architecture of the Internet of Things	We do not have in the world today a reference model for an IoT Architecture.

WP6.SW1.EU.SECU.NFUNC.1	Nonfunctional Requirements	IoT-A need to establish the technical ways to ensure security and resilience	Security, why? Simply because the IoT - I am sure you will demonstrate it - is a kind of critical information infrastructure which means that if ever for whatever reason there is a failure somewhere on the IoT the impact will be so high that it would be a social loss, like if we do not have more electricity.
WP6.SW1.EU.STAND.DCONS.1	Design constraints	IoT-A shall work on pre-normative aspect of the IoT	We cannot wait that the pre-competitive R&D works have been done, we need to set the stage for what kind of standard should we need for biking the IoT a reality that is not only useful from an economical and social point of view but also would be industrially correct.
WP6.SW1.EU.STAND.FUNC.1	Functional Requirements	IoT-A shall enable M2M communications and self-decision	You can foresee that this communications will be between objects. The objects being endorsed with the capability to decide themselves. They will be able to preempt what we need and when we need.

6. Annex: Use Case Summaries & Descriptions

6.1 Siemens, Lufthansa Cargo & Edinburgh Napier University use cases

Summary by Johannes Riedl & Alexander Salinas

6.1.1 "Multidimensional Automated Trustworthy Seamless Distribution Monitoring"

6.1.1.1 Stakeholder Contributors to this use case

Christoph Thümmler (Celestor Ltd, Edinburgh Napier University), Markus Witte (Lufthansa Cargo), Thomas Jell (Siemens IT Solutions), Amine Houyou (Siemens Corporate Technology)

6.1.1.2 Background & Motivation

Assuring a globally sustainable healthcare system is today one of the major challenges facing industrialized societies. IT-based solutions have been helping the healthcare system run more efficiently and will continue to evolve to deal with the increasing demands. In order to let all people participate and benefit from that evolution, intelligent solutions throughout the whole value chain need to be developed. In this use-case, a special focus is made on medical products and goods consumed within the healthcare system. The intra-hospital logistics as well as the transport and logistics are very suitable examples of the latter value chain.

In general there are three major challenges:

1. Costs need to be limited to a moderate level

Even if there have and will be major successes in developing new patient treatments which allow fighting the most difficult diseases, the costs for the treatment needs to be kept on a moderate level to be able to let the large community benefit from the achievements. This requires continuous optimizations throughout all related logistics and healthcare processes.

2. Offer healthcare services in any location

There are quite some demographic changes observed today. Also due to the ever advanced medical care, the average age is continuously increasing. The ability to keep the medical care (which of course includes prevention, treatment and rehabilitation) on a high level is only possible – organizationally and cost-wise – if the medical care is not only offered on a clinical/central level but also on a peripheral level. Home care is playing more and more an important role there.

3. Manage the challenges of a distributed value chain

Today most industries are already organized in a quite decentralized fashion. This means the production sites for medicine or technical equipment could be distributed all over the world to significantly make use of local advantages. This requires in turn quite efficient logistical solutions to manage all the processes without worsening the costs position or the quality of the products.

Significant contributions can be provided by suitable IoT-solutions as will be seen in the following use case descriptions. Thus first requirements on an IoT-Architecture will be extracted from this use case.

6.1.1.3 Summary of use case

The medical care scenario sketched in the section before needs to include and consider not only the medical treatment itself, but also the whole value chain. The main components of this value chain are:

- Production and production logistics
- Transport and transport logistics
- Distribution of pharmaceuticals and distribution logistics
- Intra-clinical and home care logistics

For all these areas, complete and seamless solutions need to be developed which easily interface/interwork with each other. This also means that each of these components can and should be considered independently from the other ones, especially concerning the requirements occurring there. But in addition, clear handover points and well defined interfaces need to be foreseen between them, to realize a manageable intelligence along the whole chain. In most of these areas special emphasis needs to be put on scalability of the foreseen technical solutions, since this is always a critical point when it comes to the productive use of such new solutions, especially in the IoT context.

The following technological challenges should be addressed for every component in the value chain mentioned before:

a) Status / Context monitoring

For every pharmaceutical or medical item a seamless monitoring is required, i.e. the context of everything needs to be known at any given time:

For the pharmaceutical items, a specific temperature range might be assured to avoid any damage to the pharmaceutics. So it needs to be possible to clarify whether the “Cold/Hot Chain” has been violated or not.

For the medical equipment, the detailed information on its location would be very important to identify counterfeits or to find such equipment in large clinical premises within a reasonable time. Thus a suitable asset management is required.

b) Efficiency enhancement through automatisms

Today most documentation of patient data is done manually. The result is that pharmaceutical items exceed their expiring dates due to missing automated organization of which specific items should be used first. In addition, getting access to treatment data from a remote location is often done via mail or personal delivery and is thus very time intensive and medical equipment is simply disappearing or not found when it is needed. All this leads to a lot of wasted time and money. This situation could be improved a lot by tracking all the items/things (see Status/Context monitoring), providing context data on them at any time and location, allowing for automated evaluation of the collected data and reacting immediately on a “dangerous” situation to protect against the breakdown of items, and to enable automatisms in general which help to optimize the use of time and money.

c) Security and privacy

Of course quite a lot of critical data is handled which must not be available to all players or to the public. Very specific roles need to be defined with dedicated data access rights. Technologies to implement these roles are required - for example, patient data is only accessible by authorized medical personal or item location information cannot be misused for thievery and so on.

Finally for successful business integration one always has to keep in mind how the migration from today’s approach to the envisaged optimized solution could happen.

6.2 Alcatel-Lucent Services use cases

Summary by: Alain Pastor

6.2.1 "Safe Smart City"

6.2.1.1 Stakeholder Contributors to this use case

Philippe Bereski (Alcatel-Lucent Services). *Note: The aspirations of the stakeholder are written in italics.*

6.2.1.2 Background

The city is changing and embeds a lot of equipment including Closed-circuit television equipment (CCTV). As an example, Chicago is considered the most watched city in the US with an estimated 10,000 surveillance cameras both privately and publically owned. Cities include a lot of infrastructure such as waiting stations, bulbs light and screen displays for announcement s and real information. There are also many systems of traffic control. All these systems are built in silos: none of them can cooperate. Today, there is almost no way to link a CCTV system with a traffic management system, because they are speaking about different things. As an observer, one can understand for sure, just by looking to the state of the street, that there is a traffic jam or that the street is empty. But, technologically speaking, there is no method yet implemented to inject this information directly into a car or traffic management system of the city.

6.2.1.3 Summary of use case

Actors:

- Police, fire brigades, hospitals...
- Transport companies (BUS, TAXI, METRO...)
- CCTV camera manufacturer and applications developers

- Maintenance/manufacturer (vehicles, street furniture's, traffic lights...)
- System developers/integrators

Common smart cities applications are:

- Traffic management
- CCTV
- General announcement screens
- Maintenance of the city furniture's

These applications are built in vertical silos, therefore none of them communicate together. Their integration is a nightmare, even though it could bring new services or greatly improve existing ones.

As an example, CCTV system could inform traffic management of the length of the waiting queue at a crossroad. Having smart traffic lights receiving such input from the CCTV system could help change the schedule of green/red light to optimize the traffic.

A constraint programming approach with smart objects could help implementing some high level decision. For example, we can imagine the following "from that time to that time, I want a green wave on these street to ease the journey of this car id".

Regarding traffic monitoring systems, I would like the traffic light to be sufficiently intelligent to know that there are twenty cars behind me in this street and only two of them in the cross. So, I would like the green light to be intelligent enough to decide the time to change its own timing. As traffic manager, I would like to give a higher level order: I say "from this point to this point, at that time there will be a fire brigade that need to reach very quickly this trouble and I would expect that all the green lights will adapt themselves automatically and will create a "green wave" in order to accelerate the journey of these guys".

Smart bubbles in streets lights, could help managing their replacement in an optimal way.

My wish is to be able to retrieve directly from any objects all of their capacities, and for any kind of capacity. If I take a bulb, it could tell me "I am a 100 watts bulb, I am still working for 1000 hours and I might fail in about 100 hours". So, from this information, I know when I have to repair/replace this bulb. I will know the same information for all bulbs, and then I can plan a major maintenance, a journey across the city, in order to change the bubbles that need to be.

Smart communicating objects, would help writing complex city management system just like object programming has helped writing complex applications.

So, my need is really to have very intelligent objects. An object that can talk to another: I need common means to exchange information, a physical channel, but I also need a way to exchange semantics between objects. And, I would like, as an integrator, to be able to understand every kind of semantics that an object brings to me. If I am a CCTV camera, I will have to say "I have such video camera capacity (codec, definition of image capture, zoom…) but maybe tomorrow I will add something else: another capacity. So we need a mean to create semantics and to exchange those semantics between objects. The benefit is the ability to write very quickly, very effectively, new *applications in order to break the silo between systems and to get much more information from everything belong to object by building complex objects. And most of the things shall be centralized: if I have new objects, I shall be able to say somewhere "here are the semantics, here are the concepts that lie with the objects".*

The use case is broken down in the following important preconditions and steps in terms of executable actions:

Standard communications between objects, from a communication channel point of view but also from a semantic point of view. (Standardization of object semantic is somehow similar to the standardization of MIB (Management Information Base) of telecommunication equipments).

- Open and flexible description of object capabilities (ex. 1: CCTV camera has a given codec, is PTZ capable, has a specific definition and frame rates, is at particular location. ex. 2: a traffic light is at such location, is currently green/orange/red, is in activity since such time...).
    - This description stands for the value of some parameters of the object, but also for
    - The semantic of each parameter.
- Objects can be aggregated into more complex object (ex: street is a collection of crossroads, traffic lights, CCTV cameras, speed meter, gates to buildings, parking meters...).

6.3 ETSI use cases

Summary by Alexander Salinas

6.3.1 eHealth

6.3.1.1 Stakeholder Contributors to the use cases

Patrick Guillemin (ETSI)

6.3.1.2 Background

The term eHealth arises in recent publications with increasing frequency meaning the healthcare practice supported by electronic processes and communication. This includes human-device interactions as well as Machine to Machine (M2M) communication. In the following sub use case descriptions for particular eHealth scenarios are provided.

6.3.1.3 Summaries of Sub- use cases to eHealth

1) Remote Patient Monitoring (RPM)

At the highest level the generic remote monitoring use case focuses on the communication of patients' remote device sensor measurements to their clinicians' supporting systems, Electronic Health Records (EHR) and/or their personally controlled health record (PHR). Within the M2M scope, the use case is focused on the transport of messages between the remote monitoring devices and the M2M service capability provider layer. Architecturally, elements or interfaces above the service capability provider layer, such as supporting electronic systems used by the clinicians or intermediaries, are beyond the scope of this use case.

Actors:

- Patients
- Remote Monitoring Device (RMD)
- M2M service capability provider
- M2M application entity

2) Patient – Provider Secure Messaging

The term "patient – provider secure messaging" includes secure messages between patients and providers that involve at least one M2M Device or Application. The use of the term "provider" includes both clinicians and clinician support staff. This use case includes the following messaging scenarios:

- M2M Device (or system/application) to M2M Device (or system/application)
- M2M Device (or system/application) to User (patient or provider)
- User (patient or provider) to M2M Device (or system/application)

Actors:

- Patient
- Patient Caregivers
- Provider (Clinician, Clinician Support Staff)
- Healthcare Entities
- Medical Monitoring/Telemetry Device
- Electronic Medical Record/Personal Health Record/Health Database
- Electronic Medical Record/Personal Health Record/Health Database Suppliers

3) Measurement of Very Low Voltage Body Signals

In a Remote Patient Monitoring scenario where low voltage body signals need to be acquired for health remote monitoring purposes, the acquisition process could be really disturbed by radio transmission activities, e.g. GSM/GPRS, that can take place on nearest co-located radio parts of the same M2M device.

Actors:

- Patients
- Remote Monitoring Device (RMD)
- M2M service capability provider
- M2M application entity

6.3.2 Automotive Applications in M2M capable networks

6.3.2.1 Stakeholder Contributors to the use cases

Patrick Guillemin (ETSI)

6.3.2.2 Background

M2M applications in the automotive context are an emerging market where standardization gaps are still existing. Therefore organizations such as ETSI deal with standardization issues as for instance M2M automotive applications. Potentially and partially already developed applications cover fields from controlling systems to tracking and tracing assets, i.e. cars, to monitoring status of certain assets.

6.3.2.3 Detailed Sub- use case Descriptions

1) Electric Vehicle Charging

The use case addresses the particular needs of electricity vehicle charging. Three typical scenarios are considered; charging at the home; charging in an apartment complex; charging in a commercial complex. For each of these there are corresponding minor charge cycle scenarios; short duration boost charge; medium duration half charge; long duration slow charge.

The residential case considers a lightly populated urban environment with a low density of electric vehicles. The charging of vehicles then assumes that the load can be accommodated by the distribution network without the need for coordination with other charging stations. However, in use cases where electric vehicle owners cluster their charging this may result in excessive transformer loading. Similarly, where fast chargers are deployed, this will further increase transformer loading; both of the alternative residential scenarios necessitate coordination amongst charging stations.

The apartment complex case is a medium-high density urban environment with a corresponding density of vehicles. The charging of vehicles is assumed to occur over the same period, most likely during off peak periods, overnight or at weekends, necessitating some coordination amongst the vehicles on charge to assure that the distribution network capacity is not exceeded.

In the commercial complex case multiple simultaneous users must be accommodated to assure that an adequate charge of the vehicles is achieved in the time available which may vary from a short interval, say half an hour, to an eight hour charge. In contrast with the apartment scenario the commercial case will involve charging of vehicles during peak and off-peak periods.

The associated minor charge cycles cover a short duration 30 minute boost cycle to accommodate an anticipated need for a limited capacity charge to accommodate a round trip of, say, 25km. The medium term charge may be required within two hours to permit a round trip of 40 km. In both of these cases the tariff will be of less consideration to the consumer who has a time sensitive need. The overnight slow charge would assure a full charge with a charge cycle optimized to use low tariff electricity.

During a charging cycle and depending on the installation, 20 amps single phase to 100amps three phase per connection point may be draw from the power network. In the medium and high density scenarios described above this may stress the supply network. In order to minimize the adverse effects of peak loading on the network and the longevity of network assets, a decentralized coordination and control system is envisaged.

Actors:

- Asset Responsible Entity
- Bill Responsible Entity
- Distribution Network Operator
- Efficiency Responsible Entity
- Read Data Recipient
- Consumer

2) Fleet Management / Theft Tracking

One often-envisioned application for automotive M2M communications is to track mobile assets – either for purposes of managing a fleet of vehicles or to determine the location of stolen property.

This is an important M2M use case for two reasons. First, it employs a subset of the generic M2M architecture described in TS 102 690 (M2M Functional Architecture) and this use case can serve as guidance to the industry on how to configure and deploy an M2M network for fleet management and/or theft tracking. Second, this use case captures requirements that are unique to a specific class of M2M applications involving devices that are highly mobile (i.e., moving at a high velocity over a wide geographic region) and that interface with location-determination technology.

Actors:

- Asset Owners
- High Value Assets
- Location Infrastructure
- Telecommunication Network and Operator
- Tracking Server

3) Vehicle-to-Infrastructure communications

Proposed the European ITS Directive paves the way for the implementation of eSafety applications into vehicles, while the eCall as the European initiative will bring mobile communication into the vehicle at rapid pace.

While Vehicle manufacturers have begun to drive Vehicle-to-Vehicle communication with – for instance - Wireless Access in Vehicular Environments (WAVE) and pWLAN – Vehicle to roadside use case has not been covered to its full extent in earlier M2M use cases and also improves the viability of the Automotive M2M business case.

Actors:

- Asset Owners/Users
- Assets
- Location Infrastructure
- Telecommunication Network and Operator
- Traffic Information Serve

6.4 Centro Ricerche Fiat use cases

Summary by: Sonja Meyer

6.4.1 Collaborative City

6.4.1.1 Stakeholder Contributors to this use case

Julien Mascolo (Centro Ricerche Fiat (C.R.F.))

6.4.1.2 Background

As a summary, the use case collaborative city **covers the following business processes and applications.**

- Provide services to the different communities in the city and make them collaborate to reach a common goal and make our future city a collaborative city
- Mobility is central to the life in the city. People need to enter and access all areas of the city
- Heating and transportation are the two activities which impact the most in term of pollution
- Products suggest the owners how to achieve their individual needs (Commands) with also the maximum optimization of community and macro level objectives (Directives).

6.4.1.3 Summary of use case

Actors:

- User's home
- Public transport manager
- Road operator
- Vehicles
- Citizens
- Logistic operators
- Commercial activities (shops, office, industries, companies…)
- Local government

The use case is broken down in the following important preconditions and steps in terms of executable actions:

- Locate
- (user) Understand needs
- (object) Understand actions to perform and act independently
- Communicate: suggestions, directives
- (infrastructure) Act

The desired outcome and added value to the customer covers the following ordered list:

- Public transport manager
  - Reliability
  - % of use of the transport means
- Road operator
  - Traffic jams
- Vehicles
  - Consumption
- Citizens
  - mobility
- Logistic operators
  - Accessibility
  - Time to city centre
- Commercial activities (shops, office, industries, companies…)
  - Development of activity
- Local government
  - Traffic jams
  - Development of different urban areas

6.4.2 Electric Vehicle Lifecycle services

6.4.2.1 Stakeholder Contribution to this use case

Julien Mascolo (C.R.F)

6.4.2.2 Background

The lifecycle of an electric vehicle (EV) covers the following business application areas:

- Manufacturing ("Beginning of life")
- Logistics
- Usage (charging), maintenance/ other services ("Middle of life")
- End-of-life of components (battery) and vehicle

During the lifecycle of an EV, the following general phases are sequentially performed:

- Marketing & Branding
- Design & Testing
- Production (Orders)
- Logistic of Distribution to Dealers (Selling)
- Customer, Care & Maintenance (Usage)
- Used Car (End of Life)

During the lifecycle the EV drivers could make use of IoT technologies regarding the aspects:

- Batteries=40% of total vehicle cost
- Ensure capacity, reliability, efficiency, sustainability

6.4.2.3 Summary of use case

Actors:

- Vehicle Original Equipment Manufacturer (OEM) such as FIAT and suppliers (tiers 1,2), including battery OEM
- Logistics operators
- Charging/ battery stations
- Power / Energy (utility)
- Integrators (“Mobility providers”)
- Other service providers (maintenance, insurance, recycling…)
- Different levels of government

The use case is broken down in the following important preconditions and steps in terms of executable actions:

- Understand the need of energy and autonomy on an individual level
- Understand the need of energy and autonomy on a community level
- Understand the availability of energy and charging stations with respect to the charging mode (fast/ home)
- Drive and route to charging and swapping station
- Charge and swap battery

- Diagnose battery and vehicle
- Recharge or dispose battery
- Dispose vehicle (understand final status of vehicle)

The desired outcome and added value to the customer covers the following ordered list:

- (OEM/ Final Customer) Ensure mobility
  - Small disturbances/ shortage of energy
  - Queues at charging stations
  - Time to charge
- (OEM/ Final Customer) Ensure energy access
- (Utility/ Gov) Ensure reliability of energy
  - small disturbances/ blackouts
  - redundancy of power plant
- (Utility/ Gov/ OEM) Ensure sustainability of energy
  - %age of renewable energy

6.5 Groupe Casino use cases

Summary by: Sonja Meyer

6.5.1 Future Retail

6.5.1.1 Stakeholder Contribution to this use case

Jean Prevost (Groupe Casino)

6.5.1.2 Background

As a summary the use case future retail covers the following business processes and applications:

- Use a RFID tag on the products in the store to enable the following application:
  - Identify the product
  - Trace it in the supply chain and store for the inventory, reception and management

- Offer Product information in the store and at home (nutrition, cross products…)
- Enable automatic payment
- Antitheft system
- Automatic replenishment when sell by date or disposed in bin

6.5.1.3 Summary of use case

Actors:

- SCM Logistics
- Payment and loyalty systems
- Antitheft systems

Bins, kitchen and fridges Suppliers

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