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Stakeholders Requirements

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ACRONYMS

API	Application Program Interface
ARM	Architecture Reference Model
CoAP	Constrained Application Protocol
DOV	Deployment and Operation View
EaaS	Experimentation-as-a-Service / Experiment-as-a-Service
EU	European Union
FC	Functional Component
Fed4FIRE	Federation For Future Internet Research and Experimentation
FI	Future Internet
FIESTA	Federated Interoperable Semantic IoT/cloud Testbeds and Applications
FR	Functional Requirement
FIRE	Future Internet Research and Experimentation
FTP	File Transfer Protocol
GUI	Graphical User Interface
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Secure
ID	Identifier
IEEE	Institute of Electrical and Electronics Engineers
IERC	IoT European Research Cluster
IM	Information Model
IMS	IP-Multimedia Subsystem
IoT	Internet of Things
IoT-A	Internet of Things - Architecture
IT	Information Technology
IV	Information View
JSON	JavaScript Object Notation
KPI	Key Performance Indicator
M2M	Machine-to-Machine
MQTT	Message Queuing Telemetry Transport
NFC code	Near Field Communication

NFR	Non-Functional Requirement
OWL	Web Ontology Language
QR code	Quick Response code
RA	Reference Architecture
REST	REpresentational State Transfer
RDF	Resource Description Framework
RFC	Request For Comments
SME	Small and Medium-sized Enterprise
SSL	Secure Sockets Layer
VE	Virtual Entity
UML	Unified Modelling Language
UMTS	Universal Mobile Telecommunication System
URI	Uniform Resource Identification
WP	Work Package
WSN	Wireless Sensor Network
XML	eXtensible Markup Language

1 POSITIONING

1.1 FIESTA-IoT Scope

Recent advances in the Internet of Things (IoT) area have progressively moved in different directions (i.e. designing technology, deploying the systems into the cloud, increasing the number of inter-connected entities, improving the collection of information in real-time, and no less important—the security aspects in IoT). IoT advances have drawn a common grand challenge that focuses on the integration of the heterogeneous IoT generated data. This key challenge is to provide a common sharing model or a set of models organizing the information coming from the connected IoT services, IoT technology and systems, and more important to be able to offer them as experimental services in order to optimise the design of new IoT systems and facilitate the generation of solutions more rapidly.

In FIESTA-IoT we focus on the problem of formulating and managing IoT data from heterogeneous systems and environments and their entity resources (such as smart devices, sensors, actuators, etc.), this vision of integrating IoT platforms, testbeds and their associated silo applications within cloud infrastructures is related to several scientific challenges, such as the need to aggregate and ensure the interoperability of data streams stemming from different IoT platforms or testbeds, as well as the need to provide tools and techniques for building applications that horizontally integrate diverse IoT Solutions. The convergence of IoT with cloud computing is a key enabler for this integration and interoperability, since it allows the aggregation of multiple IoT data streams towards the development and deployment of scalable, elastic and reliable applications that are delivered on-demand according to a pay-as-you-go model.

The activity in FIESTA-IoT is distributed in 7 Work Packages (WP). WP1 is dedicated to the project activities coordination, considering consortium administration, financial management, activity co-ordination, reporting and quality control. In FIESTA-IoT one of the main objectives is to include experimenters and new testbeds to test and provide feedback about the platform and tools, thus open calls for those tenders will be issued (these are also part of the WP1 activity and is called selection of third-parties).

WP2 focuses on stakeholder's requirements and the analysis of IoT platforms and testbeds in order to define strategies for the definition and inclusion of experiments, tools and Key Performance Indicators (KPIs). The activities in WP2 are focused on studying the IoT platforms and testbeds and the specification of the experiments, the detail of the needed tools for experimentation, and the KPIs for validating the proposed solutions. This WP will conduct the design and development of the Meta-Cloud Architecture (including the relevant directory of IoT resources) and will define the technical specification of the project. WP2 also focuses on analysing the Global Market Confidence programme and establishes the Certification Programme Specifications that will drive the global market confidence and certification actions around the IoT experimentation model.

WP3 focuses on providing technologies, interfaces, methods and solutions to represent the device and network nodes of the testbeds as virtualized resources. The virtualized resources will be represented as services and will be accessible via common service interfaces and APIs (i.e. the FIESTA Testbed interfaces/APIs). The virtualized resources and their capabilities and interfaces will be also described using semantic metadata to enable (semi-) automated discovery, selection and access to the testbed devices and resources.

WP4 will implement an infrastructure for accessing data and services from multiple distributed diverse testbeds in a secure and testbed agnostic way. To this end, it will rely on the semantic interoperability of the various testbeds (realized in WP3) and implement a single entry point for accessing the FIESTA-IoT data and resources in a seamless way and according to an on-demand Experimentation-as-a-Service (EaaS) model. The infrastructure to be implemented will be deployed in a cloud environment and will be accessible through a unified portal infrastructure.

WP5 focuses on designing, deploying and delivering a set of experiments, so as to assess the feasibility and applicability of the integration and federation techniques, procedures and functions developed during the project lifetime. It will define a complete set of experiments to test the developments coming from other WPs (mainly WP3 and 4), covering all of the specifications and requirements of WP2. Developments will be tested over available IoT environments and/or smart cities platforms. WP5 will also provide evaluation of the KPIs defined for every experiment/pilot. The final deployed experiments will include a subset of those coming from WP2, 3 and 4, as well as those provided by FIESTA Open Calls.

WP6 focuses on the establishment and validation of the project's global market confidence on IoT interoperability, which will provide a vehicle for the sustainability and wider use of the project's results. The main activity in this WP focuses on specifying and designing an IoT interoperability programme, including a set of well-defined processes that will facilitate the participation of researchers and enterprises. WP6 works on providing a range of certification and compliance tools, aimed at auditing and ensuring the openness and interoperability of IoT platforms and technologies. WP6 also focuses on interoperability testing and validation and to provide training, consulting and support services to the FIESTA-IoT participants in order to facilitate platforms and tool usability, but also to maximize the value offered to them by using FIESTA-IoT suite and tools.

WP7 focuses on ensuring that the FIESTA-IoT suite, models and tools engage well with the community outside of the project; from promotion and engagement of new customers, to the front line support of current users, and the long-term exploitation of results and sustainability of the facility itself. This will be carried out in a coordinated manner such that a consistent message and professional service is maintained. Dissemination activities and the KPI to measure the impacts will be studied and used in this WP. An ecosystem plan including the specification of processes, responsibilities and targets will be generated and the evaluation and effectiveness of the operating model will be evaluated within this WP. In this WP the successes of stakeholder engagement and reports on their satisfaction with the services offered in FIESTA-IoT will be put in place at the end of the project.

1.2 WP2 Overview

This WP covers the FIESTA-IoT requirements engineering activities and will produce the requirements associated with testbed-agnostic experimentation, as well as with the EaaS model to design and conduct experiments. WP2 is composed of five tasks (depicted in Figure 1), which tackle distinct aspects of the FIESTA-IoT EaaS Experimental Infrastructure:

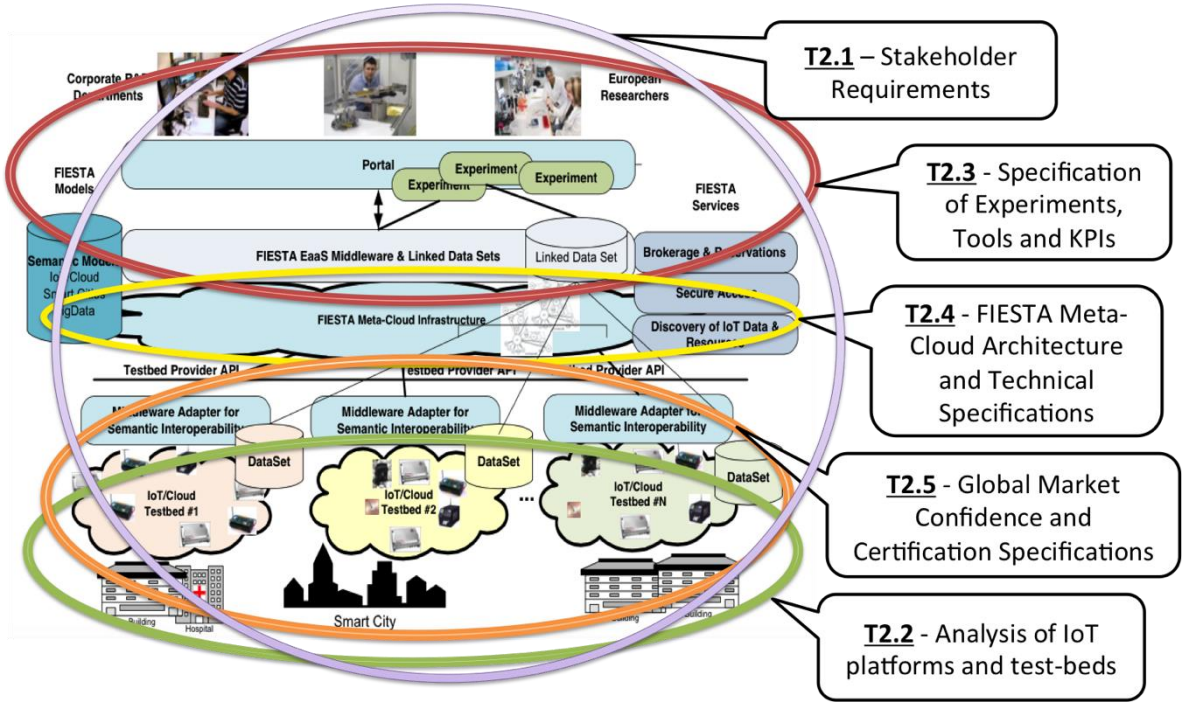


Figure 1 – FIESTA-IoT WP2 Overview

The WP2 Tasks cross all aspects of the FIESTA-IoT Infrastructure. They are:

Task 2.1. Stakeholder Requirements: This task is responsible for gathering and processing all stakeholder requirements (using the Volere requirements specifications). The involved stakeholders include: the IoT testbeds to be integrated, the experiment providers, and also researchers and experimenters. Also external projects (such as Open-IoT and Fed4Fire) will provide requirements so, to prepare FIESTA-IoT to the Open-calls. This task will produce a set of requirements that will be used by all other WP2 tasks.

Task 2.2. Analysis of IoT platforms and testbeds: This task is focused on the testbeds and IoT platforms, analysing and describing what they do and how they do it. It will also use the set of testbed requirements produced in T2.1 to better understand if each testbed can fulfil the stakeholders' requirements. This task will then model the testbeds and IoT platforms in functional blocks using the IoT-A Architecture Reference Model (ARM). It will gather what type of information they provide, and how they provide this information so that Task

2.4 can take this it into account when developing the FIESTA Architecture. The outcome of this task will provide a basis for WP3.

Task 2.3. Specification of Experiments, Tools and KPIs: This task will specify all planned experiments and extrapolate the needed tools to execute those experiments. It will use the experiment related requirements produced in T2.1 and analyse them in terms of the tools that need to be provided by FIESTA-IoT to the experimenters. It will also specify the KPIs of each experiment so that later validation can occur. The result of this Task will be used as input to WP5.

Task 2.4. FIESTA Meta-Cloud Architecture and Technical Specifications: This task will define the FIESTA Meta-Cloud Architecture, leveraging on the IoT-A ARM, and the technical specifications that will drive all of the development work of the project. It will use information from previous tasks to identify the main building blocks, design & technology choices, and specify the functional blocks of the FIESTA architecture needed for achieving FIESTA's technical objectives. This architecture will serve as a base for all of the development phase of the project and more specifically for WP4.

Task 2.5. Global Market Confidence and Certification Specifications: This task is intended to study and define the global market confidence and certification specification. This means that this task will define the certification process, and the set of requirements that are required for a testbed to comply in order to be integrated in FIESTA-IoT. The outcome of this task will be used in WP6.

As described in the previous tasks description, the outcomes of each task will be used by other tasks of this WP2, or be used as inputs for the work in other WPs.

These relations between WP2 tasks and other WPs are depicted in Figure 2.

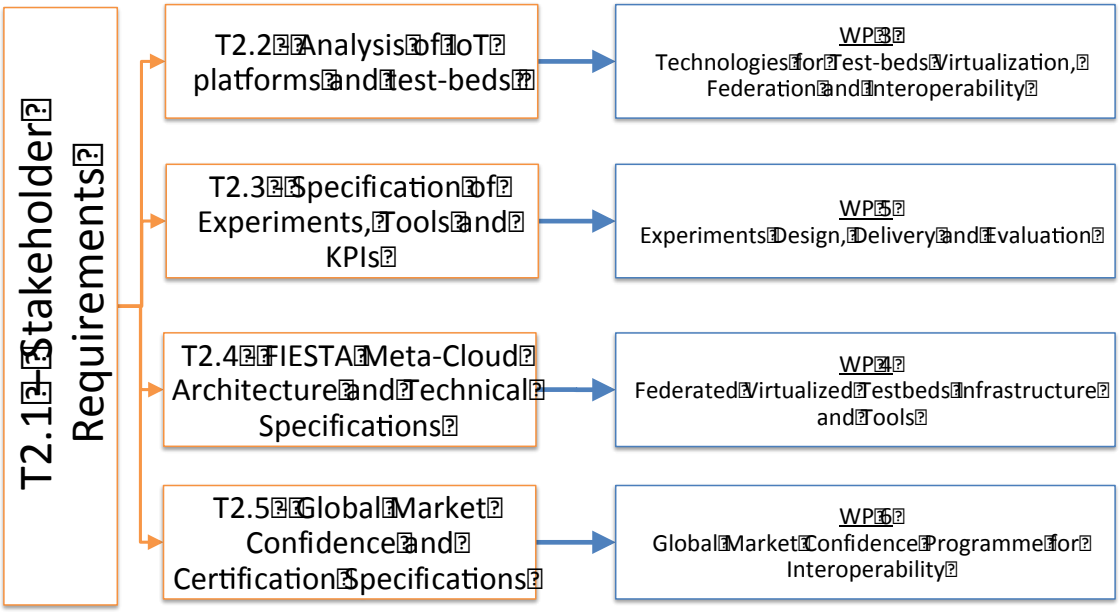


Figure 2 - Relationship between WP2 tasks and with other WPs

In reference to the Fiesta-IoT project general objective(s), WP2 has a set of defined activities (related to these sub-objectives) that are described as follow:

1) Determination of Stakeholder requirements.
2) Description of IoT platforms and testbeds in order to facilitate their integration into the FIESTA-IoT infrastructure.
3) Specification of planned experimentation and its executing tools, and the KPIs that will be used for validation.
4) Definition of the FIESTA-IoT Meta-Cloud architecture and the technical specifications required for the development WPs.
5) Definition of the Global Market Confidence and Certification specifications.

The WP2 will also result in five deliverables, which will be directly linked with the objectives and tasks of the WP. Each deliverable will be an outcome of each task, meaning that deliverable D2.1 will be provided at the end of T2.1 with the results of that specific task. The following table (Table 1) details the set of deliverables to be expected from WP2, with reference to the related tasks, the responsible partner for each deliverable and all others contributors.

Table 1 - WP2 Deliverables

No.	Deliverable	Responsible Partner	Contributors
D2.1	Stakeholders Requirements	UNPARALLEL	NUIG-DERI, NEC, UNICAN, SODERCAN, SDR
D2.2	IoT Platforms and Testbeds Analysis	Com4Innov	KETI, UNICAN, UNPARALLEL, AIT, NUIG-DERI, INRIA, NEC
D2.3	Experiments, Tools and KPIs Specification	UNPARALLEL	UNICAN, INRIA, NEC, NUIG-DERI, AIT, ITINNOV, SODERCAN
D2.4	FIESTA Meta-Cloud Architecture and Technical Specifications	UNIS	AIT, NUIG-DERI, UNICAN, ITINNOV, KETI
D2.5	Global Market Confidence and Certification Programme Specifications	EGM	AIT, SODERCAN

1.3 Audience

This deliverable addresses the following audiences:

- **Researchers and engineers within the FIESTA-IoT consortium**, who will take into account the various requirements in order to research, design and implement the architecture of the FIESTA-IoT Meta-Cloud Architecture.
- **Researchers on Future Internet Research and Experimentation (FIRE) focused on IoT and cloud computing systems experimenters at large**, given that the present deliverable could be useful reading for researchers studying alternative IoT technologies and applications, along with indications and requirements towards building/establishing experimental architectures.
- **Members of other Internet-of-Things (IoT) communities and projects (such as projects of the IERC cluster)**, who can find in this document a readily available requirements analysis for experimentation-like IoT services and tools. For these projects the document could provide insights into requirements and technological building blocks enabling the convergence between utility/cloud computing and the IoT for enabling EaaS.

1.4 Terminology and Definitions

This sub-section is intended to clarify the terminology used during this project. This initial step is intended to clarify all of the important terms used, in order to minimise misunderstandings when referring to specific parts involved in the generation of data and the FIESTA concepts. The following definitions (listed in Table 2) were set regarding the domain area of FIESTA-IoT, and so are aligned with terminologies used in the FIRE community and in reference to IoT-related projects (such as IoT-A).

Table 2 - Terminology and Definitions table

Term	Definition
Characteristic	An inherent, possibly accidental, trait, quality, or property of resources (for example, arrival rates, formats, value ranges, or relationships between field values).
Device	Technical physical component (hardware) with communication capabilities to other Information technology (IT) systems. A device can be either attached to, or embedded inside a physical entity, or monitor a physical entity in its vicinity (IoT-A, 2013). The device could be:

	• **Sensor**, A sensor is a special device that perceives certain characteristics of the real world and transfers them into a digital representation (IoT-A, 2011). • **Actuator**, An actuator is a mechanical device for moving or controlling a mechanism or system. It takes energy, usually transported by air, electric current, or liquid, and converts that into some kind of motion (IoT-A, 2011).
Discovery	Discovery is a service to find unknown resources/entities/services based on a rough specification of the desired result. It may be utilized by a human or another service. Credentials for authorization are considered when executing the discovery (IoT-A, 2013).
Information	Content of communication; data and metadata describing data. The material basis is raw data, which is processed into relevant information, including source information (e.g., analogue and state information) and derived information (e.g., statistical and historical information) (IEEE, 2007).
Measurement	The important data for the experimenter. It represents the minimum piece of information sent by a specific resource, which the experimenter needs in order to fulfil the objective of the experiment
Metadata	The metadata is the additional information associated with the measurement, facilitating its understanding.
Physical Entity	Any physical object that is relevant from a user or application perspective. (IoT-A, 2011). Physical Entities are the objects from the real world that can be sensed and measured and they are virtualized in cyber-space using Virtual Entities.

Requirement	A quantitative statement of business-need that must be met by a particular architecture or work package. (Haren, 2009)
Resource	Computational element that gives access to information about or actuation capabilities on a Physical Entity (IoT-A, 2011).
Stakeholder	An individual, group, or organization, who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project (Project Management Institute, 2013)
Testbed	A testbed is an environment that allows experimentation and testing for research and development products. A testbed provides a rigorous, transparent and replicable environment for experimentation and testing (Gavras, 2010)
Federated testbeds	A testbed federation or federated testbeds is the interconnection of two or more independent testbeds for the creation of a richer environment for experimentation and testing, and for the increased multilateral benefit of the users of the individual independent testbeds (Gavras, 2010)
Interoperability	The ability of two or more systems or components to exchange information and use the information that has been exchanged (IEEE, 1990)
Experimentation facility	An experimentation facility can be understood as an environment with an associated collection of tools and infrastructure that sits on top of one or several testbeds and can be used to conduct experiments to assess and evaluate new paradigms, architectural concepts and applications (MyFIRE, 2011)
Experiment	Experiment is a test under controlled conditions that is made to demonstrate a known truth, examine the validity of a hypothesis, or determine the efficacy of something previously untried (Soukhanov, Ellis, & Severynse, 1992)

1.5 Executive Summary

This deliverable illustrates the main requirements for the development of the FIESTA-IoT platform that will enable the deployment of IoT experiments and allow services within federated utility-based cloud computing environments. In particular, it includes and analyses requirements from the deployed IoT testbeds and experimenters. These requirements were collected from internal and external experimenters and testbeds. The majority of the external requirements were collected from European research projects such as Fed4FIRE and IoT-A. The collected requirements were analysed and processed to be used as input for the activities related with the development of the FIESTA-IoT platform.

The FIESTA-IoT requirements are constituted by several attributes, which have been carefully chosen to help in the description and analysis of the requirements. Some of the relevant attributes are: Unique Identifier, Priority, Dependencies, Category, Fit Criterion and Stakeholder. Requirements are also divided into two types depending if the requirement corresponds to functionalities that FIESTA-IoT expects/provides or corresponds to properties of FIESTA-IoT or testbeds. The approach used for defining the attributes used to analyse the requirements was based on the attributes defined by the Volere methodology.

Due to the amount of requirements collected, they are presented in views that hide some of the complexity of the whole table of requirements. These views are organized in order to make easer the analysis of: Requirement Type, Priority, Category, Stakeholders, Dependencies and Fit Criterion. The complete table of requirements is provided in the appendix.

2 FIESTA-IOT REQUIREMENTS MANAGEMENT

In order to aggregate and process all the requirements collected from the stakeholders and other external contributions (e.g. IoT-A, OpenIoT and Fed4Fire) we used a requirements technique that is widely known: the Volere requirements technique. It provides specification templates and a collection of strong requirement documents that serve as a guide to write requirements specifications.

With this requirements process, we have a common language for requirements, maintaining a consistent way and clear point of view for people with different views and skills (e.g. business people, suppliers, so on).

2.1 Volere: Overview

Volere is a collection of techniques and mechanisms for development and agile project management, which is a consequence of many years of study in a wide diversity of fields. It is focused on discovering, communicating, tracing, and managing requirements (Robertson S. , 2007).

Volere consists of three groups of interconnected components (Robertson & Robertson, 2008).

- **The Requirements Knowledge Structure**,

  It is concerned with how different items of requirements knowledge relate to each other and how to trace requirements from one level to another.

- **The Requirements Process**,

  It is concerned with procedures and activities for how to discover, populate and disseminate the requirements knowledge.

- **The Requirements Stakeholders**,

  They are the input for determining how much of the knowledge structure needs to be populated for each particular project. The project team uses knowledge of the stakeholders to determine the order in which the work needs to be done and the appropriate level of detail.

Volere developed a generic requirement specification template that provides methods to assist in the discovery and organisation of requirements knowledge, making them easier to audit. However, as each project has a specific goal, it must manipulate the variables depending on their characteristics. These variables are the: *content*, *form*, *detail* and *connectivity*, which are related with the groups aforementioned.

The *content* classifies what really matters for building the solution, it defines a scheme to manage and track all of the related requirements, i.e., it basically creates categories for requirement knowledge.

The *form* is the way to provide interaction/exposition of the requirements in relation to the packaging of the content, e.g. project phases, review cycles, meetings, and conversations. It mainly depends on how the organisation works.

The *detail* refers to the granularity of the project. It specifies the level of the subject matter, which can be high, medium or low level. It can be accomplished through the classes diagram or if intend the lowest level then use the atomic requirements.

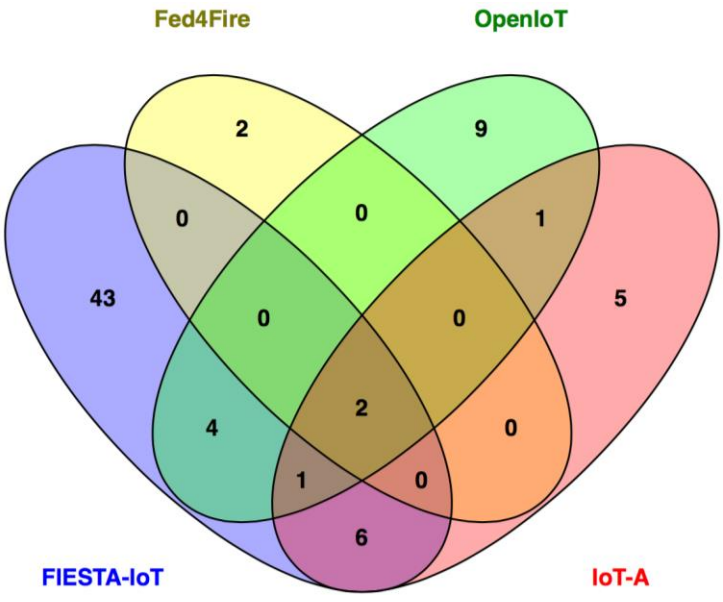
And finally, the *connectivity* is the scheme that interconnects the requirements knowledge, making it traceable.

2.2 Collecting and processing requirements

In order to provide the requirements present in this deliverable, they had to be collected and then processed and aggregated. During the collection phase, it was requested for all partners of FIESTA-IoT project, to provide the requirements they felt were needed for FIESTA-IoT. Project partners provided the requirements, based on their role within FIESTA-IoT, as experimenters, platform developers or testbed providers. This enabled us to gather a good amount of requirements targeting each of the dimensions of FIESTA-IoT. In total, we received 107 requirements from the project partners.

In addition to these requirements we wanted to broaden the range and the domains that the requirements should tackle, especially due to the fact that FIESTA-IoT will provide open-calls for both experiments and testbeds. This means that the internal requirements for supporting the in-project testbeds and experiments should be enhanced with requirements from external contributors. This led us to analyse three important projects: Fed4Fire, OpenIoT and IoT-A; that tackled different domains, by understanding what they offer and which kind of requirements they had for each of their domains. The analysis on the external projects resulted in an addition of 77 requirements.

Then all of the requirements were grouped together and the processing stage started, in order to aggregate all of the requirements. And for that, we set all the attributes for each of the requirements. After this, we started the validation process that allowed us to remove several requirements that were duplicated. This enabled us to reduce the number of requirements to an overall 73 distinct ones. The distribution of the requirements from their origin is depicted in the figure on the right.



All of these requirements were collected so that FIESTA-IoT could reach several different domains that were deemed relevant. These domains give different views that in the open calls mechanisms can be used to attract several interested players from the different target domains.

- **Platforms**: Is the domain that represents the stakeholders that develop platforms, such as the FIESTA-IoT, or OpenIoT, platforms that deal with the IoT devices and data.
- **SMEs**: Are the leading players in terms of bring innovation to the business, a view and the needs from them is critical, in order to ensure that the work developed is applied in the market.
- **Testbed**: Are the ones that will have the interest of sharing their data, having their input drives the process for ensuring that FIESTA-IoT will be developed in such a way that future testbeds are interested in joining the initiative and sharing their data.
- **Semantic**: Modelling information is a challenge, it raises some requirements, in order to ensure that FIESTA-IoT will have the proper support to take advantage of the value that using semantics brings to experimenters.
- **IoT**: Poses the challenge of dealing with big-data. IoT is typically characterised by the deployments, that are heterogeneous and of large-scale.
- **Experimentation**: At the end, all of the data is relevant for the experimenters, they are the ones that can extract value from the data, so their word is essential in understanding the purpose of the data collection and federation.
- **Architecture**: Ensuring future-proof of the FIESTA-IoT platform implies a well-defined architecture, and guidelines to support different architectures that come from different testbeds, so inputs from experts of this domain is essential to ensure interoperability of data and integration.
- **Interoperability**: One of the FIESTA-IoT challenges is to bring together the different testbeds, so expertise in Interoperability is needed to ensure integration of the existing testbeds, as preparation for the future Open-Calls testbeds.
- **Open source**: Large communities of researchers exist in the Open-Source domain, these bring together expertise from people already in the domain, and ensure that FIESTA-IoT can be promoted in these communities and be used by them.

In order to provide an overview of how the requirement contributors tackle the previously defined domains, Figure 3 represents the impact of the combined efforts of FIESTA-IoT and the three external analysed projects on the domains. The impact in a domain corresponds to the number of requirement contributors related to that domain. Note that the higher is the number of requirement contributors of a domain, the greater is the expected impact in FIESTA-IoT.

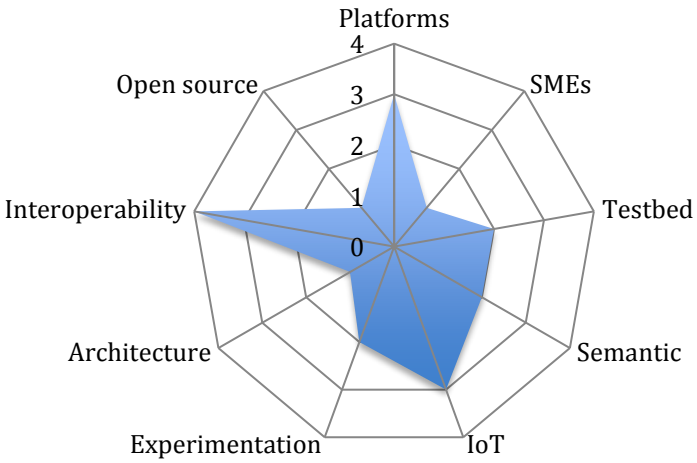


Figure 3 - Stakeholders requirements domain

2.3 Requirements attributes

Due to the specific characteristics of the project, there is the need to manipulate all of the variables, in order to minimise misunderstanding, to discover and manage all requirements and support agile development. To do this, it is important to include details about the states of requirement (e.g. priority and dependencies) and a low level description of the requirement, which is then realised by atomic requirements.

Atomic requirement is a collation of attributes that makes the requirement become measurable, testable, traceable, and detailed enough that it doesn't need more information.

Table 3 - FIESTA requirements shell

Attribute	Description
Unique ID	It identifies each requirement in a unique identifier.
Requirement Type	It specifies the type of the requirement, it becomes clear (roughly) if it is a function or a property of FIESTA. It is split by: • **Functional Requirements (FR),** They are the fundamental or essential subject matter of the product. They describe what the product has to do or what processing actions it is to take (Robertson & Robertson, 2007). • **Non-Functional Requirements (NFR),** They are the properties that the functions must have. These requirements are as important as the functional requirements for the product's success (Robertson & Robertson, 2007)
Priority	The priority of a requirement is the decision on the importance of the requirement's implementation. The priority depends highly on the specific domain of the application (Project Deliverable D6.2 –

	Updated Requirements List , 2011). Priority is divided by (Bradner, 1997): • **MUST,** It means that the definition is an absolute requirement of the specification. • **SHOULD,** It means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course. • **COULD,** It means that an item is truly optional.
Category	The category is used in order to aggregate the requirements into "meta-requirements". This aggregation facilitates the study, understanding and future processing of the requirements, from internal or external parties. Sets of categories were previously defined and are described in section 2.3.1.
Description	The description is the intent of the requirement. It is a statement about what the system has to fulfil according to the rationale (Project Deliverable D6.2 – Updated Requirements List , 2011).
Rationale	The rationale is the reason behind the requirement's existence. It explains why the requirement is important and how it contributes to the system's purpose (Project Deliverable D6.2 – Updated Requirements List , 2011).
Originator	The originator is the person or organisation who raised the requirement in the first instance. You should attach the originator's name to the requirements so we have a referral point if questions about the requirement arise or if the requirement is rejected. The person who raises the requirement must have the knowledge and authority appropriate for the type of requirement (Project Deliverable D6.2 – Updated Requirements List , 2011).
Fit Criterion	A fit criterion is a measurement for a requirement. It is needed because some requirements are too vague or ambiguous to be properly useful. For example, "The system shall be easy to use" is well-intentioned, but not yet able to be implemented. However, if you add a fit criterion such as "75% of first-time users shall be able to buy the correct cinema tickets within 90 seconds, without using the help functionality" makes it clear to the designer what is needed to make the product successful. (Robertson & Robertson, 2007)
Dependencies	Indicate if the requirement depends on another one. Relations between two or more requirements should be noted and

	separated by semicolon (Project Deliverable D6.2 – Updated Requirements List , 2011).
Conflicts	Conflicts between requirements imply that there exists contradiction upon system implementation, or one requirement makes the implementation of another requirement less feasible. (Project Deliverable D6.2 – Updated Requirements List , 2011).
Stakeholder	In this case, the stakeholders are the FIESTA-IoT work package teams that will address each specific requirement. The work packages included and available to be set as responsible for the requirement are described in section 2.3.2.
Comments	Any additional comment or observation regarding the specific requirement.

The previously defined attributes will need to be set for the FIESTA-IoT requirements. The majority of them are mandatory, however attributes such as Dependencies, Conflicts and Comments are optional.

All the requirements need to have a unique identifier, which uses a specific naming convention that is defined in Section 2.3.3. Information about the originator (owner) that has raised that requirement needs to be also present. During the requirement processing some requirements were merged or aggregated and so, a final requirement can have multiple owners. The original requirements were provided from FIESTA consortium partners, however some external IoT platforms were studied to identify if some of the requirements they had could provide added value to FIESTA. Note that FIESTA is data-driven, and so the requirements were processed with that focus.

Another mandatory attribute is the requirement type, which needs to be set as one of two pre-defined values: Functional Requirement, or Non-Functional Requirement. This needs to be specified in order to understand if the requirement is for providing functionalities or if it is for supporting the functionalities provided by FIESTA-IoT. Along with requirement type, it is also required for the requirement to have a priority set. This is also based on a pre-defined list, which goes from MUST (the higher priority) to SHOULD and finally to COULD (the lowest priority). There are also two negative priorities: MUST NOT (also higher, in negative terms) and SHOULD NOT.

The description, rationale and originator are also mandatory attributes that need to provide a description of the requirement and the rational for better understanding of the requirement itself, and the information on the originator of the requirement. On the other hand, the comments attribute is optional, and can be used for any kind of comment that can help with understanding that specific requirement. Also optional is the dependencies attribute that relates the requirement to another requirement, on which it depends, and the fit criterion, which provides information on how to validate if that requirement is supported by FIESTA-IoT.

There are also attributes such as Category and Stakeholder, which have sets of pre-defined options that can be used for each specific requirement. These two attributes are described in the following sections dedicated to them and are followed by a

section dedicated to the Unique Identifiers naming convention used for the requirements table.

2.3.1 Category

The category attribute is divided into 7 (seven) groups: Access, Measurements, Resource, FIESTA-IoT Platform, Security, Semantic Model and Interoperability.

- **Access**

  It specifies operations to provide access over the data, which can be either functions or methods to take advantage of the existing information. This category provides a notion on which requirements are related to the access to the FIESTA-IoT platform, either in terms of providing ways for the experimenter to have access to the information on the FIESTA-IoT platform, but also regarding the way that FIESTA accesses information on the testbeds. This category has both functional and non-functional requirements, due to having all the actual functionalities allowing the experimenters to access (e.g. by getting or discovering information based on characteristics or metadata) the information provided by FIESTA-IoT platform, but also, all of the requirements that do not provide functionalities per se, but aid its execution or are properties of the functionalities.

- **Measurements**

  The measurements category is used to aggregate all requirements that are related to the collection of data. All the requirements inside this group are non-functional, as all of them are properties of the data collection, or even requirements related to the measurement's metadata.

- **Resources**

  This category is used to aggregate all requirements that are related to the resources available in FIESTA-IoT. All the requirements are non-functional, as all of them are related to the resources, being properties or features of the resources, such as requirements related to the characterisation of the resources.

- **FIESTA-IoT Platform**

  The FIESTA-IoT Platform category aggregates all the requirements related to the platform itself, including its characteristics and internal functionalities that will enable the majority of the FIESTA-IoT functionalities. All kinds of data processing and enrichment within FIESTA-IoT are present here. This category has only non-functional requirements, as in terms of processing or management, they are not considered as functionalities of FIESTA-IoT, but are features of the platform itself.

- **Security**

  For FIESTA, the key security requirements are for authentication of users, authorisation of usage of data and resources, and access control of the resources. An important further concern is about data privacy particularly for private data held in testbeds, and data concerning participants in crowd-sourcing experiments. The security category includes both functional and non-functional requirements.

- **Semantic Modelling**

  The semantic modelling category is intended to provide a very specific, and distinctive aggregation of requirements related to the semantic modelling of data. This category only has non-functional requirements.

- **Interoperability**

  As the name suggests, the Interoperability category will aggregate all requirements related to the interoperability between FIESTA-IoT and the testbeds, and also about the way it enables the abstraction of the testbeds for experimenters to execute their experiments on top of FIESTA-IoT in a testbed agnostic manner. This category only has non-functional requirements.

2.3.2 Stakeholder

The Stakeholder attribute is intended to set which are the teams that handle each specific requirement. So, as the FIESTA-IoT project is structured into 7 WPs, which are:

WP 1. Project Management
WP 2. Requirements and Specifications
WP 3. Technologies for Testbeds Virtualization, Federation and Interoperability
WP 4. Federated Virtualized Testbeds Infrastructure and Tools
WP 5. Experiments Design, Delivery and Evaluation
WP 6. Global Market Confidence Programme for Interoperability
WP 7. Dissemination, Exploitation, Sustainability

So, each requirement could be set with any of these WP teams. However, by analysing all the WP teams and also by the internal organisation of WP2, it was noted that the requirements gathered in this deliverable can only be the responsibility of the WP3 and WP4 teams. This is due to the nature and organisation of both the project and WP2 specifically, as the requirements here provided are destined for the FIESTA-IoT platform development team, which consists of WP3 and WP4. Despite WP5 and WP6 being also an important part of FIESTA-IoT, they'll have a WP2 task each that will provide input for the specific WP (Task 2.3 will specify the experiments, and Task 2.5 is for Global Market Confidence and Certification Specifications). WP1 and WP7, as management and dissemination, exploitation and sustainability WPs, were also excluded from handling the requirements provided by this document.

An important aspect of this attribute is that, each requirement can have more than one stakeholder, as opposed to other attributes, such as the category or requirement type, that could only have one selection. So, one requirement may have WP3, WP4, or WP3 & WP4 as stakeholder.

2.3.3 Unique Identifier: Naming Convention

The unique identifier attribute is, as the name suggests, a unique string that univocally identifies each requirement. The unique identifier was firstly defined as integer value, however using it (e.g. in the dependencies column) it provided no notion on what each requirement was dependent on. So, the unique identifier was

changed to a more informative, composite version. So, we added to the integer value that represents the unique number of the requirement, we added a requirement type acronym identifier - FR or NFR, for Functional or Non-Functional requirements. After, we added information related to the Category of the requirement, using an acronym for each of the possible categories: ACC for Access; MEA for Measurements; RES for Resources; PLA for FIESTA-IoT Platform; SEC for Security; SEM for Semantic Modelling; and INT for Interoperability. To this, we also added a requirement short name, which is intended to provide, in a few words, its objective. Each of the parts of the unique identifier is separated with an underscore.

Table 4 - Unique IDs naming convention

Requirement number (RN)	Requirement Type (RT)	Category (CAT)	Short Description (SD)	UNIQUE ID
Integer value with two algorisms	Choose one of the following: • FR - Functional Requirement • NFR - Non-Functional Requirement	Choose one of the following: • ACC - Access • MEA - Measurements • RES - Resources • PLA - FIESTA-IoT Platform • SEC - Security • SEM - Semantic Modelling • INT - Interoperability	Short description of the Requirement	RN_RT_CAT_SD
(Example) 61	(Example) Non-Functional Requirement	(Example) Measurements	(Example) Measurements provide metadata	(Example) 61_NFR_MEA_Measurements_provide_metadata

All the requirements have specific attributes, as referred to in Table 3, which in turn has associate, downstream, a pre-defined list, depicted in Table 5. There is only one possible choice by list except the Stakeholder attribute that can have a combination of more than one WP team.

Table 5 - Pre-defined lists

Pre-Defined Lists of Requirement			
Requirement Type • Functional Requirement • Non-Functional Requirement	**Priority** • MUST • MUST NOT • SHOULD • SHOULD NOT • COULD	**Category** • Access • Measurements • Resource • FIESTA-IoT Platform • Security • Semantic Modelling • Interoperability	**Stakeholder** • WP 3 team • WP 4 team

2.4 FIESTA-IoT Requirements

In this section we present the requirements that have been properly analysed and processed after performing a collection from the stakeholders. The requirements are in the form of a table, where the columns are the attributes referred to in the previous section. For technical reasons (essentially limited space) all the columns will not be displayed. And each row is a new and distinct requirement. The overall table, with all of the attributes for each requirement can be found in Appendix I – FIESTA-IoT Requirements Table

Due to the importance of requirements in various parts of the FIESTA-IoT project, it is presented in multiple views to facilitate their analysis, interpretation and even implementation. Using this methodology, each view of the requirements will have the whole set of requirements (although with only some of the attributes), meaning that each view will be duplicating the requirements. The idea is that the reader can consult the requirements using the view that better suites his objective.

The views presented in the following sub sections are:

- View by Requirement Type: Two tables will be presented, the first with all of the Functional Requirements, and the second with all of the Non-Functional Requirements;
- View by Priority: Three tables will be presented, the first with all of the requirements that have MUST as a priority, and two others with the SHOULD and COULD priority respectively;
- View by Category: The category view will provide one table with all of the requirements for each of the pre-defined categories, so this view will provide seven distinct tables;
- View by Stakeholders: This view will provide a set of three tables, the first with all of the requirements that are set for WP3 only, another table for the requirements set for WP4 only, and a third table with the requirements that are set for both WP3 and WP4;
- Fit Criteria View: This view will provide one table with all of the requirements, with the unique ID, description, rational and Fit Criteria of each of the FIESTA-IoT requirements;
- Dependencies View: This view does not provide any tables, but a diagram showing how requirements depend on others. This view will not provide all of the requirements, but only the ones that depend on or are dependent of other requirements;

2.4.1 View by Requirement Type

This view provides a table aggregating the functions of FIESTA-IoT, and another table aggregating its properties, which are the Functional and Non-functional requirements respectively.

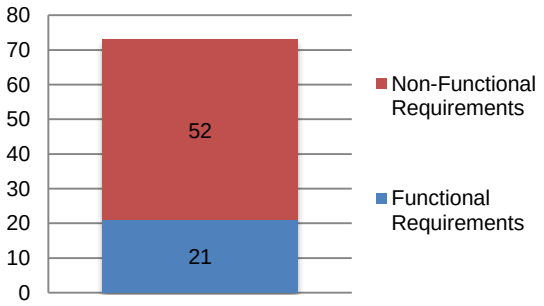


Table 6 - Requirements by Type: Functional Requirements

UNIQUE ID	Priority	Category	Description
01_FR_ACC_Resource_independent_info	MUST	Access	It must be possible to access information independently of which resource produced it
02_FR_ACC_Resources_available	SHOULD	Access	The experimenter should have the possibility to request that some specific resources are available
03_FR_ACC_Past_Present_info	MUST	Access	An experimenter must be able to access real-time information, historical information or a combination of both of them
04_FR_ACC_Discover_info_independent_testbed	MUST	Access	It must be possible to get/discover information independently of the testbed they belong to
05_FR_ACC_Dynamic_discovery_resources	SHOULD	Access	FIESTA-IoT should provide the means for dynamic discovery of resources
06_FR_ACC_Querying_data_compositions	SHOULD	Access	FIESTA should enable querying of resources, including sensors streams, but also streams stemming from their already defined composition
07_FR_ACC_Discover_data_phenomenon	MUST	Access	It must be possible to get/discover measurements based on what phenomenon is observed
08_FR_ACC_List_info_related_measurement	MUST	Access	It must be possible to list all information related to a measurement (metadata and characteristics of the resource that generated the measurement)
09_FR_ACC_List_info_related_resource	MUST	Access	It must be possible to list all information related to a resource instance (characteristics of the resource, and also measurements and metadata generated by the resource)
10_FR_ACC_Get_measurements_single_request	MUST	Access	It must be possible to get measurements from different testbeds with a single request
11_FR_ACC_Request_data_different_ways	MUST	Access	It must be possible for the experimenter to request for data in different ways (e.g. event-based, periodic, and/or autonomous)
12_FR_ACC_Choose_metadata_each_measurement	SHOULD	Access	It should be possible for the experimenter to choose the metadata associated with the measurements
13_FR_ACC_Expose_testbed_actuation_capabilities	COULD	Access	Testbed actuations could be exposed to experimenters through well-defined APIs
14_FR_ACC_Sample_specific_fractions_data	MUST	Access	It must be possible to sample a specific fraction of the data
15_FR_ACC_Discover_resources_by_characteristics	MUST	Access	It must be possible to get/discover resources based on characteristics
16_FR_ACC_Discover_measurements_by_metadata	MUST	Access	It must be possible to get/discover measurements based on metadata

UNIQUE ID	Priority	Category	Description
17_FR_ACC_Experimenter_provide_feedback	COULD	Access	The experimenter could be able to provide feedback of measurements and/or resources (e.g. such as quarantine the measurements from a specific resource)
18_FR_SEC_Testbed_authentication_mechanisms	MUST	Security	Testbed providers must provide authentication mechanisms to (secure) access services/resources
19_FR_SEC_Testbed_manage_priviledges	MUST	Security	Testbed providers must provide authorization and access control mechanisms to (secure) access services/resources
20_FR_SEC_Experimenter_single-sign-on	MUST	Security	Single-sign-on mechanism has to be in place
21_FR_SEC_Tool_manage_users	MUST	Security	FIESTA-IoT must have a tool to manage users and their respective access rights

Table 7 - Requirements by Type: Non-Functional Requirements

UNIQUE ID	Priority	Category	Description
22_NFR_ACC_Distinguish_type_of_data	MUST	Access	It must be clear to the experimenters what they are receiving, (e.g. measurements, metadata, resources, characteristics, etc.)
23_NFR_ACC_Page_in_subrequests	SHOULD	Access	When a large set of information is requested, it should be possible to page it into different sub-requests
24_NFR_ACC_Tools_planning_auto_tasks	COULD	Access	FIESTA-IoT could provide tools to enable the planning of automated tasks
25_NFR_ACC_Set_response_Max_size	SHOULD	Access	A response "Maximum Size" might be set
26_NFR_ACC_Response_adapt_dynamics_resources	SHOULD	Access	Responses from the testbed should adapt to the dynamics of underlying resources
27_NFR_ACC_Register_new_resources	MUST	Access	The platform must allow external entities to register new resources
28_NFR_ACC_Response_delay_controlled	SHOULD	Access	Response delay should remain under control independently of the complexity of the federated testbeds
29_NFR_ACC_Data_provided_as_requested	SHOULD	Access	Testbed should provide data as requested by FIESTA according to the experimenter request
30_NFR_ACC_FIESTA_well_documented	MUST	Access	FIESTA-IoT must be well documented.
31_NFR_ACC_Describe_IoT_services_and_applications	SHOULD	Access	FIESTA-IoT should provide the means for describing/formulating IoT services and applications according to high-level descriptions
32_NFR_ACC_Provide_dev_deploy_manag_config_tools	SHOULD	Access	FIESTA-IoT should provide development, deployment, management and configuration tools

UNIQUE ID	Priority	Category	Description
33_NFR_ACC_Scalability_data_collection	MUST	Access	Scalability of data collection
34_NFR_PLA_Process_non_responded_requests	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should process non responded requests from experiments
35_NFR_PLA_Manage_resources_in_query_or_experiment	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should visualise and manage the resources entailed in a specific query or experiment
36_NFR_PLA_Resources_produce_different_measurements	MUST	FIESTA-IoT Platform	FIESTA-IoT must support resources that produce different measurements that can be linked or not
37_NFR_PLA_Info_lifecycle_management	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support information (data) lifecycle management
38_NFR_PLA_Diff_types_requests_processed	MUST	FIESTA-IoT Platform	FIESTA-IoT must process event-based, periodic, and/or autonomous communication
39_NFR_PLA_Info_testbed_agnostic_way	MUST	FIESTA-IoT Platform	FIESTA-IoT must handle information in a Testbed agnostic way
40_NFR_PLA_Process_feedbacks	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should process the measurements and / or resources feedback to validate the functioning of resources
41_NFR_PLA_Minimise_processing_delay	SHOULD	FIESTA-IoT Platform	Processing delay has to be minimised when requesting information
42_NFR_PLA_Data_generated_from_processing_info	COULD	FIESTA-IoT Platform	Data generated from processing information could be provided to the experimenters
43_NFR_PLA_Optimise_computational_assets	COULD	FIESTA-IoT Platform	FIESTA-IoT infrastructures could optimise usage of computational assets (storage, computing cycle, resource utilisation, energy efficiency)
44_NFR_PLA_Prioritization_of_services	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support prioritization of services
45_NFR_PLA_Orchestration_of_resources	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should orchestrate data from resources in order to automatically formulate composite workflows as required by user/researcher applications
46_NFR_PLA_Homogeneous_classification	MUST	FIESTA-IoT Platform	Homogeneous classification through different testbeds
47_NFR_PLA_Specify_compositon_data_streams	SHOULD	FIESTA-IoT Platform	Ability to specify composition of data streams
48_NFR_PLA_Understand_not_used_info	COULD	FIESTA-IoT Platform	FIESTA-IoT could try to understand which data is not being requested by experimenters
49_NFR_PLA_Reliable_time_sync	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support testbeds in different time zones

UNIQUE ID	Priority	Category	Description
50_NFR_PLA_FIESTA_scalable_extensible_upgradable	MUST	FIESTA-IoT Platform	The FIESTA-IoT platform must be scalable, extensible and upgradable
51_NFR_PLA_FIESTA_highly_reliable	MUST	FIESTA-IoT Platform	FIESTA-IoT needs to be highly reliable
52_NFR_PLA_Elasticity_abundance_computational_assets	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should have elasticity and abundance in terms of computational assets (especially storage and computation)
53_NFR_PLA_Execution_concurrent_services	MUST	FIESTA-IoT Platform	The platform must support execution of concurrent Services including data generation and usage from the same resources
54_NFR_INT_Interop_between_fiesta_testbeds	MUST	Interoperability	Interoperability must be achieved between FIESTA-IoT and testbeds
55_NFR_INT_App_develop_integration_resources	SHOULD	Interoperability	FIESTA-IoT should enable scalable sharing, easy integration and deployment of distributed resources. Heterogeneous resources must be supported.
56_NFR_INT_Support_diff_tested_data_policies	SHOULD	Interoperability	FIESTA-IoT should support different testbed data caching policies
57_NFR_INT_Run_apps_services_interop	SHOULD	Interoperability	FIESTA-IoT should be able to run applications and services in an interoperable manner
58_NFR_MEA_Link_measurements_resources	MUST	Measurements	It must be possible to link the measurement with the resource (and its characteristics) that generated that measurement
59_NFR_MEA_Link_measurements_metadata	SHOULD	Measurements	It should be possible to link by its metadata different measurements that are related
60_NFR_MEA_Measurements_provide_metadata	MUST	Measurements	Each collected measurement must provide metadata
61_NFR_MEA_Measurements_independant_resource	MUST	Measurements	Collecting measurements without specifying the resource that produced it
62_NFR_MEA_Measurements_provide_phenomenon	MUST	Measurements	Each measurement must state the phenomenon
63_NFR_RES_Link_resource_tesbed	MUST	Resource	It must be possible to link the resource with the testbed where it is hosted
64_NFR_RES_Resource_provide_characteristics	MUST	Resource	Every resource must be characterised
65_NFR_RES_Resource_identified_code	MUST	Resource	Every resource must be univocally identified by a code
66_NFR_RES_Calculate_reputation_resource	SHOULD	Resource	Reputation of resource provider should be automatically calculated
67_NFR_RES_Experiment_participants_known	SHOULD	Resource	Resources should be identified as experiment participants

UNIQUE ID	Priority	Category	Description
68_NFR_SEC_Support_certification_authority	SHOULD	Security	FIESTA-IoT Platform should support federated identity management
69_NFR_SEC_Verify_authorise_user_actions	MUST	Security	When a user wants to execute any action FIESTA-IoT has to verify that he is authorized to do this action
70_NFR_SEC_Different_profile_types	MUST	Security	FIESTA-IoT must have different profile types (e.g. different kind of experimenters, researchers, etc.). Thereby grant different permissions
71_NFR_SEC_Privacy_collected_data	COULD	Security	Privacy of collected data
72_NFR_SEM_Semantic_annotations_data	MUST	Semantic Modelling	Semantic annotations of data
73_NFR_SEM_Mapping_semantic_model	MUST	Semantic Modelling	Mapping between testbed and FIESTA-IoT semantic model must be ensured

2.4.2 View by Priority

This view enables the reader to view the set of requirements by importance to be achieved by FIESTA-IoT project. This will help with the work methodology, classifying the requirements into different levels of priority and thus, for example, start the analysis/implementation of the requirements with higher priority. In this view, three tables will be presented, one for the MUST priority, another for the SHOULD priority, and a last one for the COULD priority.

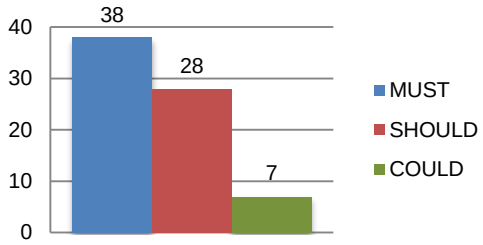


Table 8 - Requirements by Priority: MUST

UNIQUE ID	Requirement Type	Category	Description
01_FR_ACC_Resource_independent_info	Functional Requirements	Access	It must be possible to access information independently of which resource produced it
03_FR_ACC_Past_Present_info	Functional Requirements	Access	An experimenter must be able to access real-time information, historical information or a combination of both of them
04_FR_ACC_Discover_info_independent_testbed	Functional Requirements	Access	It must be possible to get/discover information independently of the testbed they belong to
07_FR_ACC_Discover_data_phenomenon	Functional Requirements	Access	It must be possible to get/discover measurements based on what phenomenon is observed
08_FR_ACC_List_info_related_measurement	Functional Requirements	Access	It must be possible to list all information related to a measurement (metadata and characteristics of the resource that generated the measurement)

UNIQUE ID	Requirement Type	Category	Description
09_FR_ACC_List_info_related_resource	Functional Requirements	Access	It must be possible to list all information related to a resource instance (characteristics of the resource, and also measurements and metadata generated by the resource)
10_FR_ACC_Get_measurements_single_request	Functional Requirements	Access	It must be possible to get measurements from different testbeds with a single request
11_FR_ACC_Request_data_different_ways	Functional Requirements	Access	It must be possible for the experimenter to request for data in different ways (e.g. event-based, periodic, and/or autonomous)
14_FR_ACC_Sample_specific_fractions_data	Functional Requirements	Access	It must be possible to sample a specific fraction of the data
15_FR_ACC_Discover_resources_by_characteristics	Functional Requirements	Access	It must be possible to get/discover resources based on characteristics
16_FR_ACC_Discover_measurements_by_metadata	Functional Requirements	Access	It must be possible to get/discover measurements based on metadata
18_FR_SEC_Testbed_authentication_mechanisms	Functional Requirements	Security	Testbed providers must provide authentication mechanisms to (secure) access services/resources
19_FR_SEC_Testbed_manage_priviledges	Functional Requirements	Security	Testbed providers must provide authorization and access control mechanisms to (secure) access services/resources
20_FR_SEC_Experimenter_single-sign-on	Functional Requirements	Security	Single-sign-on mechanism has to be in place
21_FR_SEC_Tool_manage_users	Functional Requirements	Security	FIESTA-IoT must have a tool to manage users and their respective access rights
22_NFR_ACC_Distinguish_type_of_data	Non-Functional Requirements	Access	It must be clear to the experimenters what they are receiving, (e.g. measurements, metadata, resources, characteristics, etc.)
27_NFR_ACC_Register_new_resources	Non-Functional Requirements	Access	The platform must allow external entities to register new resources
30_NFR_ACC_FIESTA_well_documented	Non-Functional Requirements	Access	FIESTA-IoT must be well documented.
33_NFR_ACC_Scalability_data_collection	Non-Functional Requirements	Access	Scalability of data collection
36_NFR_PLA_Resources_produce_different_measurements	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT must support resources that produce different measurements that can be linked or not
38_NFR_PLA_Diff_types_requests_processed	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT must process event-based, periodic, and/or autonomous communication
39_NFR_PLA_Info_testbed_agnostic_way	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT must handle information in a testbed agnostic way

UNIQUE ID	Requirement Type	Category	Description
46_NFR_PLA_Homogeneous_classification	Non-Functional Requirements	FIESTA-IoT Platform	Homogeneous classification through different testbeds
50_NFR_PLA_FIESTA_scalable_extensible_upgradable	Non-Functional Requirements	FIESTA-IoT Platform	The FIESTA-IoT platform must be scalable, extensible and upgradable
51_NFR_PLA_FIESTA_highly_reliable	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT needs to be highly reliable
53_NFR_PLA_Execution_concurrent_services	Non-Functional Requirements	FIESTA-IoT Platform	The platform must support execution of concurrent Services including data generation and usage from the same resources
54_NFR_INT_Interop_between_fiesta_testbeds	Non-Functional Requirements	Interoperability	Interoperability must be achieved between FIESTA-IoT and testbeds
58_NFR_MEA_Link_measurements_resources	Non-Functional Requirements	Measurements	It must be possible to link the measurement with the resource (and its characteristics) that generated that measurement
60_NFR_MEA_Measurements_provide_metadata	Non-Functional Requirements	Measurements	Each collected measurement must provide metadata
61_NFR_MEA_Measurements_independant_resource	Non-Functional Requirements	Measurements	Collecting measurements without specifying the resource that produced it
62_NFR_MEA_Measurements_provide_phenomenon	Non-Functional Requirements	Measurements	Each measurement must state the phenomenon
63_NFR_RES_Link_resource_tesbed	Non-Functional Requirements	Resource	It must be possible to link the resource with the testbed where it is hosted
64_NFR_RES_Resource_provide_characteristics	Non-Functional Requirements	Resource	Every resource must be characterised
65_NFR_RES_Resource_identified_code	Non-Functional Requirements	Resource	Every resource must be univocally identified by a code
69_NFR_SEC_Verify_authorise_user_actions	Non-Functional Requirements	Security	When a user wants to execute any action FIESTA-IoT has to verify that he is authorized to do this action
70_NFR_SEC_Different_profile_types	Non-Functional Requirements	Security	FIESTA-IoT must have different profile types (e.g. different kind of experimenters, researchers, etc.). Thereby grant different permissions
72_NFR_SEM_Semantic_annotations_data	Non-Functional Requirements	Semantic Modelling	Semantic annotations of data
73_NFR_SEM_Mapping_semantic_model	Non-Functional Requirements	Semantic Modelling	Mapping between testbed and FIESTA-IoT semantic model must be ensured

Table 9 - Requirements by Priority: SHOULD

UNIQUE ID	Requirement Type	Category	Description
02_FR_ACC_Resources_available	Functional Requirements	Access	The experimenter should have the possibility to request that some specific resources are available
05_FR_ACC_Dynamic_discovery_resources	Functional Requirements	Access	FIESTA-IoT should provide the means for dynamic discovery of resources
06_FR_ACC_Querying_data_compositions	Functional Requirements	Access	FIESTA should enable querying of resources, including sensors streams, but also streams stemming from their already defined composition
12_FR_ACC_Choose_metadata_each_measurement	Functional Requirements	Access	It should be possible to the experimenter to choose the metadata associated with the measurements
23_NFR_ACC_Page_in_subrequests	Non-Functional Requirements	Access	When a large set of information is requested, it should be possible to page it into different sub-requests
25_NFR_ACC_Set_response_Max_size	Non-Functional Requirements	Access	A response "Maximum Size" might be set
26_NFR_ACC_Response_adapt_dynamics_resources	Non-Functional Requirements	Access	Responses from the testbed should adapt to the dynamics of underlying resources
28_NFR_ACC_Response_delay_controlled	Non-Functional Requirements	Access	Response delay should remain under control independently of the complexity of the federated testbeds
29_NFR_ACC_Data_provided_as_requested	Non-Functional Requirements	Access	Testbed should provide data as requested by FIESTA according to the experimenter request
31_NFR_ACC_Describe_IoT_services_and_applications	Non-Functional Requirements	Access	FIESTA-IoT should provide the means for describing/formulating IoT services and applications according to high-level descriptions
32_NFR_ACC_Provide_dev_deploy_manag_config_tools	Non-Functional Requirements	Access	FIESTA-IoT should provide development, deployment, management and configuration tools
34_NFR_PLA_Process_non_responded_requests	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT should process non responded requests from experiments
35_NFR_PLA_Manage_resources_in_query_or_experiment	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT should visualise and manage the resources entailed in a specific query or experiment
37_NFR_PLA_Info_lifecycle_management	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT should support information (data) lifecycle management
40_NFR_PLA_Process_feedbacks	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT should process the measurements and / or resources feedback to validate the functioning of resources
41_NFR_PLA_Minimise_processing_delay	Non-Functional Requirements	FIESTA-IoT Platform	Processing delay has to be minimised when requesting information

UNIQUE ID	Requirement Type	Category	Description
44_NFR_PLA_Prioritization_of_services	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT should support prioritization of services
45_NFR_PLA_Orchestration_of_resources	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT should orchestrate data from resources in order to automatically formulate composite workflows as required by user/researcher applications
47_NFR_PLA_Specify_compositon_data_streams	Non-Functional Requirements	FIESTA-IoT Platform	Ability to specify composition of data streams
49_NFR_PLA_Reliable_time_sync	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT should support testbeds in different time zones
52_NFR_PLA_Elasticity_abundance_computational_assets	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT should have elasticity and abundance in terms of computational assets (especially storage and computation)
55_NFR_INT_App_develop_integration_resources	Non-Functional Requirements	Interoperability	FIESTA-IoT should enable scalable sharing, easy integration and deployment of distributed resources. Heterogeneous resources must be supported.
56_NFR_INT_Support_diff_tested_data_policies	Non-Functional Requirements	Interoperability	FIESTA-IoT should support different testbed data caching policies
57_NFR_INT_Run_apps_services_interop	Non-Functional Requirements	Interoperability	FIESTA-IoT should be able to run applications and services in an interoperable manner
59_NFR_MEA_Link_measurements_metadata	Non-Functional Requirements	Measurements	It should be possible to link by its metadata different measurements that are related
66_NFR_RES_Calculate_reputation_resource	Non-Functional Requirements	Resource	Reputation of resource provider should be automatically calculated
67_NFR_RES_Experiment_participants_known	Non-Functional Requirements	Resource	Resources should be identified as experiment participants
68_NFR_SEC_Support_certification_authority	Non-Functional Requirements	Security	FIESTA-IoT Platform should support federated identity management

Table 10 - Requirements by Priority: COULD

UNIQUE ID	Requirement Type	Category	Description
13_FR_ACC_Expose_testbed_actuation_capabilities	Functional Requirements	Access	Testbed actuations could be exposed to experimenters through well-defined APIs
17_FR_ACC_Experimenter_provide_feedback	Functional Requirements	Access	The experimenter could be able to provide feedback of measurements and/or resources (e.g. such as quarantine the measurements from a specific resource)

UNIQUE ID	Requirement Type	Category	Description
24_NFR_ACC_Tools_planning_auto_tasks	Non-Functional Requirements	Access	FIESTA-IoT could provide tools to enable the planning of automated tasks
42_NFR_PLA_Data_generated_from_processing_info	Non-Functional Requirements	FIESTA-IoT Platform	Data generated from processing information could be provided to the experimenters
43_NFR_PLA_Optimise_computational_assets	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT infrastructures could optimise usage of computational assets (storage, computing cycle, resource utilisation, energy efficiency)
48_NFR_PLA_Understand_not_used_info	Non-Functional Requirements	FIESTA-IoT Platform	FIESTA-IoT could try to understand which data is not being requested by experimenters
71_NFR_SEC_Privacy_collected_data	Non-Functional Requirements	Security	Privacy of collected data

2.4.3 View by Category

In this view by category, the idea was to aggregate the requirements into groups that facilitate the study, understanding and future processing of the requirements, from internal or external parties. So, seven tables will be depicted next, one for each of the following categories: Access, Measurements, Resources, FIESTA-IoT Platform, Security, Semantic Modelling, and Interoperability.

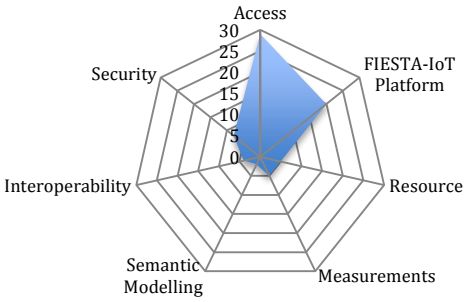


Table 11 - Requirements by Category: Access

UNIQUE ID	Requirement Type	Priority	Description
01_FR_ACC_Resource_independent_info	Functional Requirements	MUST	It must be possible to access information independently of which resource produced it
02_FR_ACC_Resources_available	Functional Requirements	SHOULD	The experimenter should have the possibility to request that some specific resources are available
03_FR_ACC_Past_Present_info	Functional Requirements	MUST	An experimenter must be able to access real-time information, historical information or a combination of both of them
04_FR_ACC_Discover_info_independent_testbed	Functional Requirements	MUST	It must be possible to get/discover information independently of the testbed they belong to
05_FR_ACC_Dynamic_discovery_resources	Functional Requirements	SHOULD	FIESTA-IoT should provide the means for dynamic discovery of resources
06_FR_ACC_Querying_data_compositions	Functional Requirements	SHOULD	FIESTA should enable querying of resources, including sensors streams, but also streams stemming from their already defined composition

UNIQUE ID	Requirement Type	Priority	Description
07_FR_ACC_Discover_data_phenomenon	Functional Requirements	MUST	It must be possible to get/discover measurements based on what phenomenon is observed
08_FR_ACC_List_info_related_measurement	Functional Requirements	MUST	It must be possible to list all information related to a measurement (metadata and characteristics of the resource that generated the measurement)
09_FR_ACC_List_info_related_resource	Functional Requirements	MUST	It must be possible to list all information related to a resource instance (characteristics of the resource, and also measurements and metadata generated by the resource)
10_FR_ACC_Get_measurements_single_request	Functional Requirements	MUST	It must be possible to get measurements from different testbeds with a single request
11_FR_ACC_Request_data_different_ways	Functional Requirements	MUST	It must be possible for the experimenter to request for data in different ways (e.g. event-based, periodic, and/or autonomous)
12_FR_ACC_Choose_metadata_each_measurement	Functional Requirements	SHOULD	It should be possible to the experimenter to choose the metadata associated with the measurements
13_FR_ACC_Expose_testbed_actuation_capabilities	Functional Requirements	COULD	Testbed actuations could be exposed to experimenters through well-defined APIs
14_FR_ACC_Sample_specific_fractions_data	Functional Requirements	MUST	It must be possible to sample a specific fraction of the data
15_FR_ACC_Discover_resources_by_characteristics	Functional Requirements	MUST	It must be possible to get/discover resources based on characteristics
16_FR_ACC_Discover_measurements_by_metadata	Functional Requirements	MUST	It must be possible to get/discover measurements based on metadata
17_FR_ACC_Experimenter_provide_feedback	Functional Requirements	COULD	The experimenter could be able to provide feedback of measurements and/or resources (e.g. such as quarantine the measurements from a specific resource)
22_NFR_ACC_Distinguish_type_of_data	Non-Functional Requirements	MUST	It must be clear to the experimenters what they are receiving, (e.g. measurements, metadata, resources, characteristics, etc.)
23_NFR_ACC_Page_in_subrequests	Non-Functional Requirements	SHOULD	When a large set of information is requested, it should be possible to page it into different sub-requests
24_NFR_ACC_Tools_planning_auto_tasks	Non-Functional Requirements	COULD	FIESTA-IoT could provide tools to enable the planning of automated tasks
25_NFR_ACC_Set_response_Max_size	Non-Functional Requirements	SHOULD	A response "Maximum Size" might be set
26_NFR_ACC_Response_adapt_dynamics_resources	Non-Functional Requirements	SHOULD	Responses from the testbed should adapt to the dynamics of underlying resources
27_NFR_ACC_Register_new_resources	Non-Functional Requirements	MUST	The platform must allow external entities to register new resources

UNIQUE ID	Requirement Type	Priority	Description
28_NFR_ACC_Response_delay_controlled	Non-Functional Requirements	SHOULD	Response delay should remain under control independently of the complexity of the federated testbeds
29_NFR_ACC_Data_provided_as_requested	Non-Functional Requirements	SHOULD	Testbed should provide data as requested by FIESTA according to the experimenter request
30_NFR_ACC_FIESTA_well_documented	Non-Functional Requirements	MUST	FIESTA-IoT must be well documented.
31_NFR_ACC_Describe_IoT_services_and_applications	Non-Functional Requirements	SHOULD	FIESTA-IoT should provide the means for describing/formulating IoT services and applications according to high-level descriptions
32_NFR_ACC_Provide_dev_deploy_manag_config_tools	Non-Functional Requirements	SHOULD	FIESTA-IoT should provide development, deployment, management and configuration tools
33_NFR_ACC_Scalability_data_collection	Non-Functional Requirements	MUST	Scalability of data collection

Table 12 - Requirements by Category: Measurements

UNIQUE ID	Requirement Type	Priority	Description
58_NFR_MEA_Link_measurements_resources	Non-Functional Requirements	MUST	It must be possible to link the measurement with the resource (and its characteristics) that generated that measurement
59_NFR_MEA_Link_measurements_metadata	Non-Functional Requirements	SHOULD	It should be possible to link by its metadata different measurements that are related
60_NFR_MEA_Measurements_provide_metadata	Non-Functional Requirements	MUST	Each collected measurement must provide metadata
61_NFR_MEA_Measurements_independant_resource	Non-Functional Requirements	MUST	Collecting measurements without specifying the resource that produced it
62_NFR_MEA_Measurements_provide_phenomenon	Non-Functional Requirements	MUST	Each measurement must state the phenomenon

Table 13 - Requirements by Category: Resource

UNIQUE ID	Requirement Type	Priority	Description
63_NFR_RES_Link_resource_tesbed	Non-Functional Requirements	MUST	It must be possible to link the resource with the testbed where it is hosted
64_NFR_RES_Resource_provide_characteristics	Non-Functional Requirements	MUST	Every resource must be characterised

65_NFR_RES_Resource_identified_code	Non-Functional Requirements	MUST	Every resource must be univocally identified by a code
66_NFR_RES_Calculate_reputation_resource	Non-Functional Requirements	SHOULD	Reputation of resource provider should be automatically calculated
67_NFR_RES_Experiment_participants_known	Non-Functional Requirements	SHOULD	Resources should be identified as experiment participants

Table 14 - Requirements by Category: FIESTA-IoT Platform

UNIQUE ID	Requirement Type	Priority	Description
34_NFR_PLA_Process_non_responded_requests	Non-Functional Requirements	SHOULD	FIESTA-IoT should process non responded requests from experiments
35_NFR_PLA_Manage_resources_in_query_or_experiment	Non-Functional Requirements	SHOULD	FIESTA-IoT should visualise and manage the resources entailed in a specific query or experiment
36_NFR_PLA_Resources_produce_different_measurements	Non-Functional Requirements	MUST	FIESTA-IoT must support resources that produce different measurements that can be linked or not
37_NFR_PLA_Info_lifecycle_management	Non-Functional Requirements	SHOULD	FIESTA-IoT should support information (data) lifecycle management
38_NFR_PLA_Diff_types_requests_processed	Non-Functional Requirements	MUST	FIESTA-IoT must process event-based, periodic, and/or autonomous communication
39_NFR_PLA_Info_testbed_agnostic_way	Non-Functional Requirements	MUST	FIESTA-IoT must handle information in a testbed agnostic way
40_NFR_PLA_Process_feedbacks	Non-Functional Requirements	SHOULD	FIESTA-IoT should process the measurements and / or resources feedback to validate the functioning of resources
41_NFR_PLA_Minimise_processing_delay	Non-Functional Requirements	SHOULD	Processing delay has to be minimised when requesting information
42_NFR_PLA_Data_generated_from_processing_info	Non-Functional Requirements	COULD	Data generated from processing information could be provided to the experimenters
43_NFR_PLA_Optimise_computational_assets	Non-Functional Requirements	COULD	FIESTA-IoT infrastructures could optimise usage of computational assets (storage, computing cycle, resource utilisation, energy efficiency)
44_NFR_PLA_Prioritization_of_services	Non-Functional Requirements	SHOULD	FIESTA-IoT should support prioritization of services
45_NFR_PLA_Orchestration_of_resources	Non-Functional Requirements	SHOULD	FIESTA-IoT should orchestrate data from resources in order to automatically formulate composite workflows as required by user/researcher applications
46_NFR_PLA_Homogeneous_classification	Non-Functional Requirements	MUST	Homogeneous classification through different testbeds

UNIQUE ID	Requirement Type	Priority	Description
47_NFR_PLA_Specify_compositon_data_streams	Non-Functional Requirements	SHOULD	Ability to specify composition of data streams
48_NFR_PLA_Understand_not_used_info	Non-Functional Requirements	COULD	FIESTA-IoT could try to understand which data is not being requested by experimenters
49_NFR_PLA_Reliable_time_sync	Non-Functional Requirements	SHOULD	FIESTA-IoT should support testbeds in different time zones
50_NFR_PLA_FIESTA_scalable_extensible_upgradable	Non-Functional Requirements	MUST	The FIESTA-IoT platform must be scalable, extensible and upgradable
51_NFR_PLA_FIESTA_highly_reliable	Non-Functional Requirements	MUST	FIESTA-IoT needs to be highly reliable
52_NFR_PLA_Elasticity_abundance_computational_assets	Non-Functional Requirements	SHOULD	FIESTA-IoT should have elasticity and abundance in terms of computational assets (especially storage and computation)
53_NFR_PLA_Execution_concurrent_services	Non-Functional Requirements	MUST	The platform must support execution of concurrent Services including data generation and usage from the same resources

Table 15 - Requirements by Category: Security

UNIQUE ID	Requirement Type	Priority	Description
18_FR_SEC_Testbed_authentication_mechanisms	Functional Requirements	MUST	Testbed providers must provide authentication mechanisms to (secure) access services/resources
19_FR_SEC_Testbed_manage_priviledges	Functional Requirements	MUST	Testbed providers must provide authorization and access control mechanisms to (secure) access services/resources
20_FR_SEC_Experimenter_single-sign-on	Functional Requirements	MUST	Single-sign-on mechanism has to be in place
21_FR_SEC_Tool_manage_users	Functional Requirements	MUST	FIESTA-IoT must have a tool to manage users and their respective access rights
68_NFR_SEC_Support_certification_authority	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform should support federated identity management
69_NFR_SEC_Verify_authorise_user_actions	Non-Functional Requirements	MUST	When a user wants to execute any action FIESTA-IoT has to verify that he is authorized to do this action
70_NFR_SEC_Different_profile_types	Non-Functional Requirements	MUST	FIESTA-IoT must have different profile types (e.g. different kind of experimenters, researchers, etc.). Thereby grant different permissions
71_NFR_SEC_Privacy_collected_data	Non-Functional Requirements	COULD	Privacy of collected data

Table 16 - Requirements by Category: Semantic Modelling

UNIQUE ID	Requirement Type	Priority	Description
72_NFR_SEM_Semantic_annotations_data	Non-Functional Requirements	MUST	Semantic annotations of data
73_NFR_SEM_Mapping_semantic_model	Non-Functional Requirements	MUST	Mapping between testbed and FIESTA-IoT semantic model must be ensured

Table 17 - Requirements by Category: Interoperability

UNIQUE ID	Requirement Type	Priority	Description
54_NFR_INT_Interop_between_fiesta_testbeds	Non-Functional Requirements	MUST	Interoperability must be achieved between FIESTA-IoT and testbeds
55_NFR_INT_App_develop_integration_resources	Non-Functional Requirements	SHOULD	FIESTA-IoT should enable scalable sharing, easy integration and deployment of distributed resources. Heterogeneous resources must be supported.
56_NFR_INT_Support_diff_tested_data_policies	Non-Functional Requirements	SHOULD	FIESTA-IoT should support different testbed data caching policies
57_NFR_INT_Run_apps_services_interop	Non-Functional Requirements	SHOULD	FIESTA-IoT should be able to run applications and services in an interoperable manner

2.4.4 View by Stakeholder

In this view, the requirements are presented in order to differentiate who will assume responsibility for each specific requirement. Therefore this will facilitate the search that each stakeholder (WP team) has to handle. As explained before, there are only requirements set for WP 3 team, WP 4 team, or a combination of both.

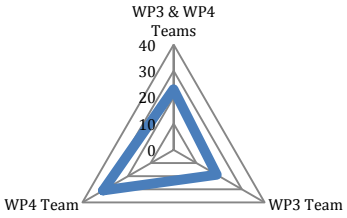


Table 18 - Requirements by Stakeholder: WP3 team

UNIQUE ID	Requirement Type	Priority	Category	Description
22_NFR_ACC_Distinguish_type_of_data	Non-Functional Requirements	MUST	Access	It must be clear to the experimenters what they are receiving, (e.g. measurements, metadata, resources, characteristics, etc.)
26_NFR_ACC_Response_adapt_dynamics_resources	Non-Functional Requirements	SHOULD	Access	Responses from the testbed should adapt to the dynamics of underlying resources
29_NFR_ACC_Data_provided_as_requested	Non-Functional Requirements	SHOULD	Access	Testbed should provide data as requested by FIESTA according to the experimenter request
33_NFR_ACC_Scalability_data_collection	Non-Functional Requirements	MUST	Access	Scalability of data collection
36_NFR_PLA_Resources_produce_different_measurements	Non-Functional Requirements	MUST	FIESTA-IoT Platform	FIESTA-IoT must support resources that produce different measurements that can be linked or not
38_NFR_PLA_Diff_types_requests_processed	Non-Functional Requirements	MUST	FIESTA-IoT Platform	FIESTA-IoT must process event-based, periodic, and/or autonomous communication
49_NFR_PLA_Reliable_time_sync	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support testbeds in different time zones
50_NFR_PLA_FIESTA_scalable_extensible_upgradable	Non-Functional Requirements	MUST	FIESTA-IoT Platform	The FIESTA-IoT platform must be scalable, extensible and upgradable
54_NFR_INT_Interop_between_fiesta_testbeds	Non-Functional Requirements	MUST	Interoperability	Interoperability must be achieved between FIESTA-IoT and testbeds
56_NFR_INT_Support_diff_tested_data_policies	Non-Functional Requirements	SHOULD	Interoperability	FIESTA-IoT should support different testbed data caching policies
58_NFR_MEA_Link_measurements_resources	Non-Functional Requirements	MUST	Measurements	It must be possible to link the measurement with the resource (and its characteristics) that generated that measurement
60_NFR_MEA_Measurements_provide_metadata	Non-Functional Requirements	MUST	Measurements	Each collected measurement must provide metadata

UNIQUE ID	Requirement Type	Priority	Category	Description
61_NFR_MEA_Measurements_independant_resource	Non-Functional Requirements	MUST	Measurements	Collecting measurements without specifying the resource that produced it
62_NFR_MEA_Measurements_provide_phenomenon	Non-Functional Requirements	MUST	Measurements	Each measurement must state the phenomenon
64_NFR_RES_Resource_provide_characteristics	Non-Functional Requirements	MUST	Resource	Every resource must be characterised
65_NFR_RES_Resource_identified_code	Non-Functional Requirements	MUST	Resource	Every resource must be univocally identified by a code
67_NFR_RES_Experiment_participants_known	Non-Functional Requirements	SHOULD	Resource	Resources should be identified as experiment participants
72_NFR_SEM_Semantic_annotations_data	Non-Functional Requirements	MUST	Semantic Modelling	Semantic annotations of data
73_NFR_SEM_Mapping_semantic_model	Non-Functional Requirements	MUST	Semantic Modelling	Mapping between testbed and FIESTA-IoT semantic model must be ensured

Table 19 - Requirements by Stakeholder: WP4 team

UNIQUE ID	Requirement Type	Priority	Category	Description
01_FR_ACC_Resource_independent_info	Functional Requirements	MUST	Access	It must be possible to access information independently of which resource produced it
02_FR_ACC_Resources_available	Functional Requirements	SHOULD	Access	The experimenter should have the possibility to request that some specific resources are available
04_FR_ACC_Discover_info_independent_testbed	Functional Requirements	MUST	Access	It must be possible to get/discover information independently of the testbed they belong to
05_FR_ACC_Dynamic_discovery_resources	Functional Requirements	SHOULD	Access	FIESTA-IoT should provide the means for dynamic discovery of resources
07_FR_ACC_Discover_data_phenomenon	Functional Requirements	MUST	Access	It must be possible to get/discover measurements based on what phenomenon is observed
12_FR_ACC_Choose_metadata_each_measurement	Functional Requirements	SHOULD	Access	It should be possible to the experimenter to choose the metadata associated with the measurements
14_FR_ACC_Sample_specific_fractions_data	Functional Requirements	MUST	Access	It must be possible to sample a specific fraction of the data

UNIQUE ID	Requirement Type	Priority	Category	Description
15_FR_ACC_Discover_resources_by_characteristics	Functional Requirements	MUST	Access	It must be possible to get/discover resources based on characteristics
16_FR_ACC_Discover_measurements_by_metadata	Functional Requirements	MUST	Access	It must be possible to get/discover measurements based on metadata
17_FR_ACC_Experimenter_provide_feedback	Functional Requirements	COULD	Access	The experimenter could be able to provide feedback of measurements and/or resources (e.g. such as quarantine the measurements from a specific resource)
19_FR_SEC_Testbed_manage_priviledges	Functional Requirements	MUST	Security	Testbed providers must provide authorization and access control mechanisms to (secure) access services/resources
20_FR_SEC_Experimenter_single-sign-on	Functional Requirements	MUST	Security	Single-sign-on mechanism has to be in place
21_FR_SEC_Tool_manage_users	Functional Requirements	MUST	Security	FIESTA-IoT must have a tool to manage users and their respective access rights
23_NFR_ACC_Page_in_subrequests	Non-Functional Requirements	SHOULD	Access	When a large set of information is requested, it should be possible to page it into different sub-requests
24_NFR_ACC_Tools_planning_auto_tasks	Non-Functional Requirements	COULD	Access	FIESTA-IoT could provide tools to enable the planning of automated tasks
25_NFR_ACC_Set_response_Max_size	Non-Functional Requirements	SHOULD	Access	A response "Maximum Size" might be set
30_NFR_ACC_FIESTA_well_documented	Non-Functional Requirements	MUST	Access	FIESTA-IoT must be well documented.
31_NFR_ACC_Describe_IoT_services_and_applications	Non-Functional Requirements	SHOULD	Access	FIESTA-IoT should provide the means for describing/formulating IoT services and applications according to high-level descriptions
32_NFR_ACC_Provide_dev_deploy_manag_config_tools	Non-Functional Requirements	SHOULD	Access	FIESTA-IoT should provide development, deployment, management and configuration tools
34_NFR_PLA_Process_non_responded_requests	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should process non responded requests from experiments
35_NFR_PLA_Manage_resources_in_query_or_experiment	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should visualise and manage the resources entailed in a specific query or experiment
39_NFR_PLA_Info_testbed_agnostic_way	Non-Functional Requirements	MUST	FIESTA-IoT Platform	FIESTA-IoT must handle information in a testbed agnostic way

UNIQUE ID	Requirement Type	Priority	Category	Description
40_NFR_PLA_Process_feedbacks	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should process the measurements and / or resources feedback to validate the functioning of resources
44_NFR_PLA_Prioritization_of_services	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support prioritization of services
45_NFR_PLA_Orchestration_of_resources	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should orchestrate data from resources in order to automatically formulate composite workflows as required by user/researcher applications
52_NFR_PLA_Elasticity_abundance_computational_assets	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should have elasticity and abundance in terms of computational assets (especially storage and computation)
57_NFR_INT_Run_apps_services_interop	Non-Functional Requirements	SHOULD	Interoperability	FIESTA-IoT should be able to run applications and services in an interoperable manner
68_NFR_SEC_Support_certification_authority	Non-Functional Requirements	SHOULD	Security	FIESTA-IoT Platform should support federated identity management
69_NFR_SEC_Verify_authorise_user_actions	Non-Functional Requirements	MUST	Security	When a user wants to execute any action FIESTA-IoT has to verify that he is authorized to do this action
70_NFR_SEC_Different_profile_types	Non-Functional Requirements	MUST	Security	FIESTA-IoT must have different profile types (e.g. different kind of experimenters, researchers, etc.). Thereby grant different permissions
71_NFR_SEC_Privacy_collected_data	Non-Functional Requirements	COULD	Security	Privacy of collected data

Table 20 - Requirements by Stakeholder: WP3 & WP4 team

UNIQUE ID	Requirement Type	Priority	Category	Description
03_FR_ACC_Past_Present_info	Functional Requirements	MUST	Access	An experimenter must be able to access real-time information, historical information or a combination of both of them
06_FR_ACC_Querying_data_compositions	Functional Requirements	SHOULD	Access	FIESTA should enable querying of resources, including sensors streams, but also streams stemming from their already defined composition

UNIQUE ID	Requirement Type	Priority	Category	Description
08_FR_ACC_List_info_related_measurement	Functional Requirements	MUST	Access	It must be possible to list all information related to a measurement (metadata and characteristics of the resource that generated the measurement)
09_FR_ACC_List_info_related_resource	Functional Requirements	MUST	Access	It must be possible to list all information related to a resource instance (characteristics of the resource, and also measurements and metadata generated by the resource)
10_FR_ACC_Get_measurements_single_request	Functional Requirements	MUST	Access	It must be possible to get measurements from different testbeds with a single request
11_FR_ACC_Request_data_different_ways	Functional Requirements	MUST	Access	It must be possible for the experimenter to request for data in different ways (e.g. event-based, periodic, and/or autonomous)
13_FR_ACC_Expose_testbed_actuation_capabilities	Functional Requirements	COULD	Access	Testbed actuations could be exposed to experimenters through well-defined APIs
18_FR_SEC_Testbed_authentication_mechanisms	Functional Requirements	MUST	Security	Testbed providers must provide authentication mechanisms to (secure) access services/resources
27_NFR_ACC_Register_new_resources	Non-Functional Requirements	MUST	Access	The platform must allow external entities to register new resources
28_NFR_ACC_Response_delay_controlled	Non-Functional Requirements	SHOULD	Access	Response delay should remain under control independently of the complexity of the federated testbeds
37_NFR_PLA_Info_lifecycle_management	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support information (data) lifecycle management
41_NFR_PLA_Minimise_processing_delay	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	Processing delay has to be minimised when requesting information
42_NFR_PLA_Data_generated_from_processing_info	Non-Functional Requirements	COULD	FIESTA-IoT Platform	Data generated from processing information could be provided to the experimenters
43_NFR_PLA_Optimise_computational_assets	Non-Functional Requirements	COULD	FIESTA-IoT Platform	FIESTA-IoT infrastructures could optimise usage of computational assets (storage, computing cycle, resource utilisation, energy efficiency)
46_NFR_PLA_Homogeneous_classification	Non-Functional Requirements	MUST	FIESTA-IoT Platform	Homogeneous classification through different testbeds

UNIQUE ID	Requirement Type	Priority	Category	Description
47_NFR_PLA_Specify_compositon_data_streams	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	Ability to specify composition of data streams
48_NFR_PLA_Understand_not_used_info	Non-Functional Requirements	COULD	FIESTA-IoT Platform	FIESTA-IoT could try to understand which data is not being requested by experimenters
51_NFR_PLA_FIESTA_highly_reliable	Non-Functional Requirements	MUST	FIESTA-IoT Platform	FIESTA-IoT needs to be highly reliable
53_NFR_PLA_Execution_concurrent_services	Non-Functional Requirements	MUST	FIESTA-IoT Platform	The platform must support execution of concurrent Services including data generation and usage from the same resources
55_NFR_INT_App_develop_integration_resources	Non-Functional Requirements	SHOULD	Interoperability	FIESTA-IoT should enable scalable sharing, easy integration and deployment of distributed resources. Heterogeneous resources must be supported.
59_NFR_MEA_Link_measurements_metadata	Non-Functional Requirements	SHOULD	Measurements	It should be possible to link by its metadata different measurements that are related
63_NFR_RES_Link_resource_tesbed	Non-Functional Requirements	MUST	Resource	It must be possible to link the resource with the testbed where it is hosted
66_NFR_RES_Calculate_reputation_resource	Non-Functional Requirements	SHOULD	Resource	Reputation of resource provider should be automatically calculated

2.4.5 Fit Criteria View

This view provides the reader with a different set of attributes for each requirement, which enables the better understanding of what each of them is and how is it going to be validated in the context of FIESTA-IoT. So, this view provides only one table, with the ID, description, rational and Fit Criterion for each of the requirements.

Table 21 - Requirements by Fit Criterion

UNIQUE ID	Description	Rationale	Fit Criterion
01_FR_ACC_Resource_independent_info	It must be possible to access information independently of which resource produced it	Experimenters are primarily interested on the information not on the resource that produced it	Data access queries are performed without specifying any resource identifier
02_FR_ACC_Resources_available	The experimenter should have the possibility to request that some specific resources are available	Some experiments are useful if a set of resources are working at time and in a period of time	Experimenter is able to select resources that should be working during the duration of the experiment

UNIQUE ID	Description	Rationale	Fit Criterion
03_FR_ACC_Past_Present_info	An experimenter must be able to access real-time information, historical information or a combination of both of them	Data sets as well as data streams are relevant for experimentation	Subscriptions to data as well as queries indicating time periods are supported
04_FR_ACC_Discover_info_independent_testbed	It must be possible to get/discover information independently of the testbed they belong to	All resources from the different testbeds shall be exposed through a common interface	Data access queries are performed without specifying any resource or testbed identifier
05_FR_ACC_Dynamic_discovery_resources	FIESTA-IoT should provide the means for dynamic discovery of resources	The experimenter should be able to reach different resources dynamically	Experimenter discover resources without having prior knowledge of their existence
06_FR_ACC_Querying_data_compositions	FIESTA should enable querying of resources, including sensors streams, but also streams stemming from their already defined composition	The processing of data from FIESTA-IoT can generate new sets of data	Experimenter can request a data stream with data from multiple resources
07_FR_ACC_Discover_data_phenomenon	It must be possible to get/discover measurements based on what phenomenon is observed	Experimenter might be interested on those measurements about a physical quantities, expressed in some unit and with a particular value (e.g. temperature in degrees Celsius above 20)	Experimenter specifies which information she/he is interested in based on the phenomenon observed and its value
08_FR_ACC_List_info_related_measurement	It must be possible to list all information related to a measurement (metadata and characteristics of the resource that generated the measurement)	The experimenter must have access to all information related to a specific measurement	Experimenter has access to list all information related to a measurement
09_FR_ACC_List_info_related_resource	It must be possible to list all information related to a resource instance (characteristics of the resource, and also measurements and metadata generated by the resource)	The experimenter must have access to all information related to a specific resource	Experimenter has access to list all information related to a resource instance

UNIQUE ID	Description	Rationale	Fit Criterion
10_FR_ACC_Get_measurements_single_request	It must be possible to get measurements from different testbeds with a single request	All measurements from the resources in different testbeds shall be exposed through a common interface	One query provides information from different testbeds in the same format
11_FR_ACC_Request_data_different_ways	It must be possible for the experimenter to request for data in different ways (e.g. event-based, periodic, and/or autonomous)	The experimenter may ask to receive data in multiple ways, based on certain events, on each time period, etc.	Subscriptions and triggering services related to an experiment
12_FR_ACC_Choose_metadata_each_measurement	It should be possible to the experimenter to choose the metadata associated with the measurements	The experimenter must be able to choose which metadata he receives associated with the measurements	Experimenters can specify what they want to receive as metadata
13_FR_ACC_Expose_testbed_actuation_capabilities	Testbed actuations could be exposed to experimenters through well-defined APIs	Well-defined APIs are required to enable experimenters to use actuation capabilities of testbeds	Experiments have information of the actuation capabilities available in the federation and are able to use it
14_FR_ACC_Sample_specific_fractions_data	It must be possible to sample a specific fraction of the data	We do not need to get data from all resources, just a representative sample	Experimenter must limit the number of resources the data come from
15_FR_ACC_Discover_resources_by_characteristics	It must be possible to get/discover resources based on characteristics	Experimenters want to search for resources by specific & customized characteristics	Experimenter specifies which devices she/he is interested in based on the phenomena they capture, their characteristics (location, quality, services they expose, etc.) and gets a complete description of them
16_FR_ACC_Discover_measurements_by_metadata	It must be possible to get/discover measurements based on metadata	Experimenters want to search for measurements by specific & customized metadata parameters	Experimenter specifies which information she/he is interested in based on the characteristics (quality, periodicity etc.) of the sensor that generated it
17_FR_ACC_Experimenter_provide_feedback	The experimenter could be able to provide feedback of measurements and/or resources (e.g. Such as quarantine the measurements from a specific resource)	Sometimes a resource shows intermittent and unpredictable malfunctions	Experimenter is able to a feedback mechanism to report data and/or resources anomalies

UNIQUE ID	Description	Rationale	Fit Criterion
18_FR_SEC_Testbed_authentication_mechanisms	Testbed providers must provide authentication mechanisms to (secure) access services/resources	Testbed provider shall be able to define who is allowed to access the testbed	All interactions are authenticated and authorised before they are replied
19_FR_SEC_Testbed_manage_priviledges	Testbed providers must provide authorization and access control mechanisms to (secure) access services/resources	Testbed provider must be in full control of the resources that it provides and to whom they are provided	Individual testbeds are able to limit the resources, data-sets and data-streams that are exposed to FIESTA-IoT experimenters
20_FR_SEC_Experimenter_single-sign-on	Single-sign-on mechanism has to be in place	Experimenter must feel authentication and authorization is as transparent as possible for her	Experimenter registers to the platform once and obtain credentials that can be used in as many queries as necessary
21_FR_SEC_Tool_manage_users	FIESTA-IoT must have a tool to manage users and their respective access rights	It should be easy to create a user and administer her rights	API for experimenters to request credentials and for platform administrators to provide them and to manage their associated access rights
22_NFR_ACC_Distinguish_type_of_data	It must be clear to the experimenters what they are receiving, (e.g. measurements, metadata, resources, characteristics, etc.)	For experimenting and for maintaining the testbed it is important to easily and quickly distinguish the type of data provided	Experimenter is able to identify what is the information he received
23_NFR_ACC_Page_in_subrequests	When a large set of information is requested, it should be possible to page it into different sub-requests	Sometimes the amount of information to be requested is so large that it is better to divide the request in smaller sub-requests	The querying API supports the experimenter to access all the pieces to build the complete result

UNIQUE ID	Description	Rationale	Fit Criterion
24_NFR_ACC_Tools_planning_auto_tasks	FIESTA-IoT could provide tools to enable the planning of automated tasks	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	Experimenter is able to plan automated tasks
25_NFR_ACC_Set_response_Max_size	A response "Maximum Size" might be set	Sometimes the amount of information to be requested is so large that the response might be so heavy that the system is blocked	The result from a query is chopped into multiple pieces if it exceeds a given maximum size.
26_NFR_ACC_Response_adapt_dynamics_resources	Responses from the testbed should adapt to the dynamics of underlying resources	New resources might appear and others might disappear from the testbed and the responses from the testbed should adapt to this situations	The experimenter does not have to alter his/her experiment to keep receiving the information that best fits his/her demands independently of the dynamics of the testbed (nodes appearing, nodes dying, nodes losing wireless connection, etc.)
27_NFR_ACC_Register_new_resources	The platform must allow external entities to register new resources	Platform should be open to external parties contributing with new sensor and actuators	API to register new resources, services, data-sets or data-streams
28_NFR_ACC_Response_delay_controlled	Response delay should remain under control independently of the complexity of the federated testbeds	Experimenters need the testbed to answer their requests quickly. The time between the generation of a measurement and its reception from the experimenter needs to be low	Responses times are pre-defined

UNIQUE ID	Description	Rationale	Fit Criterion
29_NFR_ACC_Data_provided_as_requested	Testbed should provide data as requested by FIESTA according to the experimenter request	Experiments may need occasional data or historical data for the executing of experiments	Experimenter receives data as requested
30_NFR_ACC_FIESTA_well_documented	FIESTA-IoT must be well documented.	The experimenter needs to cope with the features of the system and it must be easy to deeply understand all the features and interfaces.	Experimenter is able to understand any features and interfaces provided by FIESTA-IoT. Documentation available on-line. 90% satisfaction from experimenters regarding FIESTA-IoT documentation
31_NFR_ACC_Describe_IoT_services_and_applications	FIESTA-IoT should provide the means for describing/formulating IoT services and applications according to high-level descriptions	End users need a high-level interface	Experimenter is able to use a high-level interface to describe applications and services
32_NFR_ACC_Provide_dev_deploy_manag_config_tools	FIESTA-IoT should provide development, deployment, management and configuration tools	Development tools ease development, while deployment and management tools ease the maintenance and operation of the IoT/cloud infrastructure	Experimenter is able to access and use experiment development tools
33_NFR_ACC_Scalability_data_collection	Scalability of data collection	FIESTA must be able to handle huge amounts of data	FIESTA-IoT is able to manage large data collections without over-burden the platform
34_NFR_PLA_Process_non_responded_requests	FIESTA-IoT should process non responded requests from experiments	FIESTA-IoT should have knowledge of the experimenters requests not being answered by FIESTA	FIESTA-IoT identifies experiments not receiving data
35_NFR_PLA_Manage_resources_in_query_or_experiment	FIESTA-IoT should visualise and manage the resources entailed in a specific query or experiment	FIESTA-IoT will be able to access the status of the resources (based on their semantic annotation), and accordingly provide a relevant visualization of properties such as status, manufacturer, type, geolocation and more	FIESTA-IoT is able access and process resource-oriented information

UNIQUE ID	Description	Rationale	Fit Criterion
36_NFR_PLA_Resources_produce_different_measurements	FIESTA-IoT must support resources that produce different measurements that can be linked or not	Some resources produce messages that mix information from the different sensors it is equipped with. Sometimes these different pieces of information are interrelated while others not	It is possible to access to individual pieces of information generated by the devices deployed in the federated testbeds
37_NFR_PLA_Info_lifecycle_management	FIESTA-IoT should support information (data) lifecycle management	Deal with the lifecycle of information (how to distinguish, if information (tag) is temporary not available or not valid anymore?)	FIESTA-IoT has information lifecycle management
38_NFR_PLA_Diff_types_requests_processed	FIESTA-IoT must process event-based, periodic, and/or autonomous communication	FIESTA-IoT must enable the experimenter to receive data in multiple ways, based on certain events, on each time period, etc.	FIESTA-IoT offers multiple ways to experimenters request data
39_NFR_PLA_Info_testbed_agnostic_way	FIESTA-IoT must handle information in a testbed agnostic way	FIESTA-IoT needs to provide data to experimenters independently of the testbed that produces it	FIESTA-IoT handles information independently of the testbed that produces it
40_NFR_PLA_Process_feedbacks	FIESTA-IoT should process the measurements and / or resources feedback to validate the functioning of resources	An experimenter can have suspicions or a bad-working resource. It can mark it for further processing	FIESTA processes feedback from experiments regarding measurements and resources
41_NFR_PLA_Minimise_processing_delay	Processing delay has to be minimised when requesting information	The delay for processing a measurement needs to be minimised	Experimenters need to receive their data in what they feel in an acceptable interval
42_NFR_PLA_Data_generated_from_processing_info	Data generated from processing information could be provided to the experimenters	The processing of information from FIESTA-IoT can generate new sets of data that can be of use for experimenters	Experimenter is able to access data sets produced by FIESTA-IoT by processing data from testbeds

UNIQUE ID	Description	Rationale	Fit Criterion
43_NFR_PLA_Optimise_computational_assets	FIESTA-IoT infrastructures could optimise usage of computational assets (storage, computing cycle, resource utilisation, energy efficiency)	This is the key prerequisite for economically viable IoT service deployments; this is in line with cloud economics pursued by a service provider	Algorithms use by FIESTA-IoT are aware of optimisation of the resources used and energy efficiency
44_NFR_PLA_Prioritization_of_services	FIESTA-IoT should support prioritization of services	In case of time-sensitive services the system needs to assure that important services are prioritized	FIESTA-IoT supports the execution of services with different priorities
45_NFR_PLA_Orchestration_of_resources	FIESTA-IoT should orchestrate data from resources in order to automatically formulate composite workflows as required by user/researcher applications	User applications include composite queries, but also actuating workflows; the on-demand nature of the platform requires the intelligent selection and combination/orchestration of multiple resources	FIESTA-IoT orchestrate data from resources in order to optimise the requests from experiments
46_NFR_PLA_Homogeneous_classification	Homogeneous classification through different testbeds	A global classification of resources attending different points of view (quality, measurement error, indoor or outdoor, etc.) will be useful for cross-site experiments	Devices are catalogued using the same rules and models across the different underlying testbeds
47_NFR_PLA_Specify_compositon_data_streams	Ability to specify composition of data streams	Some experiments will benefit from an in-network composition of data streams	Experimenter is able to specify a data stream produced by the composition of data streams
48_NFR_PLA_Understand_not_used_info	FIESTA-IoT could try to understand which data is not being requested by experimenters	By analysing data that is not being requested, FIESTA-IoT can provide information in terms of efficiency of the testbeds	FIESTA-IoT identifies data provided by testbeds that is not used by any experiment
49_NFR_PLA_Reliable_time_sync	FIESTA-IoT should support testbeds in different time-zones	FIESTA must be synchronized with the testbeds providing data in different time zones	FIESTA-IoT supports time synchronization with testbeds

UNIQUE ID	Description	Rationale	Fit Criterion
50_NFR_PLA_FIESTA_scalable_extensible_upgradable	The FIESTA-IoT platform must be scalable, extensible and upgradable	Testbeds can grow; New testbeds can be added	New testbeds added during Open Calls
51_NFR_PLA_FIESTA_highly_reliable	FIESTA-IoT needs to be highly reliable	FIESTA-IoT infrastructure must be able to guarantee reliability levels defined through pre-established SLAs	>90% of experimenter's satisfaction regarding FIESTA-IoT reliability
52_NFR_PLA_Elasticity_abundance_computational_assets	FIESTA-IoT should have elasticity and abundance in terms of computational assets (especially storage and computation)	This stems directly from the cloud nature of the FIESTA-IoT platform	FIESTA-IoT is able to store data from experiments during the requested period and process any experiment that did not expire
53_NFR_PLA_Execution_concurrent_services	The platform must support execution of concurrent Services including data generation and usage from the same resources	Several experimenters must be able to use the information generated by the same resource at any time	Multiple experimenters access the same service at the same time (e.g. are subscribed to the same kind of information and receive the notifications concurrently or request the same data-set at the same time)
54_NFR_INT_Interop_between_fiesta_testbeds	Interoperability must be achieved between FIESTA-IoT and testbeds	Formal (machine-readable) language must be used inside the testbed interfaces	API for testbeds to provide services requested by the FIESTA-IoT platform
55_NFR_INT_App_develop_integration_resources	FIESTA-IoT should enable scalable sharing, easy integration and deployment of distributed resources. Heterogeneous resources must be supported.	Application development and integration involves multiple distributed and heterogeneous resources	FIESTA-IoT is able to handle data from heterogeneous resources
56_NFR_INT_Support_diff_tested_data_policies	FIESTA-IoT should support different testbed data caching policies	There are testbeds that allow FIESTA-IoT to store a copy of all testbed data, others that don't allow FIESTA-IoT to cache its data and also testbed that don't keep historical data	FIESTA-IoT supports the integration of testbeds with different caching policies

UNIQUE ID	Description	Rationale	Fit Criterion
57_NFR_INT_Run_apps_services_interop	FIESTA-IoT should be able to run applications and services in an interoperable manner	The problem is to provide a framework, a set of scenarios where these applications should be developed in harmony, in an interoperable way and in a way that responses to the real needs of organization and people	FIESTA-IoT provides interoperability between the applications and services that it runs
58_NFR_MEA_Link_measurements_resources	It must be possible to link the measurement with the resource (and its characteristics) that generated that measurement	Context of the measurements are also relevant to an experimenter	It is possible to link the information to the originator of the information
59_NFR_MEA_Link_measurements_metadata	It should be possible to link by its metadata different measurements that are related	Information generated by different sources or by the same source at different situation (time, location, context) can be interrelated and these relations might be interesting for an experimenter	It is possible to link different measurements that are related by metadata
60_NFR_MEA_Measurements_provide_metadata	Each collected measurement must provide metadata	The measurements need to provide metadata (e.g. timestamp, unit, location, etc.)	Information provided to the experimenter includes added-value metadata in addition to the actual value of the sensed phenomenon
61_NFR_MEA_Measurements_independant_resource	Collecting measurements without specifying the resource that produced it	Experimenters are primarily interested on the information not on the resource that produced it	Data access queries are performed without specifying any resource identifier
62_NFR_MEA_Measurements_provide_phenomenon	Each measurement must state the phenomenon	The phenomenon of each collected measurement must be known	Experimenter is able to identify the phenomenon corresponding to each measurement received
63_NFR_RES_Link_resource_tesbed	It must be possible to link the resource with the testbed where it is hosted	Since resources will come from multiple testbed providers and IoT providers it should be possible to track down who is the responsible for each of them	Resources' metadata includes the concept of owner

UNIQUE ID	Description	Rationale	Fit Criterion
64_NFR_RES_Resource_provide_characteristics	Every resource must be characterised	The resource needs to provide its own characteristics (e.g. static/mobile, indoor/outdoor, etc.)	FIESTA-IoT knows the characteristics of each resource
65_NFR_RES_Resource_identified_code	Every resource must be univocally identified by a code	It is fundamental to avoid ambiguity	Resources are provided a unique identifier within the FIESTA-IoT platform
66_NFR_RES_Calculate_reputation_resource	Reputation of resource provider should be automatically calculated	Complexity of the testbeds made it hard to carry manual management of the infrastructure	Resources' metadata includes the concept of reputation. All FIESTA-IoT resources are assigned a reputation value
67_NFR_RES_Experiment_participants_known	Resources should be identified as experiment participants	It is important to know which resources are participating in each of the experiments	FIESTA-IoT identifies all resources that participate or participated in each experiment
68_NFR_SEC_Support_certification_authority	FIESTA-IoT Platform should support federated identity management	Federate over identity providers of different testbeds. Authentication in one domain, allows authentication across FIESTA-IoT testbeds	Experimenters identities are valid for making queries that involves multiple testbeds to be resolved
69_NFR_SEC_Verify_authorise_user_actions	When a user wants to execute any action FIESTA-IoT has to verify that he is authorized to do this action	FIESTA-IoT must have full control of the data that it provides and to whom they are provided	All queries are authenticated and authorised before they are replied
70_NFR_SEC_Different_profile_types	FIESTA-IoT must have different profile types (e.g. different kind of experimenters, researchers, etc.). Thereby grant different permissions	Testbeds providers may be interested in a measurement of a specific resource, which cannot happen to experimenter or crowdsourcing type because security issues	All queries are authorised before they are replied
71_NFR_SEC_Privacy_collected_data	Privacy of collected data	The collected data is personal in nature, and thus its privacy could be ensured	FIESTA-IoT has authorization mechanisms that ensure data privacy
72_NFR_SEM_Semantic_annotations_data	Semantic annotations of data	Semantic annotation of data helps in interoperability	FIESTA-IoT provides semantic interoperability between measurements from testbeds
73_NFR_SEM_Mapping_semantic_model	Mapping between testbed and FIESTA-IoT semantic model must be ensured	Information from testbeds must be described according to the FIESTA-IoT semantic Model	FIESTA-IoT handles data from testbeds without any information regarding tesbeds' semantic models

2.4.6 View by Dependencies

Another important view to highlight is the dependencies between requirements. In this view, tables provide little added value as; this is because they do not show the relations between requirements, so this is shown in the form of a diagram instead. This diagram, depicted in Figure 4, shows only the requirements that depend or are dependent of other requirements.

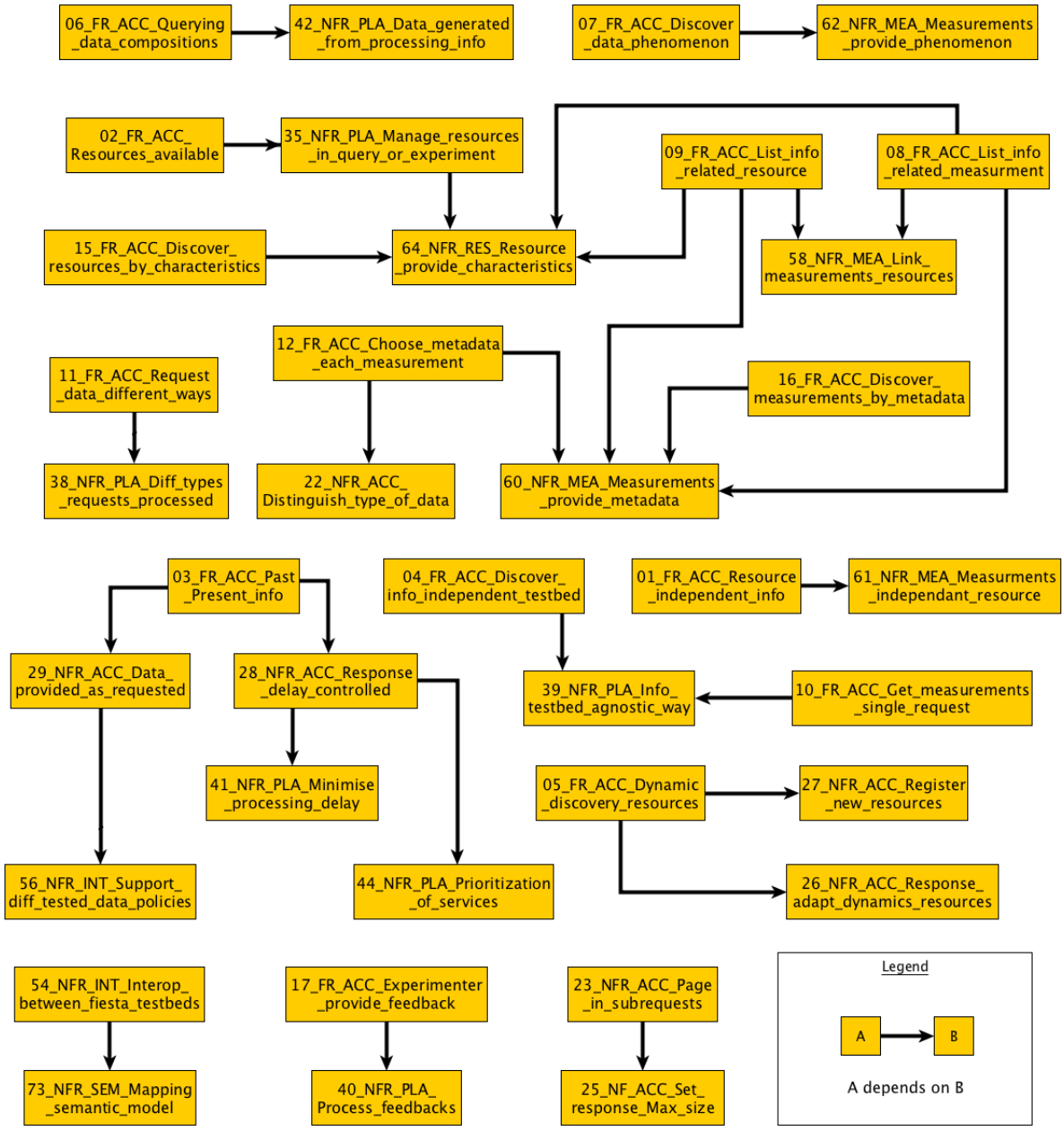


Figure 4 - FIESTA-IoT requirements: Dependencies View

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APPENDIX I – FIESTA-IOT REQUIREMENTS TABLE

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
01_FR_ACC_Resource_independent_info	Functional Requirements	MUST	Access	It must be possible to access information independently of which resource produced it	Experimenters are primarily interested on the information not on the resource that produced it	UC	Data access queries are performed without specifying any resource identifier	61_NFR_MEA_Measurements_independant_resource	WP 4 team
02_FR_ACC_Resources_available	Functional Requirements	SHOULD	Access	The experimenter should have the possibility to request that some specific resources are available	Some experiments are useful if a set of resources are working at time and in a period of time	SDR	Experimenter is able to select resources that should be working during the duration of the experiment	35_NFR_PLA_Manage_resources_in_query_or_experiment	WP 4 team
03_FR_ACC_Past_Present_info	Functional Requirements	MUST	Access	An experimenter must be able to access real-time information, historical information or a combination of both of them	Data sets as well as data streams are relevant for experimentation	UC, IoT-A, NEC	Subscriptions to data as well as queries indicating time periods are supported	28_NFR_ACC_Response_delay_controlled; 29_NFR_ACC_Data_provided_as_requested	WP 3 team & WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
04_FR_ACC_Discover_info_independent_testbed	Functional Requirements	MUST	Access	It must be possible to get/discover information independently of the testbed they belong to	All resources from the different testbeds shall be exposed through a common interface	UC	Data access queries are performed without specifying any resource or testbed identifier	39_NFR_PLA_Info_testbed_agnostic_way	WP 4 team
05_FR_ACC_Dynamic_discovery_resources	Functional Requirements	SHOULD	Access	FIESTA-IoT should provide the means for dynamic discovery of resources	The experimenter should be able to reach different resources dynamically	OpenIoT	Experimenter discover resources without having prior knowledge of their existence	27_NFR_ACC_Register_new_resources; 26_NFR_ACC_Response_adapt_dynamics_resources.	WP 4 team
06_FR_ACC_Querying_data_compositions	Functional Requirements	SHOULD	Access	FIESTA should enable querying of resources, including sensors streams, but also streams stemming from their already defined composition	The processing of data from FIESTA-IoT can generate new sets of data	OpenIoT	Experimenter can request a data stream with data from multiple resources	42_NFR_PLA_Data_generated_from_processing_info	WP 3 team & WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
07_FR_ACC_Discover_data_phenomenon	Functional Requirements	MUST	Access	It must be possible to get/discover measurements based on what phenomenon is observed	Experimenter might be interested on those measurements about a physical quantities, expressed in some unit and with a particular value (e.g. temperature in degrees Celsius above 20)	UC, UNIS	Experimenter specifies which information she/he is interested in based on the phenomenon observed and its value	62_NFR_MEA_Measurements_provide_phenomenon	WP 4 team
08_FR_ACC_List_info_related_measurement	Functional Requirements	MUST	Access	It must be possible to list all information related to a measurement (metadata and characteristics of the resource that generated the measurement)	The experimenter must have access to all information related to a specific measurement	UC, IoT-A, FED4FIRE, OpenIoT	Experimenter has access to list all information related to a measurement	58_NFR_MEA_Link_measurements_resources; 60_NFR_MEA_Measurements_provide_metadata; 64_NFR_RES_Resource_provide_characteristics	WP 3 team & WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
09_FR_ACC_List_info_related_resource	Functional Requirements	MUST	Access	It must be possible to list all information related to a resource instance (characteristics of the resource, and also measurements and metadata generated by the resource)	The experimenter must have access to all information related to a specific resource	UC, IoT-A, FED4FIRE, OpenIoT	Experimenter has access to list all information related to a resource instance	58_NFR_MEA_Link_measurements_resources; 60_NFR_MEA_Measurements_provide_metadata 64_NFR_RES_Resource_provide_characteristics;	WP 3 team & WP 4 team
10_FR_ACC_Get_measurements_single_request	Functional Requirements	MUST	Access	It must be possible to get measurements from different testbeds with a single request	All measurements from the resources in different testbeds shall be exposed through a common interface	UC	One query provides information from different testbeds in the same format	39_NFR_PLA_Info_testbed_agnostic_way	WP 3 team & WP 4 team
11_FR_ACC_Request_data_different_ways	Functional Requirements	MUST	Access	It must be possible for the experimenter to request for data in different ways (e.g. event-based, periodic, and/or autonomous)	The experimenter may ask to receive data in multiple ways, based on certain events, on each time period, etc.	NEC, IoT-A	Subscriptions and triggering services related to an experiment	38_NFR_PLA_Diff_types_requests_processed	WP 3 team & WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
12_FR_ACC_Choose_metadata_each_measurement	Functional Requirements	SHOULD	Access	It should be possible for the experimenter to choose the metadata associated with the measurements	The experimenter must be able to choose which metadata he receives associated with the measurements	OpenIoT	Experimenters can specify what they want to receive as metadata	22_NFR_ACC_Distinguish_type_of_data; 60_NFR_MEA_Measurements_provide_metadata	WP 4 team
13_FR_ACC_Expose_testbed_actuation_capabilities	Functional Requirements	COULD	Access	Testbed actuations could be exposed to experimenters through well-defined APIs	Well-defined APIs are required to enable experimenters to use actuation capabilities of testbeds	UNIS	Experiments have information of the actuation capabilities available in the federation and are able to use it		WP 3 team & WP 4 team
14_FR_ACC_Sample_specific_fractions_data	Functional Requirements	MUST	Access	It must be possible to sample a specific fraction of the data	We do not need to get data from all resources, just a representative sample	INRIA	Experimenter must limit the number of resources the data come from		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
15_FR_ACC_Discover_resources_by_characteristics	Functional Requirements	MUST	Access	It must be possible to get/discover resources based on characteristics	Experimenters want to search for resources by specific & customized characteristics	UC, UNIS, NEC, INRIA	Experimenter specifies which devices she/he is interested in based on the phenomena they capture, their characteristics (location, quality, services they expose, etc.) and gets a complete description of them	64_NFR_RES_Resource_provide_characteristics	WP 4 team
16_FR_ACC_Discover_measurements_by_metadata	Functional Requirements	MUST	Access	It must be possible to get/discover measurements based on metadata	Experimenters want to search for measurements by specific & customized metadata parameters	UC, UNIS, NEC, INRIA	Experimenter specifies which information she/he is interested in based on the characteristics (quality, periodicity etc.) of the sensor that generated it	60_NFR_MEA_Measurements_provide_metadata	WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
17_FR_ACC_Experimenter_provide_feedback	Functional Requirements	COULD	Access	The experimenter could be able to provide feedback of measurements and/or resources (e.g. such as quarantine the measurements from a specific resource)	Sometimes a resource shows intermittent and unpredictable malfunctions	SDR	Experimenter is able to a feedback mechanism to report data and/or resources anomalies	40_NFR_PLA_Process_feedbacks	WP 4 team
18_FR_SEC_Testbed_authentication_mechanisms	Functional Requirements	MUST	Security	Testbed providers must provide authentication mechanisms to (secure) access services/resources	Testbed provider shall be able to define who is allowed to access the testbed	UC, IoT-A, OpenIoT	All interactions are authenticated and authorised before they are replied		WP 3 team & WP 4 team
19_FR_SEC_Testbed_manage_priviledges	Functional Requirements	MUST	Security	Testbed providers must provide authorization and access control mechanisms to (secure) access services/resources	Testbed provider must be in full control of the resources that it provides and to whom they are provided	UC	Individual testbeds are able to limit the resources, data-sets and data-streams that are exposed to FIESTA-IoT experimenters		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
20_FR_SEC_Experimenter_single-sign-on	Functional Requirements	MUST	Security	Single-sign-on mechanism has to be in place	Experimenter must feel authentication and authorization is as transparent as possible for her	UC	Experimenter registers to the platform once and obtain credentials that can be used in as many queries as necessary		WP 4 team
21_FR_SEC_Tool_manage_users	Functional Requirements	MUST	Security	FIESTA-IoT must have a tool to manage users and their respective access rights	It should be easy to create a user and administer her rights	UC, NEC	API for experimenters to request credentials and for platform administrators to provide them and to manage their associated access rights		WP 4 team
22_NFR_ACC_Distinguish_type_of_data	Non-Functional Requirements	MUST	Access	It must be clear to the experimenters what they are receiving, (e.g. measurements, metadata, resources, characteristics, etc.)	For experimenting and for maintaining the testbed it is important to easily and quickly distinguish the type of data provided	NEC	Experimenter is able to identify what type is the information he received		WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
23_NFR_ACC_Page_in_sub requests	Non-Functional Requirements	SHOULD	Access	When a large set of information is requested, it should be possible to page it into different sub-requests	Sometimes the amount of information to be requested is so large that it is better to divide the request in smaller sub-requests	UC, NEC	The querying API supports the experimenter to access all the pieces to build the complete result	25_NFR_ACC_Set_response_Max_size	WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
24_NFR_ACC_Tools_planning_auto_tasks	Non-Functional Requirements	COULD	Access	FIESTA-IoT could provide tools to enable the planning of automated tasks	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	IoT-A	Experimenter is able to plan automated tasks		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
25_NFR_ACC_Set_response_Max_size	Non-Functional Requirements	SHOULD	Access	A response "Maximum Size" might be set	Sometimes the amount of information to be requested is so large that the response might be so heavy that the system is blocked	UC	The result from a query is chopped into multiple pieces if it exceeds a given maximum size		WP 4 team
26_NFR_ACC_Response_adapt_dynamics_resources	Non-Functional Requirements	SHOULD	Access	Responses from the testbed should adapt to the dynamics of underlying resources	New resources might appear and others might disappear from the testbed and the responses from the testbed should adapt to this situations	UC	The experimenter does not have to alter his/her experiment to keep receiving the information that best fits his/her demands independently of the dynamics of the testbed (nodes appearing, nodes dying, nodes losing wireless connection, etc.)		WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
27_NFR_ACC_Register_new_resources	Non-Functional Requirements	MUST	Access	The platform must allow external entities to register new resources	Platform should be open to external parties contributing with new sensor and actuators	NEC, UC	API to register new resources, services, data-sets or data-streams		WP 3 team & WP 4 team
28_NFR_ACC_Response_delay_controlled	Non-Functional Requirements	SHOULD	Access	Response delay should remain under control independently of the complexity of the federated testbeds	Experimenters need the testbed to answer their requests quickly. The time between the generation of a measurement and its reception from the experimenter needs to be low	UC, NEC, Open-IoT	Responses times are pre-defined	41_NFR_PLA_Minimise_processing_delay 44_NFR_PLA_Prioritization_of_services	WP 3 Team & WP 4 team
29_NFR_ACC_Data_provided_as_requested	Non-Functional Requirements	SHOULD	Access	Testbed should provide data as requested by FIESTA according to the experimenter request	Experiments may need occasional data or historical data for the executing of experiments	UC, IoT-A	Experimenter receives data as requested	56_NFR_INT_Support_diff_tested_data_policies	WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
30_NFR_ACC_FIESTA_well_documented	Non-Functional Requirements	MUST	Access	FIESTA-IoT must be well documented.	The experimenter needs to cope with the features of the system and it must be easy to deeply understand all the features and interfaces.	NEC	Experimenter is able to understand any features and interfaces provided by FIESTA-IoT. Documentation available on-line. 90% satisfaction from experimenters regarding FIESTA-IoT documentation		WP 4 team
31_NFR_ACC_Describe_IoT_services_and_applications	Non-Functional Requirements	SHOULD	Access	FIESTA-IoT should provide the means for describing/formulating IoT services and applications according to high-level descriptions	End users need a high-level interface	OpenIoT	Experimenter is able to use a high-level interface to describe applications and services		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
32_NFR_ACC_Provide_dev_deploy_manag_config_tools	Non-Functional Requirements	SHOULD	Access	FIESTA-IoT should provide development, deployment, management and configuration tools	Development tools ease development, while deployment and management tools ease the maintenance and operation of the IoT/cloud infrastructure	OpenIoT	Experimenter is able to access and use experiment development tools		WP 4 team
33_NFR_ACC_Scalability_data_collection	Non-Functional Requirements	MUST	Access	Scalability of data collection	FIESTA must be able to handle huge amounts of data	INRIA	FIESTA-IoT is able to manage large data collections without over-burden the platform		WP 3 team
34_NFR_PLA_Process_non_responded_requests	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should process non responded requests from experiments	FIESTA-IoT should have knowledge of the experimenters requests not being answered by FIESTA	Fed4FIRE	FIESTA-IoT identifies experiments not receiving data		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
35_NFR_PLA_Manage_resources_in_query_or_experiment	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should visualise and manage the resources entailed in a specific query or experiment	FIESTA-IoT will be able to access the status of the resources (based on their semantic annotation), and accordingly provide a relevant visualization of properties such as status, manufacturer, type, geolocation and more	SDR, OpenIoT	FIESTA-IoT is able access and process resource-oriented information	64_NFR_RES_Resource_provide_characteristics	WP 4 team
36_NFR_PLA_Resources_produce_different_measurements	Non-Functional Requirements	MUST	FIESTA-IoT Platform	FIESTA-IoT must support resources that produce different measurements that can be linked or not	Some resources produce messages that mix information from the different sensors it is equipped with. Sometimes these different pieces of information are interrelated while others not	UC, OpenIoT	It is possible to access to individual pieces of information generated by the devices deployed in the federated testbeds		WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
37_NFR_PLA_Info_lifecycle_management	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support information (data) lifecycle management	Deal with the lifecycle of information (how to distinguish, if information (tag) is temporary not available or not valid anymore?)	IoT-A	FIESTA-IoT has information lifecycle management		WP 3 team & WP 4 team
38_NFR_PLA_Diff_types_requests_processed	Non-Functional Requirements	MUST	FIESTA-IoT Platform	FIESTA-IoT must process event-based, periodic, and/or autonomous communication	FIESTA-IoT must enable the experimenter to receive data in multiple ways, based on certain events, on each time period, etc.	NEC, IoT-A	FIESTA-IoT offers multiple ways to experimenters request data		WP 3 team
39_NFR_PLA_Info_testbed_agnostic_way	Non-Functional Requirements	MUST	FIESTA-IoT Platform	FIESTA-IoT must handle information in a testbed agnostic way	FIESTA-IoT needs to provide data to experimenters independently of the testbed that produces it	NEC	FIESTA-IoT handles information independently of the testbed that produces it		WP 4 team
40_NFR_PLA_Process_feedbacks	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should process the measurements and / or resources feedback to validate the functioning of resources	An experimenter can have suspicions or a bad-working resource. It can mark it for further processing	SDR	FIESTA processes feedback from experiments regarding measurements and resources		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
41_NFR_PLA_Minimise_processing_delay	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	Processing delay has to be minimised when requesting information	The delay for processing a measurement needs to be minimised	UC	Experimenters need to receive their data in what they feel in an acceptable interval		WP 3 Team & WP 4 team
42_NFR_PLA_Data_generated_from_processing_info	Non-Functional Requirements	COULD	FIESTA-IoT Platform	Data generated from processing information could be provided to the experimenters	The processing of information from FIESTA-IoT can generate new sets of data that can be of use for experimenters	OpenIoT	Experimenter is able to access data sets produced by FIESTA-IoT by processing data from testbeds		WP 3 team & WP 4 team
43_NFR_PLA_Optimise_computational_assets	Non-Functional Requirements	COULD	FIESTA-IoT Platform	FIESTA-IoT infrastructures could optimise usage of computational assets (storage, computing cycle, resource utilisation, energy efficiency)	This is the key prerequisite for economically viable IoT service deployments; this is in line with cloud economics pursued by a service provider	OpenIoT, IoT-A	Algorithms use by FIESTA-IoT are aware of optimisation of the resources used and energy efficiency		WP 3 Team & WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
44_NFR_PLA_Prioritization_of_services	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support prioritization of services	In case of time-sensitive services the system needs to assure that important services are prioritized	IoT-A	FIESTA-IoT supports the execution of services with different priorities		WP 4 team
45_NFR_PLA_Orchestration_of_resources	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should orchestrate data from resources in order to automatically formulate composite workflows as required by user/researcher applications	User applications include composite queries, but also actuating workflows; the on-demand nature of the platform requires the intelligent selection and combination/orchestration of multiple resources	OpenIoT	FIESTA-IoT orchestrate data from resources in order to optimise the requests from experiments		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
46_NFR_PLA_Homogeneous_classification	Non-Functional Requirements	MUST	FIESTA-IoT Platform	Homogeneous classification through different testbeds	A global classification of resources attending different points of view (quality, measurement error, indoor or outdoor, etc.) will be useful for cross-site experiments	SDR, UC	Devices are catalogued using the same rules and models across the different underlying testbeds		WP 3 team & WP 4 team
47_NFR_PLA_Specify_compositon_data_streams	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	Ability to specify composition of data streams	Some experiments will benefit from an in-network composition of data streams	INRIA	Experimenter is able to specify a data stream produced by the composition of data streams		WP 3 team & WP 4 team
48_NFR_PLA_Understand_not_used_info	Non-Functional Requirements	COULD	FIESTA-IoT Platform	FIESTA-IoT could try to understand which data is not being requested by experimenters	By analysing data that is not being requested, FIESTA-IoT can provide information in terms of efficiency of the testbeds	Fed4FIRE	FIESTA-IoT identifies data provided by testbeds that is not used by any experiment		WP 3 team & WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
49_NFR_PLA_Reliable_time_sync	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should support testbeds in different time zones	FIESTA must be synchronized with the testbeds providing data in different time zones	IoT-A	FIESTA-IoT supports time synchronization with testbeds		WP 3 team
50_NFR_PLA_FIESTA_scalable_extensible_upgradable	Non-Functional Requirements	MUST	FIESTA-IoT Platform	The FIESTA-IoT platform must be scalable, extensible and upgradable	Testbeds can grow; New testbeds can be added	UC, IoT-A, NEC	New testbeds added during Open Calls		WP 3 team
51_NFR_PLA_FIESTA_highly_reliable	Non-Functional Requirements	MUST	FIESTA-IoT Platform	FIESTA-IoT needs to be highly reliable	FIESTA-IoT infrastructure must be able to guarantee reliability levels defined through pre-established SLAs	NEC	>90% of experimenter's satisfaction regarding FIESTA-IoT reliability		WP 3 team & WP 4 team
52_NFR_PLA_Elasticity_abundance_computational_assets	Non-Functional Requirements	SHOULD	FIESTA-IoT Platform	FIESTA-IoT should have elasticity and abundance in terms of computational assets (especially storage and computation)	This stems directly from the cloud nature of the FIESTA-IoT platform	OpenIoT	FIESTA-IoT is able to store data from experiments during the requested period and process any experiment that did not expire		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
53_NFR_PLA_Execution_concurrent_services	Non-Functional Requirements	MUST	FIESTA-IoT Platform	The platform must support execution of concurrent Services including data generation and usage from the same resources	Several experimenters must be able to use the information generated by the same resource at any time	UC	Multiple experimenters access the same service at the same time (e.g. are subscribed to the same kind of information and receive the notifications concurrently or request the same data-set at the same time)		WP 3 Team & WP 4 team
54_NFR_INT_Interop_between_fiesta_testbeds	Non-Functional Requirements	MUST	Interoperability	Interoperability must be achieved between FIESTA-IoT and testbeds	Formal (machine-readable) language must be used inside the testbed interfaces	UC	API for testbeds to provide services requested by the FIESTA-IoT platform	73_NFR_SEM_Mapping_semantic_model	WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
55_NFR_INT_App_develop_integration_resources	Non-Functional Requirements	SHOULD	Interoperability	FIESTA-IoT should enable scalable sharing, easy integration and deployment of distributed resources. Heterogeneous resources must be supported.	Application development and integration involves multiple distributed and heterogeneous resources	OpenIoT	FIESTA-IoT is able to handle data from heterogeneous resources		WP 3 team & WP 4 team
56_NFR_INT_Support_diff_tested_data_policies	Non-Functional Requirements	SHOULD	Interoperability	FIESTA-IoT should support different testbed data caching policies	There are testbeds that allow FIESTA-IoT to store a copy of all testbed data, others that don't allow FIESTA-IoT to cache its data and also testbed that don't keep historical data	INRIA	FIESTA-IoT supports the integration of testbeds with different caching policies		WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
57_NFR_INT_Run_apps_services_interop	Non-Functional Requirements	SHOULD	Interoperability	FIESTA-IoT should be able to run applications and services in an interoperable manner	The problem is to provide a framework, a set of scenarios where these applications should be developed in harmony, in an interoperable way and in a way that responses to the real needs of organization and people	IoT-A	FIESTA-IoT provides interoperability between the applications and services that it runs		WP 4 team
58_NFR_MEA_Link_measurements_resources	Non-Functional Requirements	MUST	Measurements	It must be possible to link the measurement with the resource (and its characteristics) that generated that measurement	Context of the measurements are also relevant to an experimenter	UC	It is possible to link the information to the originator of the information		WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
59_NFR_MEA_Link_measurements_metadata	Non-Functional Requirements	SHOULD	Measurements	It should be possible to link by its metadata different measurements that are related	Information generated by different sources or by the same source at different situation (time, location, context) can be interrelated and these relations might be interesting for an experimenter	UC	It is possible to link different measurements that are related by metadata		WP 3 team & WP 4 team
60_NFR_MEA_Measurements_provide_metadata	Non-Functional Requirements	MUST	Measurements	Each collected measurement must provide metadata	The measurements need to provide metadata (e.g. timestamp, unit, location, etc.)	NEC, UC, SDR	Information provided to the experimenter includes added-value metadata in addition to the actual value of the sensed phenomenon		WP 3 team
61_NFR_MEA_Measurements_independant_resource	Non-Functional Requirements	MUST	Measurements	Collecting measurements without specifying the resource that produced it	Experimenters are primarily interested on the information not on the resource that produced it	UC	Data access queries are performed without specifying any resource identifier		WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
62_NFR_MEA_Measurements_provide_phenomenon	Non-Functional Requirements	MUST	Measurements	Each measurement must state the phenomenon	The phenomenon of each collected measurement must be known	UI	Experimenter is able to identify the phenomenon corresponding to each measurement received		WP 3 team
63_NFR_RES_Link_resource_tesbed	Non-Functional Requirements	MUST	Resource	It must be possible to link the resource with the testbed where it is hosted	Since resources will come from multiple testbed providers and IoT providers it should be possible to track down who is the responsible for each of them	UC	Resources' metadata includes the concept of owner		WP 3 team & WP 4 team
64_NFR_RES_Resource_provide_characteristics	Non-Functional Requirements	MUST	Resource	Every resource must be characterised	The resource needs to provide its own characteristics (e.g. static/mobile, indoor/outdoor, etc.)	UI	FIESTA-IoT knows the characteristics of each resource		WP 3 team
65_NFR_RES_Resource_identified_code	Non-Functional Requirements	MUST	Resource	Every resource must be univocally identified by a code	It is fundamental to avoid ambiguity	NEC, UC, OpenIoT	Resources are provided a unique identifier within the FIESTA-IoT platform		WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
66_NFR_RES_Calculate_reputation_resource	Non-Functional Requirements	SHOULD	Resource	Reputation of resource provider should be automatically calculated	Complexity of the testbeds made it hard to carry manual management of the infrastructure	UC	Resources' metadata includes the concept of reputation. All FIESTA-IoT resources are assigned a reputation value		WP 3 Team & WP 4 team
67_NFR_RES_Experiment_participants_known	Non-Functional Requirements	SHOULD	Resource	Resources should be identified as experiment participants	It is important to know which resources are participating in each of the experiments	INRIA	FIESTA-IoT identifies all resources that participate or participated in each experiment		WP 3 team
68_NFR_SEC_Support_certification_authority	Non-Functional Requirements	SHOULD	Security	FIESTA-IoT Platform should support federated identity management	Federate over identity providers of different testbeds. Authentication in one domain, allows authentication across FIESTA-IoT testbeds	UC	Experimenters identities are valid for making queries that involves multiple testbeds to be resolved		WP 4 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
69_NFR_SEC_Verify_authorise_user_actions	Non-Functional Requirements	MUST	Security	When a user wants to execute any action FIESTA-IoT has to verify that he is authorized to do this action	FIESTA-IoT must have full control of the data that it provides and to whom they are provided	UC	All queries are authenticated and authorised before they are replied		WP 4 team
70_NFR_SEC_Different_profile_types	Non-Functional Requirements	MUST	Security	FIESTA-IoT must have different profile types (e.g. different kind of experimenters, researchers, etc.). Thereby grant different permissions	Testbeds providers may be interested in a measurement of a specific resource, which cannot happen to experimenter or crowdsourcing type because security issues	UC, NEC, IoT-A	All queries are authorised before they are replied		WP 4 team
71_NFR_SEC_Privacy_collected_data	Non-Functional Requirements	COULD	Security	Privacy of collected data	The collected data is personal in nature, and thus its privacy must be ensured	INRIA	FIESTA-IoT has authorization mechanisms that ensure data privacy		WP 4 team
72_NFR_SEM_Semantic_annotations_data	Non-Functional Requirements	MUST	Semantic Modelling	Semantic annotations of data	Semantic annotation of data helps in interoperability	INRIA	FIESTA-IoT provides semantic interoperability between measurements from testbeds		WP 3 team

UNIQUE ID	Requirement Type	Priority	Category	Description	Rationale	Originator	Fit Criterion	Dependencies	Stakeholder
73_NFR_SEM_Mapping_semantic_model	Non-Functional Requirements	MUST	Semantic Modelling	Mapping between testbed and FIESTA-IoT semantic model must be ensured	Information from testbeds must be described according to the FIESTA-IoT semantic Model	UI	FIESTA-IoT handles data from testbeds without any information regarding tesbeds' semantic models		WP 3 team

APPENDIX II – IOT STATE OF THE ART OVERVIEW AND PROJECT OBJECTIVES SUMMARY

This section summarizes a general review about other IoT-related projects and initiatives. The project objectives from each initiative are highlighted and as possible those ones that fit on relevant areas to the FIESTA-IoT Project. Each project is introduced as table containing three sections: 1) summary data, 2) a short abstract, and 3) the main project research objective(s) or the main activity. The projects and initiatives contained in this appendix constitute the State of the Art (SoTA) summary.

Table 22: ADVENTURE – ADaptive Virtual ENterprise ManufacTURing Environment

Project Name	ADVENTURE - ADaptive Virtual ENterprise ManufacTURing Environment http://www.fp7-adventure.eu/
Description	The goal of the project is the creation of a framework that provides the tools to combine factories in a pluggable way to manufacture a particular product. This includes the creation of manufacturing processes, finding partners as well as real-time monitoring of the processes that are put into play. The goal of the ADVENTURE is the creation of a framework that provides the tools to combine factories in a pluggable way to manufacture a particular product. ADVENTURE will help virtual factories and enterprises move beyond existing operational limitations by providing concrete tools and approaches for leveraging the information exchange between factories. Factory process optimization will be enabled by the integration of runtime factory selection, forecasting, monitoring, and on-the-fly collaboration. ADVENTURE aims at simplifying the establishment, management, adaptation, and monitoring of dynamic manufacturing processes in virtual. Technologies from the field of Ubiquitous Computing and the Internet of Things, e.g., wireless sensors, will be adopted in order to support the monitoring and governance of processes.
Main Activity, Objective(s)	Internet-of-Things technologies to support the manufacturing process in factories

Table 23: BUTLER - uBiquitous, secUre inTernet-of-things with Location and contExt-awaReness

Project Name	BUTLER - uBiquitous, secUre inTernet-of-things with Location and contExt-awaReness

	http://www.tst-sistemas.es/en/rd/butler/
Description	BUTLER is a European project focused in the integration of existing technologies and creation of new ones, emphasizing pervasiveness, context-awareness and security for IoT. Its major challenges are, from a systemic viewpoint, smart resource management and digital security; and from a user/service perspective, the pervasiveness (uniformity of performance anytime and anywhere) and awareness (inversely proportional to the degree of knowledge required from users). By using TSmarT platform, BUTLER is deploying a network of smart objects (small, autonomous and intelligent nodes) to accomplish with realizing the vision of the Internet-of-Things.
Main Activity, Objective(s)	Deployment of smart objects networks, TSmarT platform.

Table 24: CALIPSO - Connect All IP-based Smart Objects!

Project Name	CALIPSO - Connect All IP-based Smart Objects! http://www.ict-calipso.eu/
Description	CALIPSO builds Internet Protocol (IP) connected smart object networks, but with novel methods to attain very low power consumption, thereby providing both interoperability and long lifetimes. CALIPSO leans on the significant body of work on sensor networks to integrate radio duty cycling and data-centric mechanisms into the IPv6 stack, something that existing work has not previously done. CALIPSO works within the IETF/IPv6 framework, which includes the recent IETF RPL and CoAP protocols. This gives a structure for evaluation that has not previously been available. We use Contiki open source OS, Europe's leading smart object OS, as the target development environment for prototyping and experimental evaluation.
Main Activity, Objective(s)	Internet-connected smart object networks, IETF RPL and CoAP protocols used on sensors, build of sensor networks to integrate radio duty cycling and data-centric mechanisms.

Table 25: CASAGRAS2 - Coordination and Support Action for Global RFID-related Activities and Standardization – 2

Project Name	CASAGRAS2 - Coordination and Support Action for Global RFID-related Activities and Standardization - 2 http://www.iot-casagras.org/
Description	CASAGRAS2 is a key group of international partners representing Europe, the USA, China, Japan and Korea who has joined a strategic EU funded 7th Framework initiative that will look at global standards, regulatory and other issues concerning RFID and its role in realising an “Internet of Things.” This is regarded as a global integrated intelligent infrastructure that will exploit developments in pervasive networking and interfacing with the physical world through existing and future developments in RFID and associated technologies. It is expected that the Internet of Things will engage with today’s internet and its future development providing an integrated item intelligent world that can serve the future information and management needs of industry and commerce and the wider needs of the information society.
Main Activity, Objective(s)	Dissemination, standardization and presence for OpenIoT activities

Table 26: CityPulse – Real-Time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications

Project Name	CityPulse – Real-Time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications http://ict-citypulse.eu
Description	Real-Time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications CityPulse provides innovative smart city applications by adopting an integrated approach to the Internet of Things and the Internet of People. The project will facilitate the creation and provision of reliable real-time smart city applications by bringing together the two disciplines of knowledge-based computing and reliability testing.
Main Activity, Objective(s)	CityPulse provides innovative smart city applications by adopting an integrated approach to the Internet of Things and the Internet of People. The project will facilitate the creation and provision of reliable real-time smart city applications by bringing together the two disciplines of knowledge-based computing and reliability testing.

Table 27: CLOUD-TM: A Novel Programming Paradigm for Cloud Computing

Project Name	CLOUD-TM - Cloud-TM: A Novel Programming Paradigm for Cloud Computing http://www.cloudtm.eu/
Description	The appearance of the first commercial Cloud Computing platforms has represented a significant step towards the materialization of the vision of utility-computing. However, the promise of infinite scalability catalyzing much of the recent hype about Cloud Computing is still menaced by one major pitfall: the lack of programming paradigms and abstractions capable of bringing the power of parallel programming into the hands of ordinary programmers. Cloud-TM aims at defining a novel programming paradigm to facilitate the development and administration of cloud applications. It will develop a Self-Optimizing Distributed Transactional Memory middleware that will spare programmers from the burden of coding for distribution, persistence and fault-tolerance, letting them foc`us on delivering differentiating business value. Further, the Cloud-TM platform aims at minimizing the operational costs of cloud applications, pursuing optimal efficiency via autonomic resource provisioning and pervasive self-tuning schemes.
Main Activity, Objective(s)	Programming paradigms and abstractions for the support of application development in the Cloud; standardization efforts

Table 28: COMPOSE - Collaborative Open Market to Place Objects at your Service

Project Name	COMPOSE - Collaborative Open Market to Place Objects at your Service http://compose-project.eu/
Description	COMPOSE is a EU FP7 project set up to enable an open marketplace of services for the IoT. New services can be seamlessly integrated in real and in virtual worlds through the convergence of the Internet of Services (IoS) with the IoT. This is realized in COMPOSE by an open and scalable marketplace infrastructure, in which smart objects are associated to services that can be combined, managed, and integrated in a standardized manner to easily and quickly build innovative applications.
Main Activity,	IoT services, Business Associations, open Source and Infrastructure.

Objective(s)	

Table 29: CLOUD4SOA: A Cloud Interoperability Framework and Platform for User-centric, Semantically-enhanced Service-oriented Application Design, Deployment and Distributed Execution

Project Name	CLOUD4SOA A Cloud Interoperability Framework and Platform for User-centric, Semantically-enhanced Service-oriented Application Design, Deployment and Distributed Execution http://www.cloud4soa.eu/
Description	The Cloud4SOA initiative focuses on resolving the semantic interoperability issues that exist in current Clouds platforms and infrastructures and on introducing a user-centric approach for applications which are built upon and deployed using Cloud resources. The vision of Cloud4SOA is to open up the Cloud market to small-medium European PaaS providers and strengthen their market position, and to alleviate the vendor lock-in barrier for Cloud developers. Cloud4SOA will address the above challenge by enhancing the Cloud-based application development, deployment and migration by semantically interconnecting heterogeneous Platform as a Service (PaaS) offerings across different providers that share the same technology, and will facilitate the access and lifecycle management for Cloud-based application developers to the PaaS offering that best matches their computational and business needs.
Main Activity, Objective(s)	Support of interoperability between different clouds / cloud vendors; standardization efforts

Table 30: CONTRAIL: Open Computing Infrastructures for Elastic Services

Project Name	CONTRAIL - Open Computing Infrastructures for Elastic Services http://contrail-project.eu/
Description	CONTRAIL will vertically integrate an open-source distributed operating system for autonomous resource management in Infrastructure-as-a-Service environments, and high level services and runtime environments as foundations for Platform-as-a-Service. It will provide a tightly integrated software stack in open source including a comprehensive set of system, runtime and high level services providing standardized interfaces for supporting

	cooperation and resource sharing over Cloud federations. CONTRAIL will address key technological challenges in existing commercial and academic Clouds: the lack of standardized rich and stable interfaces; limited trust from customers; and relatively poor Quality of Service (QoS) guarantees regarding the performance and availability of Cloud resources. The main contribution of CONTRAIL is an integrated approach to virtualization, offering Infrastructure-as-a- Service, services for IaaS Cloud Federation, and Platform-as-a-Service. It will aim at equalling current commercial Clouds, and surpassing them in a number of selected key domains to facilitate industrial up-take of Federated Cloud computing.
Main Activity, Objective(s)	Open-source distributed operating system; standardized interfaces for supporting cooperation and resource sharing in the Cloud

Table 31: COSMOS - Cultivate resilient smart Objects for Sustainable city applicatiOnS

Project Name	COSMOS - Cultivate resilient smart Objects for Sustainable city applicatiOnS http://iot-cosmos.eu/
Description	The project COSMOS (Cultivate resilient smart Objects for Sustainable city applicatiOnS) aims at enhancing the sustainability of smart city applications. COSMOS enables things to evolve and act in a more autonomous way, proposing things that are able to learn. The project integrates decentralized management mechanisms in IoT based systems, allowing applications to exploit large number of things and analytics on networks of data they produce. Management decisions and runtime adaptability is based on things security, trust, administrative, location, relationships, information, and contextual properties.
Main Activity, Objective(s)	End-to-End Security and Data Life Service Management for Internet of Things services

Table 32: CumuloNimbo A Highly Scalable Transactional Multi-Tier Platform as a Service

Project Name	CumuloNimbo A Highly Scalable Transactional Multi-Tier Platform as a Service http://cumulonimbo.eu/
Description	CumuloNimbo targets to obtain a highly scalable transactional platform as a service (PaaS). One of the innovations will be attaining scalability without trading off consistency as it is the norm in today's PaaS. One of the

	main challenges associated with cloud technologies and the next generation of Platforms as a Service (PaaS) is the question of how to provide ease of programming, consistency and scalability at the same time. CumuloNimbo aims at developing a radically new Platform as a Service that will provide high scalability (100+ service nodes) without sacrificing data consistency and ease of programming. The targeted PaaS will be a multi-tier software stack for cloud computing providing the same functionality to current, software multi-tier stacks, such as Java EE, SAP Netweaver or .NET. Providing scalability without trading off consistency is a major breakthrough that will enable European stakeholders in service platforms, such as SAP, to position in the cloud computing market with a competitive advantage.
Main Activity, Objective(s)	Large-scale data management in the Cloud; abstraction layer to ease application development

Table 33: ClouT – Cloud of Things

Project Name	ClouT - Cloud of Things http://clout-project.eu/ ClouT
Description	ClouT is a joint European-Japanese ICT project . The major concept is to use Cloud Computing to bridge the Internet of Things with Internet of People via Internet of Services. The goal is to make cities smarter by exploiting all possible information sources (e.g., from sensors) and to help them facing the emerging challenges such as efficient energy management, economic growth, and development.
Main Activity, Objective(s)	IoT services, Business Associations, open Source and Infrastructure.

Table 34: FI-WARE - Future Internet Core Platform

Project Name	FI-WARE - Future Internet Core Platform http://www.fi-ware.eu/

Description	FI-WARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications – building a true foundation for the Future Internet. The project will develop Open Specifications of these Generic Enablers, together with a reference implementation of them available for testing. This way, it is aimed to develop working specifications that influence Future Internet standards.
Main Activity, Objective(s)	The reference architecture and some of its design elements, such as Cloud Hosting, Data/Context Management, Internet of Things (IoT) Services.

Table 35: FiSTAR - Internet Connected Objects for Reconfigurable Ecosystems

Project Name	FiStar – Future Internet Social Technological Alignment in Healthcare http://fi-star.eu/
Description	The two-year research project develops new services for the e-health industry. In seven European regions new services for various medical use case scenarios are designed as cloud computing services, following the Future Internet (FI) approach and the outcomes of FI- PPP Phase 1. Special focus is put on the use of generic and specific enablers that are available on cloud-based architectures and platforms.
Main Activity, Objective(s)	FI-STAR establishes trials in the Health Care domain building on Future Internet (FI) technology leveraging on the outcomes of FI-PPP.

Table 36: iCity - Internet Connected Objects for Reconfigurable Ecosystems

Project Name	iCity http://www.icityproject.eu/
Description	The iCity project's vision makes a step further on the concept of Open Data by offering a novel approach of Opened Information Systems where the municipal ICT networks already deployed in urban spaces will be made available and accessible to the general public with the objective of maximizing the number of deployed services of

	public interest. The main expected outputs of iCity are: 1-A novel platform that will give access to open information and Opened Information Systems in the participant cities; 2-An ecosystem of services of public interest created by interested third parties; and 3- A new methodology for user engagement in the creation of services of public interest.
Main Activity, Objective(s)	iCity works for the quality of citizen's lives, developing applications that provide public data and interest services.

Table 37: iCORE - Internet Connected Objects for Reconfigurable Ecosystems

Project Name	iCORE - Internet Connected Objects for Reconfigurable Ecosystems http://www.iot-icore.eu/
Description	The iCore proposed solution is a cognitive framework comprising three levels of functionality, reusable for various and diverse applications. The levels under consideration are virtual objects(VOs), composite virtual objects (CVOs) and functional blocks for representing the user/stakeholder perspectives. iCore initiative addresses two key issues in the context of the Internet of Things (IoT), namely how to abstract the technological heterogeneity that derives from the vast amounts of heterogeneous objects, while enhancing reliability and how to consider the views of different users/stakeholders (owners of objects & communication means) for ensuring proper application provision, business integrity and, therefore, maximise exploitation opportunities.
Main Activity, Objective(s)	Composition of virtual objects (CVOs) and functional blocks for representing the user/stakeholder perspectives and Internet of Things (IoT) Services.

Table 38: IoT-A - Internet of Things Architecture

Project Name	IoT-A – Internet of Things Architecture http://iot-a.eu/
Description	The project IoT-A (Internet of Things Architecture) developed a comprehensive architectural reference model as a

	foundation for interoperability of Internet-of- Things systems. This includes guidelines for the design of protocols, interfaces and algorithms. Important aspects moreover are an efficient integration into the service layer of the Future Internet and scalable look up and discovery of resources. IoT-A implemented real life use cases to demonstrate the benefits of the developed architecture.
Main Activity, Objective(s)	Specification and guidelines for building IoT architectures.

Table 39: IoT@Work - IoT at Work

Project Name	IoT@Work https://iot-at-work.eu/
Description	The focus of the project IoT@Work was on harnessing IoT technologies in industrial and automation environments. That is to allow devices, machines, and objects to interact with each other without relying on human intervention, setting-up and commissioning the embedded intelligence in the Industry Automation domain. The project developed a Plug and Work concept centered on industrial systems. The IoT@Work uses a semantically annotated data model where attributes of a device profile are modeled as RDF triples. Further aspects of the project were configuration of a highly complex and demanding industrial communication networks, as well as an IT security and access rights.
Main Activity, Objective(s)	High complexity of operations, Security and privacy for the Internet of Things.

Table 40: IoT-I - Internet of Things Initiative

Project Name	IoT-I - Internet of Things Initiative http://www.iot-i.eu/
Description	The IoT initiative (IoT-i) brings together key actors from all relevant currently fragmented IoT communities in

	Europe to work jointly towards a common vision of the Internet of Things. It represents the first serious attempt in building a unified IoT community in Europe, going across boundaries of disparate technology sectors, in order to create a joint European strategic vision of the IoT and aligning this vision with the current developments on the Future Internet.
Main Activity, Objective(s)	Dissemination, standardization and presence for OpenIoT activities. OpenIoT has contributed to D1.3 of IoT-I project.

Table 41: IoT.EST - Internet of Things Environment for Service Creation and Testing

Project Name	IoT.EST - Internet of Things Environment for Service Creation and Testing http://ict-iotest.eu/iotest/
Description	IoT.est establishes and eases the creation and provision of IoT enabled business services by bringing together the three disciplines Internet of Things, Service Engineering and Testing, The project integrates self-testing capabilities in the service development and maintenance from the beginning. The project investigates how formal test procedures can be integrated in the service development, and especially in the service creation environment using a systematic approach. IoT.est will develop a test-driven service creation environment (SCE) for Internet of Things enabled business services. The SCE aim is to enable the acquisition of data and control/actuation of sensors, objects and actuators. The project will provide the means and tools to define and instantiate IoT services that exploit data across domain boundaries and facilitate run-time monitoring which enables autonomous service adaptation to environment/context and network parameter (e.g. QoS) changes. The project will prototype its major concepts and will evaluate the results for exploitation towards future IoT service creation, deployment and testing products.
Main Activity, Objective(s)	Data acquisition and control/actuation of sensors, objects and actuators.

Table 42: IoT6 - Universal Integration of the Internet of Things through an IPv6-based Service Oriented Architecture enabling heterogeneous components interoperability

Project Name	IoT6 - Universal Integration of the Internet of Things through an IPv6-based Service Oriented Architecture enabling heterogeneous components interoperability

	http://www.iot6.eu/
Description	IoT6 stands for Universal Integration of the Internet of Things through an IPv6-based Service Oriented Architecture enabling heterogeneous components interoperability. IoT6 research about the potential of IPv6 and related standards to support the future Internet of Things and to overcome its current fragmentation. IoT6 aims also to develop a highly scalable IPv6-based service-oriented architecture to achieve interoperability, mobility, cloud computing integration and intelligence distribution among heterogeneous smart things components, applications and services. Alike Explore innovative forms of interactions with multi-protocol integration & interoperability with heterogeneous devices, mobile & cellular networks, cloud computing services (SaaS), RFID tags and related systems, such as EPCIS, Information and intelligence distribution.
Main Activity, Objective(s)	Recommendations on Internet of Things, Service Oriented Architecture enabling interoperability, mobility, cloud computing and intelligence distribution.

Table 43: MOBiNET - Europe-Wide Platform for Cooperative Mobility Services

Project Name	MOBiNET - Europe-Wide Platform for Cooperative Mobility Services http://mobinet.eu
Description	MOBiNET is a EU FP7 project that ends in 2016. This project is developing, a deployable and operative platform for the technical and organisational foundations of an open, multi-vendor platform for Europe-wide mobility services. Its main goal is to provide an easy access to ITS services and simplifying development of new services and support cooperative system-enabled service deployment. MOBiNET offers a comprehensive Europe-wide directory of mobility and transport-related data and services, An e-marketplace as an e-commerce network linking content providers, service providers and end users, Traveller assistance tools for service roaming and virtual ticketing, Third-party service composition to discover and add content and services to existing products, A smart Communication Manager for end-user devices and A Service Development Kit to enable easy creation of new user services.
Main Activity, Objective(s)	MOBiNET will open the door to harmonised services, seamless connectivity, instant access to transport data, single subscription and billing for travellers and a one-stop shop for mobility services.

Table 44: Open-IoT – Open Source Cloud Solution for the Internet of Things

Project Name	OpenIoT- Open source blueprint for large-scale self-organizing cloud environments for IoT applications http://www.openiot.eu/
Description	OpenIoT is an open source middleware platform for physical and virtual IoT/cloud integration. OpenIoT enables the on demand pay-as-you go delivery of IoT services such as “Sensing-as-a-Service”. OpenIoT enables flexible configuration and deployment of algorithms for collection and filtering information streams stemming from internet-connected objects, while at the same time generating and processing important business/applications events. OpenIoT is perceived as a middleware solution for the Dynamic Integration and Discovery for the Internet of Things enabling Service Creation and Delivery by means of interoperable self-organizing management on cloud environments for sensors, sensor networks and smart devices along with semantic open-linked data techniques, utility computing, and including security and privacy schemes.
Main Activity, Objective(s)	Physical and Virtual sensors data representation and Dynamic creation and deployment of Services and IoT applications. OpenIoT collects and uses data from multiple heterogeneous sensors with almost zero-level programming for enabling IoT Services on demand

Table 45: OPTICITIES – Open Source Cloud Solution for the Internet of Things

Project Name	OPTICITIES http://opticities.com
Description	OPTICITIES is an FP7 project that aims at supporting European cities in the experimentation of ITS (Intelligent Transport Systems) solutions for goods and passenger mobility, with particular reference to inter- modality and soft modes, that is transport modes that are alternative to the use of cars (public transport, bicycle mobility, carpooling, car sharing, etc.).
Main Activity, Objective(s)	OPTICITIES aims for associate major cities, groups and SMEs at the forefront in these fields in Europe to develop: Genuine multimodal solutions, contractual framework on data access and exchange policy allowing enlarged access to high quality data, European interoperability of urban mobility data and mobility solutions, Enhance network operators’ supervision capacity and management efficiency, Develop, try out and assess high-level innovative multimodal information and transport management services and Enhance users’ accessibility to mobility services.

Table 46: PROBE-IT - Pursuing ROadmaps and BEnchmarks for the Internet of Things

Project Name	PROBE-IT - Pursuing ROadmaps and BEnchmarks for the Internet of Things http://www.probe-it.eu/
Description	PROBE-IT works on effectively capitalise European research advances in the area of the IoT, Europe needs to ensure interoperability and acceptance of its solutions in a global context. For that, it is important to conduct key benchmarks and look at existing roadmaps in order to provide elements at European level, and study whether all of these technical issues on validation and interoperability are efficiently considered. In doing such an analysis, all research projects and international initiatives will be considered and therefore a global coordination will be put in place in full synchronisation with existing support actions. PROBE-IT will not provide overlap and support as large as the international collaboration and standardisation already provided by CASAGRAS2 or on global vision and collaboration as provided by IOT-I project. PROBE-IT will cooperate with these two projects in complementing the global portfolio with benchmarks, roadmaps and other key inputs on validation and interoperability. PROBE-IT will focus on providing overall support to current and future IoT research programmes addressing all of these important and technical issues that no project is actually delivering.
Main Activity, Objective(s)	Dissemination, standardization and presence for OpenIoT activities.

Table 47: RERUM - REliable, Resilient and secUre IoT for sMart city applications

Project Name	RERUM - REliable, Resilient and secUre IoT for sMart city applications https://ict-rerum.eu/
Description	RERUM is a FP7 project funded by the EU. This project develop a framework which will allow IoT applications in the Smart City context to consider security and privacy mechanisms early in their design phase, ensuring a configurable balance between reliability (e.g., precise data) and privacy (e.g., location of a person). Furthermore, RERUM investigates the realization of security and reliability as well as Cognitive Radio (CR) technology (e.g., to minimize wireless interference) in smart objects.
Main Activity, Objective(s)	Security and privacy mechanisms for smart cities.

Table 48: SmartSantander

Project Name	SmartSantander http://www.smartsantander.eu/
Description	SmartSantander proposes a unique in the world city-scale experimental research facility in support of typical applications and services for a smart city. This unique experimental facility will be sufficiently large, open and flexible to enable horizontal and vertical federation with other experimental facilities and stimulates development of new applications by users of various types including experimental advanced research on IoT technologies and realistic assessment of users' acceptability tests. The project envisions the deployment of 20,000 sensors in Belgrade, Guildford, Lübeck and Santander (12,000), exploiting a large variety of technologies.
Main Activity, Objective(s)	Experimental Facilities. Global sensor Networks. The OpenIoT could be deployed and used by the City of Santander in order to offer flexible services over the existing infrastructures.

Table 49: uTRUSTit - Usable TRUST in the Internet of Things

Project Name	uTRUSTit - Usable TRUST in the Internet of Things http://www.utrustit.eu/
Description	uTRUSTit is an international collaboration between six organizations from six various countries aiming at integrating the user directly in the trust chain, guaranteeing transparency in the underlying security and reliablilty properties of the Internet of Things. The results of uTRUSTit enable system manufacturers and system integrators to express the underlying security concepts to users in a comprehensible way, allowing them to make valid judgements on the trustworthiness of such systems. Further, uTRUSTit's design guidelines on trust help the industry to implement the trust-feedback toolkit developed by uTRUSTit in a secure, usable and accessible way. uTRUSTit will develop a secure, trustworthy, legally compliant and accessible toolkit and thereby close the loop of trust between the technological and psychological layers in the IoT. uTRUSTit enables the user to trust in ubiquitous systems in the IoT. The toolkit will include feedback mechanisms informing the user about the security and trustworthiness of applications and devices in the IoT and their connectivity to networks, the data to be transmitted, the security of the transmission and the trustworthiness of the recipient of the information.

Main Activity, Objective(s)	Experimental Facilities. Global Sensor Networks Experimentation.

Table 50: 4CAAST - Building the PaaS Cloud of the Future

Project Name	4CAAST Building the PaaS Cloud of the Future http://4caast.morfeo-project.org/
Description	The 4CaaSt project aims to create an advanced PaaS Cloud platform which supports the optimized and elastic hosting of Internet-scale multi-tier applications. 4CaaSt embeds all the necessary features, easing programming of rich applications and enabling the creation of a true business ecosystem where applications coming from different providers can be tailored to different users, mashed up and traded together. The 4CaaSt platform is envisioned bring significant benefits to the European economy via a greatly simplified design and delivery model for services and service compositions. The developed platform will lead to the establishment of new and highly dynamic and innovative service ecosystems. The benefiting stakeholders include application providers, consumers, application/service aggregators, and cloud providers. The platform should enable the involved parties to focus on their individual business.
Main Activity, Objective(s)	Programming paradigms and abstractions for the support of application development in the Cloud; service composition

Table 51: mOSAIC: Open-Source API and Platform for Multiple Clouds

Project Name	mOSAIC Open-Source API and Platform for Multiple Clouds http://www.mosaic-cloud.eu/
Description	Using mOSAIC solutions, Cloud-based application developers, maintainers and users will be able (a) to specify

	the service requirements in terms of a Cloud ontology and communicate them to the platform via the innovative API, (b) to postpone their decision on the procurement of Cloud services until run-time, and (c) to find best-fitting Cloud services to their actual needs and efficiently outsource computations. The platform will implement a multi-agent brokering mechanism that will search for services matching the applications' request, and possibly compose the requested service if no direct hit is found, and will facilitate competition between Cloud providers, who, in return, will be able to reach customers they could not reach before. Using mOSAIC solution developers, maintainers and users do not have to decide on a specific Cloud provider at design time, instead any time you use Cloud services, you will access the ones fitting best your needs.
Main Activity, Objective(s)	Open source API and platform for multiple clouds

Table 52: NOVI: Networking innovations Over Virtualized Infrastructures

Project Name	NOVI Networking innovations Over Virtualized Infrastructures http://www.fp7-novi.eu/
Description	NOVI's objectives are to investigate and experiment on open questions on monitoring, formal description and brokerage of virtualized resources within a federation of Future Internet platforms. NOVI's experimental research is driven by widely acknowledged Future Internet challenges. Its specific targets are expected to contribute in (a) integrating virtualization technologies at the network and computing levels with novel methods and algorithms to provision, monitor and control composite FI user slices, (b) extending federation concepts at the data, control, monitoring and Provisioning Planes, that will assist substrate providers to securely offer measurable QoS-aware cloud services, and (c) empowering end-users with smart tools to discover virtualized resources and compose services by proposing a common definition language, enhanced by semantic web concepts and tools.
Main Activity, Objective(s)	QoS-aware cloud services; resource discovery and service composition

Table 53: OPTIMIS: Optimized Infrastructure Services

Project Name	OPTIMIS Optimized Infrastructure Services http://www.optimis-project.eu/
Description	The motivation for OPTIMIS is the vision that hybrid clouds will become commonplace, realized by private clouds interacting with a rich ecosystem of public and other cloud providers. OPTIMIS is aimed at enabling organizations to automatically externalize services and applications to trustworthy and auditable cloud providers in the hybrid model. Consequently, OPTIMIS believes its activities will support and facilitate an ecosystem of providers and consumers that will benefit from the optimal operation of services and infrastructures. The optimization covers the full lifecycle of services and their interactions. The Main innovations are (a) to identify, capture and codify what an optimized cloud ecosystem driven by trust, risk, eco-efficiency and cost will look like, (b) the OPTIMIS framework and toolkit will simplify service construction, and support deployment and runtime decisions based on prior evaluation of providers, (c) to facilitate the use of resources-based on economic and eco-efficiency goals while achieving a dynamic and proactive management of cloud infrastructures, (d) to enable clouds to be composed from multiple services and resources. It will support service brokerage via interoperability, and is architecture-independent, and (e) to identify value networks for these cloud markets and recommend suitable legal and regulatory guidelines for operation.
Main Activity, Objective(s)	Service composition and interoperability in the Cloud

Table 54: REMICS: REuse and Migration of legacy applications to Interoperable Cloud Services

Project Name	REMICS REuse and Migration of legacy applications to Interoperable Cloud Services http://www.remics.eu/
Description	Building a SaaS system from scratch may require a huge investment in time and efforts. Moreover, the

	organizations legacy systems are difficult to reuse due to platform, documentation and architecture obsolescence. Existing approaches, particularly in the context of MDA (Model-Driven Architecture) and MDE (Model-Driven Engineering), have major weaknesses in the current state, such as a lack of standards for platform independent modeling, limited knowledge discovery, a lack of methods for service interoperability on model level, a lack of dedicated testing technologies for Service Clouds migration validation, and others. REMICS proposes a leap progress in legacy systems migration to Service Clouds by providing a model-driven methodology and tools, which significantly improve the baseline MDA concept. This will be achieved through driving the standardization work in OMG including PIM4Cloud specification, and support and increase impact further by providing project results under open source licences.
Main Activity, Objective(s)	Standardization efforts to ease application development in the Cloud

Table 55: ROBUST: Risk and Opportunity management of huge-scale BUSiness communiTy cooperation.

Project Name	ROBUST Risk and Opportunity management of huge-scale BUSiness communiTy cooperation. http://robust-project.eu/
Description	Online communities generate major economic value and form pivotal parts of corporate expertise management, marketing, product support, CRM, product innovation and advertising. Communities can exceed millions of users and infrastructures must support hundreds of millions discussion threads that link together billions of posts. ROBUST is targeted at developing methods to understand and manage the business, social and economic objectives of the users, providers and hosts and to meet the challenges of scale and growth in large communities. Hence, the objectives of ROBUST are to find solutions for community risk management, large scale data management, models of community polity and politics, community simulation and community data analysis.
Main Activity, Objective(s)	Large-scale data management of interlinked data

Table 56: TClouds: Trustworthy Clouds: Privacy and Resilience for Internet-scale Critical Infrastructure.

Project Name	TClouds Trustworthy Clouds: Privacy and Resilience for Internet-scale Critical Infrastructure http://www.tclouds-project.eu/
Description	The current cloud computing model comes with perceived risks concerning resilience and privacy. There are three fundamental trends in ICT whose risks mutually reinforce each other: (a) the push towards an Internet of Services, (b) cost pressures that drive a migration of ICT into so-called Infrastructure clouds, and (c) growing importance of ICT as the critical “nervous system” for socially relevant "smart" infrastructures. The TClouds project targets cloud computing security and minimization of the widespread concerns about the security of personal data by putting its focus on privacy protection in cross-border infrastructures and on ensuring resilience against failures and attacks. TClouds aims to (1) develop an advanced cloud infrastructure that can deliver computing and storage that achieves a new level of security, privacy, and resilience yet is cost-efficient, simple, and scalable, and (2) to change the perceptions of cloud computing by demonstrating the prototype infrastructure in socially significant application areas: energy and healthcare.
Main Activity, Objective(s)	Privacy, data and service protection in the cloud-based architectures, and across multiple clouds

Table 57: VISION Cloud: Virtualized Storage Services Foundation for the Future Internet.

Project Name	VISION Cloud Virtualized Storage Services Foundation for the Future Internet http://www.visioncloud.eu/
Description	The explosion of personal and organisational digital data has been recognised as one of the most significant characteristics of the decade. Generated data is growing faster than we can store it. In parallel our society has become critically dependent on services to extract valuable information from the data and drive decision making by individuals, businesses and government, across all aspects of life. In the emerging era of the Future Internet,

	the explosion of raw data and the dependence on data services is expected to be further. The primary deliverables of VISION Cloud aims for an architecture and a reference implementation of a cloud-based infrastructure, built on open standards and new technologies, to provide a scalable, flexible and dependable framework for optimised delivery of data-intensive storage services. The VISION Cloud infrastructure will support new emerging telco/media services. In doing so, the project aims to achieve significant and quantifiable improvements in service delivery productivity, quality, availability, reliability and cost.
Main Activity, Objective(s)	Architecture for cloud storage; smart services in the cloud; privacy and security

Table 58: ADVANCE: Advanced predictive-analysis-based decision-support engine for logistics.

Project Name	ADVANCE Advanced predictive-analysis-based decision-support engine for logistics http://www.advance-logistics.eu/
Description	Networked companies suffer from inefficient utilisation of resources (e.g. deadheading traffic, excess product spoilage, unbalanced capacities) due to limitations in processing localised information in larger amounts and over larger ranges. The patterns and dependencies that exist in the millions data elements created daily can only be meaningfully processed by intelligent data-mining approaches linked to strategic decision making based on longer term analyses of billions of pieces of information. ADVANCE will support networked companies in improving their information collecting and processing infrastructure, enabling strategic planning coupled with instant decision making. The project will deliver the open-source ADVANCE platform and comprehensive accompanying reference material. The ADVANCE software will provide a dual perspective on transport requirements and decision making dependent on the latest snapshot information and the best higher-level intelligence.
Main Activity, Objective(s)	Large-scale analysis and mining of interlinked data

Table 59: COGNITO: Cognitive workflow capturing and rendering with on-body sensor networks.

Project Name	COGNITO Cognitive workflow capturing and rendering with on-body sensor networks http://www.ict-cognito.org/
Description	Automatic capturing, recognition and rendering of human sensory-motor activities are essential technologies in many diverse applications, ranging from 3D virtual manuals through to training simulators and novel computer games. The goal of COGNITO is to capture, analyse, store and render with help of 3D graphics complex industrial manual tasks. The project approach is defined as follows: (a) to develop an egocentric on-body sensor network of inertial and inertial/visual sensors, (b) to infer an osteo-articular biomechanical model of the body, (c) to analyze user activity with both global ergonomic and musculoskeletal assessment, (d) to learn and analyse the workflow, and (e) to describe and store it as 3D structured graphics animations
Main Activity, Objective(s)	Real-time stream data management with heterogeneous sensor data as input

Table 60: LOD2: Creating Knowledge out of Interlinked Data

Project Name	LOD2 Creating Knowledge out of Interlinked Data http://lod2.eu
Description	The outputs of this project will range from sci-tech to socio-economic areas by providing new technologies and an underlying scientific basis for these and by applying these new technologies to a number of Semantic Web areas experiencing commercial (enterprise search, media and publishing), scientific (extraction, interlinking, ontology classification and fusion methods), and sociological (community knowledge, integration in social networks, eGovernment) success at present. The project aims to contribute high-quality interlinked versions of public Semantic Web data sets, promoting their use in new cross-domain applications by developers across the globe. The new technologies for enabling scalable management of Linked Data collections in the many billions of triples

	will raise the state of the art of Semantic Web data management, both commercial and open-source, providing opportunities for new products and spin-offs, and make RDF a viable choice for organizations worldwide as a premier data management format. The algorithms and (open-source) tools that the project will develop for data cleaning, linking and fusing will help creating and bootstrapping new data sets in domains that go much beyond the direct applications and data sets developed in the context of this project, to reach the overall goal of the project of making Linked Data the model of choice for next-generation IT systems and applications.
Main Activity, Objective(s)	Large-scale data management of Linked Data collections, standardization initiatives (pushing RDF)

Table 61: DICODE: Mastering Data-Intensive Collaboration and Decision Making

Project Name	DICODE Mastering Data-Intensive Collaboration and Decision Making http://dicode-project.eu/
Description	The goal of the Dicode project is to facilitate and augment collaboration and decision making in data-intensive and cognitively-complex settings. To do so, it will exploit and build on the most prominent high-performance computing paradigms and large data processing technologies to meaningfully search, analyze and aggregate data existing in diverse, extremely large, and rapidly evolving sources. Building on current advancements, the solution foreseen in the Dicode project will bring together the reasoning capabilities of both the machine and the humans. Services to be developed are: (i) scalable data mining services (including services for text mining and opinion mining), (ii) collaboration support services, and (iii) decision making support services. The achievement of the Dicode project's goal will be validated through three use cases: (i) scientific collaboration supported by integrated large-scale knowledge discovery in clinico-genomic research, (ii) delivering pertinent information from heterogeneous data to communities of doctors and patients in medical treatment decision making, and (iii) capturing tractable, commercially valuable high-level information from unstructured Web 2.0 data for opinion mining.
Main Activity,	Large-scale data processing/mining in distributed architectures, including clouds, exploiting semantic metadata

Objective(s)	

Table 62: ENVISION: ENVIronmental Services Infrastructure with Ontologies

Project Name	ENVISION ENVIronmental Services Infrastructure with ONtologies http://www.envision-project.eu/
Description	The project aims to support non ICT-skilled users in the process of semantic discovery and adaptive chaining and composition of environmental services. Innovations in ENVISION are: on-the-Web enabling and packaging of technologies for their use by non ICT-skilled users, support for migrating environmental models to be provided as models as a service (Maas), and the use of data streaming information for harvesting information for dynamic building of ontologies and adapting service execution. The ENVISION Environmental Decision Portal supports the creation of web-based applications enabled for dynamic discovery and visual service chaining. The ENVISION Ontology Infrastructure provides support for visual semantic annotation tools and multilingual ontology management. The ENVISION Execution Infrastructure comprises a semantic discovery catalogue and a semantic service mediator based on a generic semantic framework and adaptive service chaining with data-driven adaptability.
Main Activity, Objective(s)	Ontology-based service discovery and composition, provision of services to non ICT-skilled users

Table 63: I2WEB: Inclusive Future-Internet Web Services

Project Name	I2WEB Inclusive Future-Internet Web Services http://i2web.eu/index.html
Description	I2Web is a research project that aims to enable an accessible Future Internet for people with special needs (especially people with disabilities and older adults). The project is coping with several challenges of the Future

	Internet in regard to the ageing population and the needs of people with disabilities in the context of the ubiquitous and mobile Web, Web 2.0 developments, with user-generated content and social networks, and media convergence, like for instance, WebTV and IPTV. I2Web will develop tools for inclusive Internet service front-ends that implement user-centred design and Design for All principles, and which are supported by compliance testing tools like imergo®, developed by the project coordinator. The development of these tools must be accompanied by facilities for the discovery of the corresponding services.
Main Activity, Objective(s)	Future Internet, standardization efforts

Table 64: iProd: Integrated management of product heterogeneous data

Project Name	iProd Integrated management of product heterogeneous data http://www.iprod-project.eu/
Description	The Product Development Process (PDP) of manufacturing companies, requires the efficient management of huge amounts of data from different sources and their integration in the product chain. Present ICT solutions separately address parts of product development, but an integrated approach does not yet exist. iProd will improve the efficiency and quality of the Product Development Process developing a flexible, service oriented, customer driven software framework that will be the backbone of computer systems associated with current and new development processes. iProd will assume the challenge of complexity, semantic diversity and richness of content establishing semantically rich, open and transparent methodologies that will enable knowledge workers from aerospace, automotive and home appliances industries to manage product and process complexity, managing "higher value information" like functional specifications, requirements, decision rationale and engineering and business knowledge in general. This knowledge base along with a reasoning engine will support information sharing, collaboration across companies, common understanding of PDP among different industries and will promote efficient decision taking.
Main Activity, Objective(s)	Overlapping uses case: manufacturing, large-scale data management along the complete product chain

Table 65: LiMoSINe: Linguistically Motivated Semantic aggregatIon engiNes

Project Name	LiMoSINe Linguistically Motivated Semantic aggregatIon engiNes http://www.limosine-project.eu/about
Description	Nowadays, information is accumulated on a wide range of human activities, from science and facts, to personal content, opinions, and trends. Across the globe, people's knowledge, experiences and interactions effortlessly find their way to online outlets, alongside traditional edited content, ready to be shared with millions. LiMoSINe will integrate the research activities of leading researchers across diverse topics with a view to enabling new kinds of language-based search technology. The LiMoSINe vision is to transition access to online information from a document-centric search paradigm focused on returning disconnected atomic pieces to a truly semantic aggregation paradigm. In this new paradigm, machines will understand a user's intent, discover and organize facts, identify opinions, experiences and trends, all from inherently multilingual online sources and open knowledge repositories. LiMoSINe's aggregation engines will automatically organize search results in semantically meaningful ways.
Main Activity, Objective(s)	Semantic data management; knowledge discovery

Table 66: Monnet: Multilingual Ontologies for Networked Knowledge

Project Name	Monnet Multilingual Ontologies for Networked Knowledge http://www.monnet-project.eu
Description	The project aims to provide a general access to non-native speakers who require government or business information services. To accomplish this, the Monnet project develops a solution to the cross-language information access problem by using a novel combination of Machine Translation and Semantic Web Technology. Monnet strives to allow the business community or public service users have transparent access to key information across national and linguistic boundaries. Monnet targets this problem at the semantic level through a

	novel approach to cross-lingual information access that enriches state of the art machine translation with domain semantic (ontologies), terminological (taxonomies and term bases) and linguistic (corpora and lexical resources) information.
Main Activity, Objective(s)	Linked-Data-driven and ontology-based information system

Table 67: PlanetData

Project Name	PlanetData http://www.planet-data.eu/
Description	The project aims to Establish an interdisciplinary, sustainable European community of researchers, helping organizations to expose their data on the Web in a useful way. PlanetData drives forward the state-of-the-art in large-scale data management and its application to create useful, open data sets. This is motivated by the increasing reliance of business on large public data, the uptake of open data principles in many vertical sectors, most notably eGovernment, for public or social good, to increase the efficiency of end-user services and enable novel business models, and the need of research communities to make sense out of petabytes of scientific data, to describe and expose this data in ways that encourage and enable collaboration. Research questions relevant to large-scale data management are inherently interdisciplinary; their durable resolution requires the building of bridges between the different research communities that currently exist in isolation from each other.
Main Activity, Objective(s)	Large-scale data management in the Linked Open Data Cloud; dissemination and stadardisation issues

Table 68: VITAL-IoT - Virtualized programmable InTerfAces for innovative cost-effective IoT depLoyments in smart cities

Project Name	Vital-IoT - Virtualized programmable InTerfAces for innovative cost-effective IoT depLoyments in smart cities http://www.vital-iot.eu/
Description	VITAL is an on-going effort to realize a radical shift in the development, deployment and operation of IoT applications, through introducing an abstract virtualized digital layer that will operate across multiple IoT

	architectures, platforms and business contexts. Specifically, VITAL is looking at providing platform and business context agnostic access to Internet-Connected- Objects (ICO). Moreover. The mechanisms targets to compromise the diverse characteristics of the underlying ecosystems, thereby boosting interoperability at the technical and business levels.
Main Activity, Objective(s)	VITAL's research aims at virtualized filtering, complex event processing (CEP) and business process management mechanisms, which will be operational over a variety of IoT architectures/ecosystems.

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