PROJECT FINAL REPORT

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Abstract

This deliverable D9.5 represents the Final Report from the IoT6 project. It summarises the results of the project in terms of its achievements, overall impact and use potential.

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Project Beneficiaries

Beneficiary Number *	Beneficiary name	Beneficiary short name	Country	Date enter project	Date exit project
1 (coordinator)	Mandat International Alias Fondation pour la Cooperation Internationale	MI	Switzerland	Month 1	Month 36
2	Ericsson d.o.o. for Telecommunications	Ericsson	Republic of Serbia	Month 1	Month 36
3	RunMyProcess SAS	RMP	France	Month 1	Month 36
4	University College London	UCL	United Kingdom	Month 1	Month 36
5	Universidad de Murcia	UMU	Spain	Month 1	Month 36
6	Technische Universität Wien	VUT	Austria	Month 1	Month 36
7	Haute Ecole Specialisée de Suisse Occidentale	HESSO	Switzerland	Month 1	Month 36
8	Université du Luxembourg	UL	Luxembourg	Month 1	Month 36
9	Korea Advanced Institute of Science and Technology	KAIST	Korea	Month 1	Month 36

1 Final Publishable Summary Report

1.1 Executive Summary

The IoT6 project exploited the potential of IPv6 and related standards (6LoWPAN, CORE, COAP, etc.) to overcome shortcomings and fragmentation of the Internet of Things, in line with the IERC – Internet of Things European Research Cluster - and EC recommendations.

Its main challenges and objectives were to research, design and 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. Its potential was researched by exploring innovative forms of interactions such as:

- Information and intelligence distribution.
- Multi-protocol interoperability with and among heterogeneous devices.
- Device mobility and mobile phone networks integration, to provide ubiquitous access and seamless communication.
- Cloud computing integration with Software as a Service (SaaS).
- Smart Things Identification (STID) and IPv6 - STID Information Service (STIS) innovative interactions.

The main outcomes of IoT6 are recommendations on IPv6 features exploitation for the Internet of Things and an open and well-defined IPv6-based Service Oriented Architecture enabling interoperability, mobility, cloud computing and intelligence distribution among heterogeneous smart things components, applications and services - including with business processes management tools.

These ambitious goals have been achieved with a consortium consisting of seven international academic or research partners and two industrial partners that brought in expertise from complementary research areas such as IPv6, multi-protocol interoperability, routing protocols, security, SOAs, sensor networks, building automation, mobile phone networks, cloud computing, business processes and STIS/RFID.

IoT6 was supported by a large industry support group with renowned members, which acted as general advisors and supported the dissemination, exploitation and standardisation activities.

1.2 A summary description of project context and objectives

As mentioned by the Strategic Research Roadmap for the Internet of Things, the Internet is moving from a network of computers to a dynamic network of networks, merging the Internet of Things (IoT) together with "computer networks, the Internet of Media and the Internet of Services"[1]. The EC Communication on the Internet of Things states that machine to machine communication *"potentially concerns 50-70 billion machines, of which only 1% are connected today"*[2] By 2020, the Internet is expected to connect 50 to 100 Billion smart things and objects[3], with an increasing volume of circulating data and information. The current evolution is heading towards an increasingly interconnected, mobile, pervasive and ubiquitous Internet of Things, with potentially billions of heterogeneous things and devices communicating with each other and working together. The future Internet of Things faces major challenges:

Scalability & intelligence distribution: How to enable and manage connections with 50 to 100 billion smart things, if they are not only tagged, but required to communicate with each other. It will become more complex, more heterogeneous and will require a better distribution of intelligence[4] in order to be reliable and scalable.

Heterogeneity: The concept of "Internet of Things" is evolving from a RFID and tag focus to a larger and larger notion of "communicating things"[5], including sensors, actuators, mobile phones, etc. A concept where physical and virtual things are seamlessly integrated into the information network with distributed services. As mentioned by Pr Furness, the coordinator of the CASAGRAS project[6]: *"There is still a long way to go in exploiting the full potential of object connectivity. (…) RFID is only part of that equation"*[7]

Interoperability: The Internet of Things is very fragmented in terms of interconnectivity and interoperability. Despite the increasing role of open standards, the current environment of smart things is fragmented into many different communication protocols. According to the ITU, *"One of the main hurdles to the development of this industry is the lack of interoperable standards in both hardware and software."*[8] This heterogeneity is in part due to their historical origin and to the need to satisfy specific requirements.

Mobility: Another issue is an increasing mobility, with sensors attached to people, via their mobile phones (smart phones), to vehicles and to animals, connected to the Internet from different locations.

The Future Internet Architecture will require key features such scalability, mobility, ubiquitous accessibility, security, reliability, self-configuration and self-healing mechanisms.

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[1] Internet of Things, Strategic Research Roadmap, September 15 2009, page 7

[2] COM/2009/278 final – Internet of Things : An action plan for Europe, page 2

[3] Vision and Challenges for Realising the Internet of Things, March 2010, European cluster IERC, p13, and Ericsson perspective for the IoT, http://gigaom.com/2010/04/14/ericsson-sees-the-internet-of-things-by-2020/ and http://www.ericsson.com/news/1403231

[4] This vision is also shared by the European Technology Platform on Smart Systems Integration (EPoSS); see Joint EC / EPoSS Expert Workshop 2008 "Beyond RFID – The Internet of Things", 11-12 February 2008

[5] Internet of Things, Strategic Research Roadmap, September 15 2009, page 7

[6] CASAGRAS: Coordination and support action for global RFID-related activities and standardisation

[7] Workshop report: Internet of Things: an early reality of the future Internet, page 14

[8] ITU Internet Report, The Internet of Things 2005

1.2.1 Project context

The Internet is at a turning point in its attempt to address the aforementioned challenges. When the project started in 2011 there were about 2 billion Internet users worldwide[9] (from 360 million in 2000) and 4 billion mobile users (from 2.7 billion in 2006), using 570 million Internet-enabled handheld devices. At the end of 2012, there were already more mobile and wireless users than wired. By 2020, the Internet is expected to connect 50 to 100 billion smart things and objects[10]. Yet, the current Internet Protocol (IPv4), is limited to 4 billion IP public addresses[11] and, at the beginning of 2011, IANA had already distributed its last IPv4 addresses blocks to the regional organisations (RIRs)[12]. These were fully attributed to ISPs and other organisations by the beginning of 2012. The **Internet Protocol version IPv6** (IPv6) is the only available alternative to satisfy the growing needs for IP addresses, and many countries are preparing a large scale transition towards a dual-stack IPv4 / IPv6 network infrastructure[13]. IPv6 provides enough addresses (2^{128}) to provide each and every device and "smart thing" on earth, including circulating RFID tags, with its own public IP address. Beyond the scalability issue and the possibility to get rid of Network Address Translation (NAT) barriers, IPv6 carries new features, such as look-up, self-configuration, security and authentication mechanisms, which make the deployment of Internet of Things easier and more reliable. Its address structure enables to handle both routing information and a unique identifier of the connected device. IPv6 enables end-to-end and two-way communication, in which any IPv6 "smart thing" can connect to any other IPv6 device or system from any place and at any time. It enables the extension of the Internet to any device, sensor or actuator, which can become real nodes of the future Internet without NAT gateway and with an unlimited potential of interactions with other smart things and services.

IPv6 will deeply impact the Future Internet, as underlined by the EC Communication on IPv6[14], and the OECD Seoul Declaration on the Future of the Internet[15]. IPv6 is already being deployed with strong investments in Asia and by the US administration[16]. Japan, South Korea and China are investing massive resources to develop an IPv6-based "Internet of Things". At the 2008 Olympic Games, China showcased networks of video cameras and street lights turned into communicating IPv6 devices. Japan and South Korea have forcefully promoted IPv6 since 2000 with respectively over 70 and 50 ISPs offering IPv6 connectivity and services. The US administration has required all their suppliers to be IPv6-ready since 2003. The US Department of Defence is pushing to track all its logistics with IPv6 addresses. However, despite strong promotion efforts of the European Commission, Europe's industry seems to be lagging behind Asia and the US. IPv6 has been used mainly by the European research community such as Géant and the NRENs. Indeed, a very large community of ISPs in Europe, which has more than 50% of the world ISP community, have obtained IPv6 prefixes. There is certainly a good industry engineering community preparing their networks to be v6 ready. However, IPv6 is not on the radar of management to seize the opportunity and use it for services like IoT. As underlined by the EC communication, Internet of Things *"would benefit from a rapid deployment of IPv6"* and should *"allow an adequate level of interoperability so that innovative and competitive cross-domain systems and applications can be developed"* [17] **IoT6's ambition was therefore to explore the potential of IPv6 for the Internet of Things and to provide some concrete recommendations where IPv6 can add serious value.**

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[9] http://www.internetworldstats.com/stats.htm

[10] Vision and Challenges for Realising the Internet of Things, March 2010, European cluster IERC, p13, and Ericsson perspective for the IoT, http://gigaom.com/2010/04/14/ericsson-sees-the-internet-of-things-by-2020/

[11] IPv4 relies on 32 bits addresses; IPv6 provides an address space of 128 bits.

[12] http://www.potaroo.net/tools/ipv4/

[13] Countries like China, Japan, and Korea have developed large scale IPv6 network. The US administration requires from all their suppliers to provide IPv6 compliant ICT equipment.

[14] COM/2008/0313 final – Advancing the Internet : action plan for the deployment of IPv6 in Europe

[15] Adopted by the OECD Ministerial Meeting on the Future of the Internet Economy, Seoul Korea, 18 June 2008

[16] http://georgewbush-whitehouse.archives.gov/omb/egov/documents/DRAFT_Business_Case_&_Roadmap_for_Cpm .

[17] COM/2009/278 final – Internet of Things : An action plan for Europe, pages 7 and 8

1.2.2 Project objectives

The "IoT6" project stands for "Universal Integration of the Internet of Things through an open IPv6-based Service Oriented Architecture enabling heterogeneous components interoperability". It addressed the expectations of the ICT work programme and in particular the objectives of the ICT-2011.1.3: "Internet connected objects" and its targeted outcome "An open networked architecture".

IoT6 explored the potential of IPv6 to support the development of the Internet of Things through a highly scalable open service-oriented architecture, enabling the integration and interoperability of heterogeneous communicating things, with intelligence distribution, mobile network integration, business processes and cloud computing integration.

IoT6's ambitious aim was to:

- ➪ **Research and exploit the rich features of IPv6 and related standards** (6LoWPAN, CORE, COAP, etc.) **to support the future Internet of Things by developing a layer providing the enabling IPv6 features** (such as discovery, self-configuration, security, scalability, mobility, ubiquitous access, etc.) **to be exploited by the service layer**.
- ➪ **Research, design and develop an open and distributed IPv6-based Service-Oriented Architecture enabling interoperability, mobility, cloud computing and intelligence distribution among heterogeneous smart things components, applications and services.**
- ➪ **Use this IPv6-based architecture to develop innovative forms of interactions for the Internet of Things with:**
  - a) **Heterogeneous devices using different communication protocols** (including legacy devices), by **exploring innovative schemes for achieving multi-protocol integration and interoperability**.
  - b) **Mobile networks** to provide **ubiquitous access and seamless communication** among a large population of mobile and networked smart objects located in diverse geographical locations, with solutions such as IP Multimedia Subsystem (IMS) and the Mobile Internet Protocols.
  - c) **Cloud computing applications and services** (Software as a Service), including **business process management tools**.
  - d) **Smart Thing Information Service (STIS),** exploring STID-IPv6 interactions and possible adaptation and extension of STIS to any IPv6 device.
  - e) **Information and intelligence distribution with "Distributed resource repositories"** (for look-up and discovery services) **and "Smart routing"**.

IoT6 supported the integration of an exponentially growing and still very fragmented Internet of Things. It researched the potential of IPv6 (and related emerging protocols) to enable a global integration of the Internet of Things with applications and services in the cloud. The evolution towards IPv6 is considered as ineluctable[18] and constitutes both a challenge and an opportunity. IoT6 contributed to the standardisation process and supported the transition towards IPv6, as encouraged by the EC Communication on IPv6[19], the OECD (Organisation for Economic Co-operation and Development) Seoul Declaration on the Future of the Internet[20], the EC Communication on the Internet of Things [21], and the European cluster IERC vision for

[18] "Vision and Challenges for realising the Internet of Things" EIRC http://www.internet-of-things-research.eu/pdf/IoT_Clusterbook_March_2010.pdf

[19] COM/2008/0313 final – Advancing the Internet : action plan for the deployment of IPv6 in Europe

[20] Adopted by the OECD Ministerial Meeting on the Future of the Internet Economy, Seoul Korea, 18 June 2008

[21] COM/2009/278 final – Internet of Things : An action plan for Europe, pages 7 and 8

realising the Internet of Things[22]. IoT6 was also an opportunity to develop cooperation links with South Korea, which is a leading country on research related to IPv6 and the Internet of Things, and with the USA, through Prof. Vint Cerf.

1.3 A Summary Description of the Main Scientific and Technical Results

In this sub-section a summary of the individual work package achievements is given for the whole project duration.

The IoT6 workplan was supported by nine work packages. WP1 was responsible to provide the architecture design and requirements to be implemented by the following WPs, with clear specifications for WP2 and WP3, and the formal architecture description to be used for the dissemination (WP8).

WP2 and WP3 addressed two different layers of the IoT6 architecture:

- WP2 researched and provided the IPv6 features to be exploited by the architecture;
- WP3 researched and implemented the service layer of the architecture.

They cooperated closely in order to provide a coherent development and to provide the core architectural components (stacks and web services) required for the following WPs, in order to integrate and interconnect various systems into the new architecture.

WP4 researched and tested an innovative way to integrate heterogeneous communication protocols into the IoT6 architecture, enabling interoperability among heterogeneous devices, including non IP-based ones.

WP5 explored and researched an innovative approach of intelligence distribution by developing a smart box which tested the "smart routing" feature. It also provided the physical connectivity with part of the heterogeneous communication protocols.

WP6 researched and explored innovative forms of interactions by integrating the IoT6 architecture with STIS, mobile networks, and business processes applications and tools, with a cloud computing approach including Software as a Service (SaaS).

WP2, WP3, WP4, WP5 and WP6 interacted directly in their research and development. They delivered the required solutions for the integration, tests and validation (WP7). Feedback loops were provided to adapt and fine-tune the design according to the developments made by WP2, WP3, WP4, WP5 and WP6.

All WPs contributed to WP8 in terms of dissemination and exploitation. WP1, WP2, WP3, WP4, WP5 and WP6 also benefited from WP8 and its interaction with international alliances and standardisation bodies, which could support the WPs development.

The WPs and their interactions are shown in Figure 1, below:

[22] Report of March 2010: http://cordis.europa.eu/fp7/ict/enet/documents/iot-cluster/iot-clusterbook2009.pdf

1.3.1 Individual work package achievements

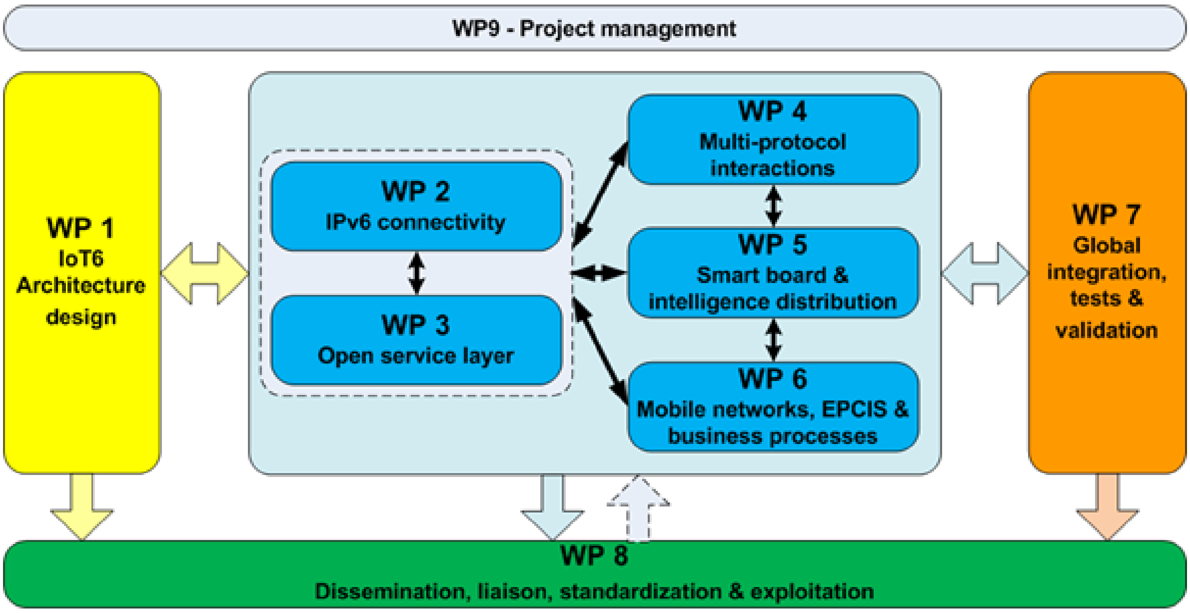

Figure 1: IoT6 Workflow

WP1 (IoT6 Architecture Design) activities started with Task T1.1 "Definition of Use Cases and Derivation of the Requirements". The identified Use Cases, the high level requirements and a high level architecture were discussed with the IoT6 Industry Advisory Board (IIAB) and their feedback was used to update the relevant outputs.

Based on the outputs of Task T1.1 (i.e. the identified Use Cases and their requirements) and taking into account the existing state of the art in terms of IoT architectures, during the second 6 months of the project, the focus was placed on the initial IoT6 architecture definition. This was done in collaboration with all technical work packages to ensure relevance of the output for all technical items. The work done in Year 1 was documented in deliverables D1.1 (IoT6 Use Case scenario and requirements definition report) and D1.2 (First version of IoT6 architecture & SOA specifications).

The initial architecture defined at the end of Year 1 was used during the second year to drive and guide research in other work packages. At the same time, using the outputs of other work packages, the initial architecture was further detailed and updated. At that time an early specification of the IoT-A architecture reference model [1] was released. As one of the main premises of the project, in regard to architecture design, was to build on the work of other projects and re-use the outputs where relevant, the initial comparison and mapping of the IoT6 architecture to the IoT Architecture Reference Model (ARM) was done. This enabled us to align the terminology and the functionality of IoT6 architecture with the one recommended by the IoT ARM. The work done in Year 2 was documented in D1.3 (Updated version of IoT6 architecture & SOA specifications).

In the final year of the project, the activities focused on the finalisation of the IoT6 architecture using the IoT ARM as the main reference point. In this period, we went through the process described by IoT ARM methodology in order to produce IoT6 architecture as much compliant with the IoT ARM as possible, given the work already done in the project. We selected one Use Case from WP7 and analysed it according to the methodology defined by the IoT ARM. Based on this analysis, we updated the IoT6 architecture and aligned it with the IoT ARM thus giving the opportunity for other projects to easily identify the additional components introduced by the IoT6 project due to specific requirements and focus on IPv6 as well as to reuse it in their projects if applicable. The work done in Year 3 was documented in deliverable D1.4 (Final version of IoT6 architecture & SOA specifications).

WP2 (IPv6 Connectivity) had the ambition to explore the potential of IPv6 from the viewpoint of a network stack. The WP was designed to investigate advanced features and to produce a network IPv6 stack incorporating these features and to incorporate security, scalability, performance and self-healing. The problem was that some of these features depended not so much on the stack as on the interaction between entities, many of which were dependent on the operating system used, and some even on the hardware. Moreover, many of the protocols were standardised in other bodies; this did not impact our using them, but did impact the timing. If the aim was only to provide a stack that could be used by other WPs, it had to be frozen by the end of Year 2; the other WPs could not cope with a stack that changed during the integration phase and changed while preparing for the demonstration.

In order to resolve this dilemma, we developed a stack as required and froze it at the end of Year 2. The stack worked with Linux for gateways and Contiki for small devices, and supported 6LoWPAN, RPL routing and all other IPv6 advanced features, by the third quarter of the second year. This stack was delivered to WP3 and hence the other WPs on schedule. All this work was discussed in detail in deliverable D2.3 (Report on IPv6-based advanced features).

During the third year, detailed experiences were recorded on the performance of this stack, and reported in deliverable D2.4 (Implementation and testing report on IPv6-based IoT6 features). In particular, while Contiki was the agreed choice of OS, several advanced IoT6 features that had to do with security (Datagram Transport Layer Security (DTLS) messages between embedded devices and between devices and gateways) required larger amounts of memory to be implemented.

Another important IoT-specific feature that was developed was GLoWBAL. This was an algorithmic mechanism for assigning IPv6 addresses to devices that might be accessible only through IP-enabled gateways, and had features understood only by a legacy technology. This mechanism was clearly very important as an enabler of large-scale deployment. Its utility was greatly enhanced by features developed in WP3 based on the Digcovery repository. It was included in the stack delivered to the partners.

Another aspect of WP2 was an investigation of how to provide security. While we showed that the popular encryption algorithms could be implemented on small devices, the provision of real security required a complete security infrastructure which was not really part of WP2, and whose provision had not been budgeted. Moreover, we had envisaged smart routing to be a feature that would be implemented at the network level. In practice, this use of the IP header had been deprecated at that level in the Standards Body (IETF), so we agreed to provide it at a service level under WP3. As a result, partly based on the reviewers' comments, we revisited the stack to incorporate datagram security DTLS with the latest versions of both the operating system Contiki, a compatible version on Linux, and the latest versions of the transport protocol CoAP adopted in the project. The implementations of the security features were found to be platform-dependent in terms of memory requirements, and could not operate on the specific constrained platforms used by the partners in the main demonstrations, which by nature would utilise more application layer resources, even though all other aspects could be identical. For this reason, we decided to validate the implementations only in another set of demonstrations, which simplify the application layer in order to shift available memory towards the secure datagram layer below the application/CoAP layer. It was pursued further with much more advanced features that were incorporated into a complete validation demonstration but not that of one involving the majority of the partners.

Having fulfilled all the other requirements of the other WPs by the end of Year 2, we moved to a very promising set of activities in Year 3. We had come to the conclusion that the use of identifiers was a logical, and much more powerful, extension of the ideas demonstrated in GLoWBAL. Moreover, we found CNRI's Handle system incorporated all the features of real security we required and could be directly combined with all the requisite features. This system was already deployed for other application domains, incorporated a strong security infrastructure and had proven scalability capability. On the request of IoT6, CNRI ensured that their system would both operate with IPv6 features and be IPv6 addressable. Moreover, they were developing a new Release, which would incorporate RESTful programming mechanisms that are central to the IoT6 approach and promised to give us a pre-release version of their new system before the end of the 3rd Year. An important advantage of this approach is the way that IPv6 addresses, Internet services and GLoWBAL interwork. IPv6 addresses are usually stored in the DNS, and this is a key feature of our WP3 approach. Anyone can access the DNS, and hence inspect the IPv6 addresses which under GLoWBAL may reveal features of the target subsystems. With Handle, such access is restricted to authorised users with a sophisticated and fine-scale authorisation. Thus, by using Handle, we have been able to demonstrate it in a Use Case that is a subset of the main one in the project but with secured, deployable and scalable features.

The main additional problem that this approach raised was managerial, not technical. Going from the network service to a complete validation required activity that really belonged in WP1, WP3 and WP7. The reporting in WP1 was straightforward; there were substantial contributions to D1.4 (Final version of IoT6 architecture & SOA specifications) which included portions on scalability, governance and security. However, the duration of WP3 was scheduled to end in January 2014, and the deliverable contents in WP2 and WP7 had been worded slightly differently. We decided, therefore, to describe our approach to the first problem to the reviewers at the end of Year 2 and received their approval. When considering how to report the validation, we determined that the description of the approach would be reported in deliverable D2.4 (Implementation and testing report on IPv6-based IoT6 features), but that deliverable D5.4 (Intelligence distribution tests and evaluation report) was a much more natural home for the detailed treatment of the Use Case even though the work was validation. However, the validation effort was charged to WP7 where it belongs technically. In addition, this work has been widely disseminated in talks, papers and the relevant EC body considering standardisation in IoT.

WP3 (**Open Service Layer**) researched and developed a service layer enabling the interaction with different kinds of Internet of Things components. We proposed an architecture and middleware for the scalable integration of actuators and sensors in a network of ubiquitous sensing. The objective was to define mechanisms to support the search for an effective service layer for the sharing of sensor and other smart things information in real time, search and browse, as well as discover resources and information in a distributed and loosely coupled approach. The work package comprised 3 Tasks:

- Task T3.1 Overlay Service Layer: Look up and discovery, context-awareness and resource repository. Within this Task, a lightweight multicast DNS (lmDNS) for IPv6-enabled Smart Objects was used in order to overcome the limitations of mDNS which is designed for host-based requirements, where they are not taking into account the design issues and constraints of Smart Objects. As a consequence, this work converged to a global discovery architecture interoperable with DNS called Digcovery and accessible via www.digcovery.net. Individual drivers were designed to interconnect different kinds of objects, things, devices, sensors and tags (RFID, Handle System, legacy technologies, etc.) Finally, a search engine, an access control policies, and a set of management functions were proposed. All these elements contributed towards the key purpose in the IoT6 project, to build an Open Service Layer which made feasible its full integration into the IPv6 architecture through protocols such as DNS, and other communication interfaces which define the Open Service Layer. Finally, as part of this Task, Local and Global Discovery interactions based on mDNS/DNS-SD and overlay networking solutions were analysed and how to publish/search globally the resources and devices registered at the local level.
- Task T3.2 Smart Routing Mechanisms: Task T3.2 produced the deliverable D3.2 on Smart Routing. Two main solutions were investigated and tested with the gateways, in order to support the traffic differentiation from the IPv6 sensor nodes to a multicast/anycast address on the IPv6 intranet.
- Task T3.3 Service Layer Implementation and Tests: This Task worked on the integration of the initial design and solution under the OSGi framework to provide a common API to be used within WP3-WP6 for validation. Also the Java OSGi bundles were extended to support some of the WP2 functionalities. The IoT6 Stack has been proven in four environments: Contiki-motes, OSGi-Gateway, Digcovery-server and mobile phones. These implementations provide the functionalities of IPv6 connectivity and Open Service Layer defined in WP2 and WP3, respectively. Both implementations support IoT6 interoperability in heterogeneous networks such as wireless sensor devices and legacy technologies (BACnet and KNX). The implementations have been divided into several modules according to their functionalities: IPv6 Addressing, Quality-of-Service, Service Discovery and Web Services, etc. The validation has been done in relation to the Use Case and

interaction with the rest of the IoT6 components.

The main outcomes of WP3 were:

- Stable IoT6 stack platform based on:
  - OSGi and Contiki components deployed and tested by other WP;
  - Digcovery platform allows registration and homogeneous access to the information provided by sensors or other devices;
  - Providing context awareness with the aid of MongoDB;
  - DigCovery makes use of enabling IPv6 QoS to control its own traffic.
- IoT6 Open Service Layer enables that Smart objects can be discoverable, accessible, available, usable, and interoperable through IPv6 technologies like:
  - Lightweight multicast DNS (lmDNS) for local discovery in IPv6-enabled Smart Objects;
  - Digcovery for scalable global discovery architecture interoperable with DNS-SD directories;
  - Common description based on ontologies (SSN) and profiles (IPSO);
  - Elastic Search for look-up and context-awareness queries.

WP4 (**Multi-protocol Interaction**) had the goal to bring non-IP based communication systems - mainly the Building Automation Systems (BAS) - from their closed domains toward the IPv6 world. Most efforts in this WP have been focused on this problem.

The first step was to understand the system architecture that could support the integration of BAS within the Internet. To this end, we reviewed the main existing building automation protocols, in order to choose the ones to take into account in the design of the architecture and to understand their main features and the constraints that they impose on the architecture itself.

In a second phase, we focused on the high level design of the architecture, choosing among available frameworks and components, with the goal of guaranteeing a seamless integration and management between all the protocols considered. Two different approaches were considered. The first approach was based on using and adapting the Universal Device Gateway (UDG)[23] with the characteristics needed to satisfy the requirements defined in the work package. The second approach was based on creating a BAS gateway using a generic semantic exploiting a standardised Information Exchange mechanism[24]. The latter approach led to the creation of the IoTSyS integration middleware[25].

When the two systems, UDG and IoTSyS, were implemented, the partners collaborated together to integrate them. This task was performed in order to demonstrate that the Control and Monitoring System (CMS) could work with different kinds of gateways, despite using different semantics to manage devices from different technologies. The integration of these two systems ensured the satisfaction of the requirements in the WP4 directives on the integration of different legacy technologies.

Much effort was spent on the implementation of the CMS, improving its previous architecture in order to allow its usage in the scenarios envisaged within this project. Various features have been research with the CMS, including: capabilities to manage Virtual Variables, Dynamic Targets and Groups of Devices; creation of an IPv6 mapping to non-IP protocols [26] (proposed as a standard) that allows the automatic assignment of a unique IPv6 address to each legacy devices residing under the CMS; the capability to distribute the

[23] http://www.devicegateway.com/
[24] https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=obix
[25] https://code.google.com/p/iotsys/
[26] http://datatracker.ietf.org/doc/draft-rizzo-6lo-6legacy/

intelligence (logic that is defined within the CMS) among different nodes, thus increasing the scalability; a novel Graphical User Interface (GUI) that allows to configure easily the devices and to design the scenarios desired using all new features introduced (this GUI is now available for computers, mobile devices and Tablets).

The next step was to integrate the CMS and the gateways into the IoT6 ecosystem. This task was performed by using the IoT6 Stack, which was designed to allow all the IoT6 Components to work together, enabling more complex scenarios.

Lastly, we performed a study about different schemes for Machine-to-Machine (specifically Device-to-Device) interactions, in order to understand their main features and their differences, and to determine which one fits the context of the project. The outcome of this study has been documented in the deliverable D4.4 (Report on heterogeneous device interoperability and multi-protocol integration).

WP5 (**Smart Board and Intelligence Distribution**) was aimed at integrating the concepts that were developed within work packages WP2, WP3 and WP4. The main goal was to **implement** and **test** the intelligence distribution tools and some specific routing and security mechanisms dealing with a complex ecosystem of heterogeneous components and heterogeneous applications and services.

The first work in WP5 was to design an embedded board ("Smart Board") offering multiple physical interfaces and supporting translation protocols able to integrate legacy devices within IPv6 networks. This embedded board was aimed at providing the different research teams with the same generic compact system able to cope with heterogeneous devices, networks and protocols such as found in Building Automation Systems (BAS).

Part of the challenge in designing that board was to ensure a large spectrum of physical accesses compatible with the numerous Use Case scenarios in deliverable D1.1 and a modularity allowing the rational use of components for different deployment scenarios. The hardware components and part of the firmware were developed in Task T5.1 as documented in deliverables D5.1 (Document on selection of circuits and functionalities) and D5.2 (Smart Board design and realisation report, including board prototype validation tests).

The multi-protocol integration, i.e. the implementation of the IoTSys architecture (designed in WP4), and its deployment on the Smart Board was carried out in Task T5.2 (with the main results described in deliverable D4.3 (Multi-protocol integration report). The multi-protocol interoperability was realised by using the OSGI framework through the development of a set of protocol bundles associated with the main BAS technologies (KNX, Bacnet, M-Bus, En-Ocean, RF-ID and ZigBee). The protocol bundles were deployed on the Smart Board, providing, together with the gateway components, a lightweight access to the heterogeneous technologies through the IoT6 stack.

A dedicated software application hosting the IoTSys as well as the Smart Routing components were developed to handle the configuration of those components at launch (IoT6 Launcher).

The distribution of intelligence (such as studied in WP4, deliverable D4.2) was ensured by integrating the Smart Board software components into the framework of the IoT6-based CMS, (UDG). IoT6-based monitoring functionalities such as resource discovery (based on the Digcovery studied in deliverable D3.1 (Look up and discovery, context-awareness and resource) and the Smart Things Information Service (STIS) have been implemented as well as powerful and flexible mechanisms providing dynamic control rules. See deliverable D4.2 (Multi-protocol architecture and system development report). Those UDG flexible mechanisms can be deployed in a multi-stage, hierarchical configuration and are therefore adaptable to a wide variety of control loops, from the lowest-level, direct control of an actuator set point, to high-level control, such as keeping a room with all its various properties in the comfort zone set by the user.

The content-based `Smart Routing' mechanism described in deliverable D3.2 was implemented within the IoTsys middleware in order to improve the routing capabilities, allowing the more efficient routing of sensor values.

Having implemented such a powerful IoT6 architecture with a plurality of actors/components, it remained to find a coherent way to challenge and test the implementation. This quite difficult task was the subject of Task T5.3: Intelligence distribution tests and evaluation and was carried out by taking into account the content of deliverable D7.1 (Test process specified), which provided a general framework (abstract architecture) for each Use Case scenario planned in deliverable D1.1 (IoT6 Use Case scenario and requirements definition report). Test cases were performed in order to evaluate the “Smart routing” and QoS features enabled by the Smart Board. The test cases showed how the Smart Board manages reliability the data flows between the heterogeneous devices (IP sensors and legacy actuators) and various control systems such as CMS, Safety Server and SaaS. The evaluation results showed that all test cases were completed properly and the smart routing and QoS mechanisms were implemented successfully in order to achieve intelligence distribution among heterogeneous IoT devices and control systems.

Last but not least, WP5 (in line with deliverable D2.4 (Implementation and testing report on IPv6-based IoT6 features findings) proposed an original way to provide security operations such as authentication, authorisation, confidentiality and integrity using distributed elements based on the Handle System and the DTLS cipher suite. Several Use Cases were proposed for the validation of security activities in the final demonstration. Although the application of a strict security policy through the deployment of a security infrastructure is beyond the scope of the IoT6 project, the Handle System provides most of the technology needed to incorporate a credible measure of security into the sort of Use Cases we are studying in IoT6. The security proposal of the Handle system has shown that this approach could have impact on IoT far beyond the IoT6 project.

WP6 (Mobile networks, EPCIS & Business Processes) focused on the research challenges related to the integration of IoT6 with mainstream applications, such as business processes applications using the cloud computing platform of Software as a Service (SaaS), mobile networks, and the Smart Thing Information Service (STIS).

In order for IoT6 to be interoperable with STIS, an analysis of unique identifiers was necessary, because STIS has its own identification system and it should be interoperable with that of IoT6, namely IPv6. Deliverable D6.1 (Unique identifier analysis report and STIS, ONS, IoT6 integration) reports on the analysis of unique identifiers and the integration of IoT6 with STIS and ONS. We analysed various unique identifiers such as Uniform Resource Identifier (URI), the Handle System micro ID (uID), Object Identifiers (OIDs), Universally Unique Identifier (UUID), Electronic Product Code (EPC), etc. Among them, we concluded that URI was the best choice for the identifier to enable interoperation among heterogeneous identifiers. In deliverable D6.3 (Interface between IoT6, STIS and ONS validation report), an interoperability test was performed to verify IoT6’s interoperability with STIS, and its result was presented. The tests included unit tests for each interface as well as integration tests between IoT6, STIS, and ONS. We showed the feasibility of design and implementation of integrated system. Finally, we tested and presented the result of the proposed unique identifier implementation in the frame of IoT6 architecture. In deliverable D6.4 (Innovative interactions between STIS and IPv6 through IoT6 report), IEEE 802.15.4-based active RFID tags with STID was introduced as innovative interactions between STIS and IPv6. To enable interaction between these Smart Things and STIS, 6LoWPAN (IPv6 over Low power Wireless Personal Area Networks) was employed as a vehicle to integrate non-IP-based Smart Things with STIS. As a result, it was shown that coverage of IEEE 802.15.4-based active RFID networks can be easily extended with the aid of 6LoWPAN networks, which is called 6LoWPAN-based active RFID networks. Also, by integrating a 6LoWPAN gateway with LLRP (Low-level Reader Protocol) readers, Smart Things and STIS can communicate with each other without any modification, through 6LoWPAN-based active RFID networks.

The requirements for the interoperability of IoT6 with mobile networks were proposed by Task T6.1. This Task had the goal to propose the best option to implement and test the aforementioned forms of interactions between mobile phones and IoT6. Deliverable D6.2 (Ubiquitous access and mobile phone network interactions report) analysed the registration procedure, addressing of mobile devices, and mobile devices acting as Gateways and half-Gateways in IoT6. It also explored various ways to integrate an IPv6-based Internet of Things into mobile phone networks, enabling mobile devices to provide access to Smart Objects, as well as to use mobile devices as sensors/actuators. Also, for ISPs not supporting IPv6, the tunnelling mechanism was used. The ability for Smartphone sensor discovery and data gathering was presented, with possible options for non-IP devices. The feasibility of mDNS implementation on a mobile phone was also studied.

For the interoperability of IoT6 with the business process management tool, the CoAP protocol and JSON format should be supported. Deliverable D6.5 (Business Process Management tools and Cloud Computing applications integration report) demonstrated the feasibility of interaction and a new kind of application. As a result, the RunMyProcess Business Process Management tool was interfaced with the Internet of Things by adding new functionalities to allow CoAP connectors and the development of a CoAP proxy to make the platform visible to CoAP objects. Also, it exposed a vision of interaction between SaaS applications, the Internet of Things and legacy Web services, called `Composite Business Ecosystems for the Web of Everything`.

WP7 (Global Integration, Test and Validation) described the Use Cases in deliverable D1.1 (IoT6 Use Case scenario and requirements definition report). These Use Cases were analysed and refined. It was found to be necessary to re-evaluate the mentioned components and how they fit with the final IoT6 architecture. To achieve this task, the Use Case descriptions were subsequently completed and spread among the partners. Thereafter, the Use Case descriptions and sequence diagrams were updated.

Furthermore, an interoperability testing strategy had to be chosen. Different testing strategies were evaluated for testing the interoperability of the IoT6 architecture. Finally, the ETSI EG 202 237 guideline - which is also the basis for the PROBE-IT EU FP7 project - was selected as suitable.

The first step of the testing guideline was to extract the interface descriptions from the Use Case descriptions and sequence diagrams. Afterwards, the test cases were developed. Deliverable D7.1 (Test process specified) describes the scenarios and interfaces between components of the IoT6 system. The test groups and test purposes were defined, as the basis for the development of formal test cases. As a result, the main outcome of this deliverable was a set of test cases necessary to perform the interoperability tests.

The next task was the development of a concise test plan for the defined test process that could be used to test the interoperability of the IoT6 components. The scenarios of the initial test strategy were adapted to a consolidated "extended Smart Office Use Case" that was agreed upon by the IoT6 consortium. The test cases originally defined in D7.1 (Test process specified) were adapted to reflect a scenario that involved all elements of the IoT6 architecture and allowed a thorough interoperability test, at the same time economically using available resources. In this context, so-called "abstract architectures" were defined for all steps of the scenario detailing the test setup and allowing the identification of communication dependencies between components and partners. Following, a distributed test plan was worked out, and dependencies between the partners were identified. The local test setups at the sites of the different involved partners were adapted to support the interoperability test procedure of this work package. Furthermore, the additional equipment needed for the final demonstration was evaluated.

Finally, in the test execution phase, several iterations of testing sessions were scheduled according to the test plan. These iterations were performed in a way that all involved partners were monitoring their systems and thus validating the correct execution of the agreed-upon extended Use Cases. The coordination of the testing efforts included regular VoIP meetings ("test days") on which the agreed upon Use Cases were executed step-by-step by the responsible partners. Each test session was documented, in terms of how many test cases associated with the Use Case could be successfully validated. Furthermore, in the event of unsuccessful test cases, the reason for their failing was logged and documented in the deliverable D7.2 (Components Instantiations and validation report).

Apart from interoperability testing, the second main focus of the work package was to evaluate the scalability of the IoT6 architecture. Therefore, a proposal for a scalability testing methodology was prepared and presented. Different approaches for scalability assessment have been used to test the various components in the compound. In this case, components of the IoT6 architecture have been analysed based on benchmarks as working prototypes were available. The performed analysis clearly shows the limits of scalability depending on the used hardware resources.

All efforts regarding interoperability and scalability testing were collected and documented in the final test report for this work package in deliverable D7.2. In deliverable D7.3 (Smart IPv6 building deployment, tests and recommendation report), the results of the deployment and tests of the IoT6 architecture and components in a real smart office environment are presented. Further, innovative future applications of the IoT6 architecture have been created and introduced thoroughly in D7.4 (Innovative business processes test and validation report).

WP8 (Dissemination, Liaison, Standardisation and Exploitation) has been heavily involved and taking the leadership in chairing and organising peer reviewed, well-known, international conferences, as well as actively participating in standardisation efforts.

A summary of the activities includes the following (see more details in section 2 and deliverable D8.2.3).

Dissemination activities

- Leadership in IoT Forum and IoT Week
- Leadership in IEEE ComSoC IoT subcommittee
- Leadership in IPv6 Forum to organise IoT6 panels
- Organised directly over one dozen conferences
    - 3 IoT Week events
    - 4 IEEE ComSoc IoT events
    - 2 IPv6 Forum panels
    - 3 esIoT workshops
- Participated in 100 partner and industry conferences
- Authored more than 3 dozen papers, including in:
    - 3 IERC Books
    - IEEE ComSoc papers
- Authored the SME handbook
- Created and maintained the IoT6 Website

Standardisation activities

The IoT6 consortium has approached the industrial community and put effort to spread the knowledge and project achievements through the standardisation bodies (IETF, ETSI and ITU-T) as they attract the leading industry players: IETF attracts some 1000 experts and ETSI has some 600 industry members. IoT6 sought to interest the industry with the project solutions and impact the standardisation process (mainly in the IETF 6LoWPAN, 6lo and 6TiSCH and ETSI ISG). Specific activities included:

- Co-authored the standardisation chapter in the IERC Book led by ETSI
- Formed an ETSI Industry Specification Group for IPv6 and IoT
- Drafted a RFC at the IETF on legacy protocol integration into IPv6

Exploitation activities

The IoT6 consortium focused exploitation activities on interaction with the SMEs and IoT industrial sector. The planned activities were organised in 3 strands:

- Organisation of dedicated events for presentation and promotion of the benefits and advantages of IPv6 based IoT solutions, focused on events targeting SMEs and IoT industrial sector players. See more details in deliverable D8.4.3.

  - Preparation of promotional material, including professionally designed content, aimed at researchers and industry, with specific focus on SMEs.
  - A series of A1 size posters providing an overview of the project and the main outcomes.
  - SME book, providing a description of the main outcomes of the project.
  - Short version of the SME book: a 10-page leaflet providing a summary of the full SME book.
  - IoT6 comic poster and leaflet.
  - IoT6 gadgets: A set of promotional gadgets such as postcards are created including Augmented Reality (AR) in collaboration with a marketing company.
- Three portable IoT6 demo setups were created to enable easy demonstration of the main project concepts and outcomes.
  - TUV portable suitcase.
  - Demonstration at the FIA conference.
  - Demonstration at the ICT Spring conference.
- Contribution to the creation of the IEEE ComSoc technical working group on Internet of Things (IoT) that was created in November 2012. The group is chaired by Latif Ladid (UL), and Vice-Chaired by: Antonio Jara (HESSO), Antonio Skarmeta (UMU) and Sebastien Ziegler (MI).

Partners' individual exploitation plans are given in deliverable D8.4.3.

1.4 Potential impact

"By the year 2020 there will be one billion computers, 5 billion users of mobile communication systems, ten billion appliances, one hundred billion sensors, and one billion billion electronic tags, most of them Internet-enabled. Getting it right means a huge economic potential. Getting it wrong would be catastrophic."

Viviane Reding, European Commissioner

1.4.1 How IoT6 addressed the impacts expected from the call

The following summarises how IoT6 addressed the expected impacts listed in the call:

Impact 1: IoT6 has opened a new range of Internet enabled services based on truly Inter-connected physical and virtual objects, person to object and object to object communication as well as their integration with enterprise business processes.

IoT6 has truly paved the way to a new range of Internet enabled services and their integration with enterprise business processes by enabling integration of cloud computing, heterogeneous devices, mobile phones networks and STIS. IoT6 has defined open architecture leveraging the capacity of IPv6 to provide ubiquitous access and seamless communication among a large population of mobile and networked smart objects located in diverse geographical locations thus enabling a cost effective integration and interoperability of heterogeneous smart things and systems. Integration of the Internet of Things with cloud computing has been enabled through Software as a Service (SaaS), such as enterprise business process management tools. A multi-protocol translation Web service providing interoperability among heterogeneous smart things and systems using different communication protocols as well as IPv6 proxy services for legacy devices to ease their integration into the future Internet was developed. IoT6 has provided STIS-IPv6 integration, thus enabling a global addressing scheme for STID and IPv6 as well as mechanisms for address registration and update, and sensor information exchange between IoT6 and STIS. Integration with mobile networks was also achieved.

The extension to the use of an IPv6-enabled Digital Object Architecture allowed secure description of the heterogeneous objects and processes that transcends the network address space. The secure linkage of identifiers with IPv6 addresses and security tokens greatly facilitated multiple stakeholders to provide independent services to common IoT sensors and actuators. It also eased the problems of IoT governance. It divorces the management of the Internet IPv6 address space from the identifier space. This allows new Stakeholders, including complete industries, to manage their identifier space without impacting the management of the Internet.

Impact 2: Novel business models based on object connectivity and supporting innovative Internet services.

IoT6 developed an open service oriented architecture easing the integration of different products and services through the Internet. It interconnected the Internet of Things with the Internet of Services through IPv6. It therefore paved the way to innovative ecosystems of companies, enabling the aggregation of complementary products and services from different companies in order to provide ad hoc solutions to the customers. It has instigated the creation of new business opportunities and revenue generating business models, stemming from the ability to structure ad-hoc platforms of heterogeneous products. These business models involve new roles and stakeholders, such as "solution brokers", who can provide ad hoc combination of resources and services. In order to evaluate this approach, several business scenarios were evaluated within the project that are clearly linked with Future Internet priorities areas like intelligent buildings. For instance, the on-line maintenance management tool enabled new maintenance services for building automation components, particularly relevant for building and construction industry, including some members of the IIAB.

Impact 3: Emergence and growth of new companies, in particular SMEs, offering innovative technical solutions for making everyday objects readable, recognisable, locatable, addressable and/or controllable via the Internet.

IoT6 has supported SMEs in the following ways:

- Produced a handbook targeting SMEs to support their exploitation of IoT6 outputs as well as their transition to IPv6.
- Directly supported RunMyProcess (as a partner in the project) and a spin-off company of UMU, Hops, as well as the further development of the UDG technology, including through the establishment of a UDG Alliance by the HES-SO, MI and the initial partners of the UDG project.
- Generally, facilitated the entry for new SMEs, by enabling them to integrate specific solutions with other solutions through an open framework. The focus on smart buildings paved the way to innovative technical solutions with huge business opportunities for companies who can offer flexible and secure solution to the users.

Also, instead of initiating an alliance to support the development and dissemination of IoT6 architecture, the project has taken the leadership of the IoT Forum and included the leader of the IPv6 Forum.

These channels enable direct support to the dissemination and adoption of IoT6 results by industries and SMEs.

Impact 4: Consensus by industry on the need (or not) for particular standards. More widely accepted benchmarks. Consensus by all stakeholders on the governance of the "Internet of Things" including key management aspects.

IoT6 is closely linked with major industries, international forums, standardisation bodies and other research projects with a European and international perspective. IoT6 is in very good position to align and contribute to the consensus by industry and other stakeholders on the need and critical use of IPv6 for the Internet of Things, with a proposed open and decentralised service-oriented architecture.

1.4.2 Industrial Exploitation

Partners (confidential) exploitation plans are provided in deliverable D8.4.3. Below, we generalise on the opportunities.

Large industries play a pivotal role in ensuring the width and depth of required service, technology and financial provisioning. The added value in being the facilitator of unprecedented services to utilities, authorities and citizens, will stipulate an incredible economic growth within these industries and in related geographical regions there upon. IoT6 has allowed these industries to position themselves at the forefront at the recently emerging smart living initiatives (e.g. Smart Cities, Living Labs, etc.), gaining a competitive edge over similar non-European developments. According to the US Company IBM, making this planet smarter i.e. more effective and efficient through instrumentation, interconnection and intelligent decision making, yields a value proposition of $93 billion per year; European industries are aiming for a stake in this.

Tapping and tightly coupling into IoT6's service platform allows involved industries to improve, distribute, market and leverage their respective product lines which range from telecom service provisioning, integration services, business planning and financial provisioning, among many others. Therefore, the benefit is seen in the following: competitiveness; employment; market position; return of investment and general added value. Indeed, competitiveness is achieved by a shorter time to market, due to open collaboration and scalability of the service platform; associated cost reductions; tapping into unprecedented business opportunities among others. Employment is leveraged (and not reduced despite the technological advancement) since new services will require hiring staff due to deployment, training and maintenance as well as new business opportunities. The market position has been greatly improved due IoT6's standards-compliant, service-enabling platform, based on IPv6 protocol, uniform semantic description of smart objects' capabilities as well as the overall architecture capable of supporting heterogeneity of smart objects and end user applications through an efficient mash-up of context information captured by the objects. Such a platform deployed in a cloud and offered as a service lowers the entry barrier and - more importantly - opens up possibilities of combining various smart objects into an integrated system, including the business process applications, capable of simultaneously providing multiple different services utilising a common infrastructure.

The presence of large industries in the project gave it a lasting value in that successful and proven technologies (i.e. the service platform), will find their way into European and international markets. As for the individual partnerships, a close collaboration with authorities and utilities allows innovative and proven technologies to hit the market. SMEs can give innovative impetus to the product development of larger industries, where a co-sell of products and services is well envisaged within IoT6. Then, universities and research centres will shape the companies' R&D lines and strategy plans, bearing in mind that emerging technologies are the number one factor in significantly impacting predictions.

1.4.3 SMES

Small to Medium-Size Enterprises are seen as an important interface between the conceptual design of innovative solutions and eventually getting to the market. Recent statistics from IBM reveal that SMEs and spin-offs are the major and only constant providers of jobs at European and international levels. Their involvement in the project is hence pivotal for economic stimulus and growth in impacted regions as well as Europe at large. The SMEs of IoT6 will exploit the generated innovation and, importantly, will be able to market these due to the availability of a generic service platform and the presence of important players in the field, including several potential clients who are members of the stakeholder group.

One of the main current issues is the lack of standardisation as well as solutions that can enable simple integration of a variety of smart objects into an efficient system. This has further impact on the potential size of the market each SME can address and increases the threat of getting locked into a proprietary solution. From the outset of the project, we decided to base the IoT6 architecture on the work done by other projects and organisations, in particular IoT-A and FI-WARE in order to design a system that is compliant and interoperable with other IoT system, thus helping in creating a larger IoT market. In addition, existing standards are used wherever possible, thus further facilitating the reuse of the IoT6 results in commercial solutions and their applicability across different scenarios.

The Software as a Service (SaaS) market is growing at 17% per year. The IoT6 project has created an open architecture enabling integration of various products and services from different companies. This constitutes an open platform on which to develop innovative dynamic and composite business solutions for the delivery of customisable high value added products and/or services to the market. It enables the development of an SME ecosystem and larger companies bringing complementary products and services that can be easily aggregated into coherent and ad hoc solutions. In other words, it paves the way for "clouds of enterprises".

IoT6 enhances European industrial competitiveness by providing the interoperability service framework that will make these business offerings possible. The open and integrative nature of the architecture will ensure interoperability between different solutions thereby offering consumers the choice to use their preferred solution. Moreover, the selected communication protocols for the project are used by many European SMEs and the testbed uses off-the-shelf products coming largely from European SMEs.

To achieve the maximum impact on SMEs, during the last year of the project, IoT6:

- Created a handbook for SMEs, gathering the main results, guidelines and recommendations extracted from IoT6, to ease and accelerate the integration of their products and solutions into IPv6 and in the IoT6 architecture.
- Organised a workshop to present the IoT6 results, and to train and support SMEs interested to integrate their products and/or solutions into our architecture.

RunMyProcess, a SME in the consortium, leverages the project results to further develop its portfolio of cloud services and extend it to the Internet of Things domain, thus opening new business opportunities for them. It will leverage the project on several aspects:

- Enhancing its platform with mobile capabilities to allow the creation and deployment of process-based applications in a Cloud – mobile converging context of a maintenance system of an IoT network of items. This is particularly relevant, and can be applied in various business scenarios.
- Developing its connectivity capabilities currently centred around http using ReST and SOAP, to include protocols relevant to the IoT context.
- Overall, this will help RunMyprocess to establish itself as a player in the growing M2M market.

During the second year of the project, RunMyProcess was acquired by Fujitsu. This transition will make it possible for the larger and quicker adoption of IoT6 results into Fujitsu solutions.

Furthermore, several IoT6 partners, such as HESSO and UMU have a tradition to work in close cooperation with SMEs for industrial dissemination and exploitation. During the second year of the project, a UMU spin-off was created, viBrain Solutions. Leveraging the experience gained in the project, this start-up aims to create smart lighting solutions. The quality was already recognised by the IPSO Alliance (finalists in the competition organised by this Alliance) as well as an award the promoter of the company received at the IoT Week. In parallel, IoT6 contributed to support the creation of another Spanish start-up named Hops.

Furthermore, the project has benefited from - and contributed to - the further development of the UDG control and monitoring system, which has its own exploitation plan to be further developed as an autonomous SME together with a non-for profit UDG Alliance to support further research projects based on UDG technology.

1.4.4 RESEARCH COMMUNITY

The academic partners are a major driver in the provision of innovative techniques, technologies and services. The outcome and lessons learnt from this project will empower and advance the various interdisciplinary centres and their stakeholders. The universities and research centres are also tightly connected to various smart city initiatives, further boosting presence and impact.

One of the most important issues often neglected by the majority of industrial partners and thus clearly advocating the presence of more academic partners is dependability, i.e. security, trust and privacy. The academic partners have thus advocated for an exploitation of their derived key protocols by public bodies, utilities, larger and smaller SMEs.

The partners were also well suited in defining and exploiting strategic research agendas driven by a scientifically strong group of faculty and researchers formed around a number of interdisciplinary research platforms that provide application area focus and long term direction. Strong links were established with external partners to define and launch research projects with relevance to the community.

Generally, the results of the IoT6 project are generating new research scopes and opportunities for the cooperation with wider stakeholder communities in the utilities and environment fields, contributing to a sustainable partnership never experienced before in facilitating hands-on-driven research work and winning top class researchers in areas such as the Internet of Things.

In this respect, the creation of the IEEE ComSoc Technical Working group on Internet of Things (IoT) in November 2012 needs a special mention; the group is Chaired by Latif Ladid (UL), and the Vice-chairs are: Antonio Jara (HESSO), Antonio Skarmeta (UMU) and Sebastien Ziegler (MI).

1.4.5 ALLIANCE CONSIDERATION

During the preparation phase of the project, the establishment of an alliance to support the development and dissemination of the IoT6 solutions and in general IPv6 based IoT systems was considered. This was further discussed among the partners during the first two years of the project. While the interest for setting up such an alliance was there, the main concern was that it would overlap with some of the other initiatives in the same domain. Through interaction with other projects and organisations active in the IoT domain, other options were explored, in particular the International IoT Forum, initiated by the FP7 IoT-I project and supported by the European Research Cluster on IoT (EIRC). Having in mind the objectives of the IoT Forum and involvement of some of the partners in its activities it deemed as a better solution to combine the efforts and use the Forum as a vehicle for promotion of IoT6 results as well as general promotion of IPv6 in IoT.

The IoT Forum was officially launched as an independent body in June 2013 during the IoT week. The IoT6 coordinator joined the Forum as one of the founding members and other project members joined later.

Active involvement in the IoT Forum enabled the project during its lifetime to promote the results through the participation of MI as well as by taking part in the events organised by the Forum (e.g. the IoT Week). In the future, one of the primary focuses of the Forum will be the promotion of a common IoT architecture model which is fully in line with the vision of our project and will greatly facilitate adoption of the project outcomes in a common IoT architecture.

1.5 Address of the Project Website

The address of the project website is www.iot6.eu.

The main contact is as follows**:**

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2 Use and Dissemination of foreground

2.1 List Of Scientific (Peer Reviewed) Publication

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
No.	**Title**	**Main author**	**Title of the periodical or the series**	**Number, date or frequency**	**Publisher**	**Place of publication**	**Year of publication**	**Relevant pages**	**Permanent identifiers (if available)**	**Is/Will open access provided to this publication?**
1	Mobile IP-based Protocol for Wireless Personal Area Networks in Critical Environments	A. Jara, R. Silva, J. Silva, M. Zamora, A. Skarmeta	Wireless Personal Communications	Volume 61, Issue 4	Springer	London	2011	711-737	ISSN: 0929-6212 DOI : 10.1007/s11277-011-0428-y	No
2	Internet of Things Technological and Societal Trends: Chapter The "Internet of Things" based on IPv6. Paving the way to Smart IPv6 Buildings	L. Ladid, P. Grossetete, S. Ziegler	IERC – Cluster Book		European Communities, 2011		2011			Yes
3	Architecture for Improving Terrestrial Logistics Based on the Web of Things	M. Castro, A. Jara, A. Skarmeta	Sensors		Sensors		2012		DOI:10.3390/s120506538	Yes
4	GLoWBAL IP: An	A. Jara,	Mobile	Volume 8,	IOS Press		2012	177-197	ISSN: 1574-	No

	adaptive and transparent IPv6 integration in the Internet of Things	M. Zamora, A. Skarmeta	Information Systems	Number 3					017x (Print) 1875-905X (Online) DOI: 10.3233/MIS-2012-0138	
5	Demand forecasting and smart devices as building blocks of smart micro grids	R.Schumann, D. Genoud	IEEE Xplore Digital Library		IEEE	Palermo	2012	689-694	ISBN: 978-1-4673-1328-5 DOI: 10.1109/IMIS. 2012.107	No
6	Integrating Building Automation Systems and IPv6 in the Internet of Things	M. Jung, C. Reinisch, W. Kastner	IEEE Xplore Digital Library		IEEE	Palermo	2012	683-688	ISBN: 978-1-4673-1328-5 DOI: 10.1109/IMIS. 2012.134	No
7	Time-delayed Collaborative Routing and MAC protocol for Maximising the Network Lifetime in MANETs	W. Cho, D. Kim	IEICE Transactions on Communications	Vol.E96-B No.9	IEICE		2013	2213-2223	Online ISSN: 1745-1345 Print ISSN: 0916-8516	No
8	IPv6 Addressing Proxy: Mapping Native Addressing from Legacy Technologies and	A. Jara, P. Moreno, P. Kirstein, S. Varakliotis,		Volume 13, Issue 5	Sensors		2013	6687-6712		Yes

	Devices to the Internet of Things (IPv6)	A. Skarmeta								
9	Evaluation of Bluetooth Low Energy Capabilities for Tele-mobile Monitoring in Home-care	A. Jara, D. Fernandez, P. Lopez, M. Zamora, A. Skarmeta, L. Marin		Volume 19, Issue 9	JUCS		2013			Yes
10	Communication Protocol for Enabling Continuous Monitoring of Elderly People through Near Field Communications	A. J. Jara, P. Lopez, D. Fernandez, M. Zamora, B. Ubeda, A.Skarmeta	Interacting with Computers: the interdisciplinary journal of Human-Computer Interaction		Oxford Journals		2013	145-168	DOI: 10.1093/iwc/iwt030	No
11	IETF 6TSCH: Combining IPv6 Connectivity with Industrial Performance	P. Thubert, T. Watteyne, M.R. Palattella, X. Vilajosana, Q. Wang	IEEE Xplore		IEEE	Taichung	2013	541-546	DOI: 10.1109/IMIS.2013.96	No
12	Participative marketing: Extending social media marketing through the identification and interaction capabilities from the Internet of things	A. Jara, M. C. Parra, A. Skarmeta	Personal and Ubiquitous Computing	Volume 18, Issue 4	Springer		2013	997-1011	DOI : 10.1007/s00779-013-0714-7	No

13	The Internet of Everything through IPv6: An Analysis of Challenges, Solutions and Opportunities	A. Jara, L. Ladid, A. Skarmeta	JoWUA	Volume 4, No. 3	JoWUA		2013	97-118		Yes
14	IoT6 – Moving to an IPv6-based future IoT	S. Ziegler, C. Crettaz, L. Ladid, S. Krco, B. Pokric, A. Skarmeta, A. Jara, W. Kastner, M. Jung	Springer Open		Springer		2013	161-172		Yes
15	Shifting primes: Optimising elliptic curve cryptography for 16-bit devices without hardware multiplier	L. Marin, A. Jara, A. Skarmeta	Mathematical and Computer Modelling	Volume 58, Issues 5-6	Elsevier		2013	1155-1174	DOI: 10.1016/j.mcm.2013.02.008	No
16	Global Standardisation Chapter of the IERC Book 2014	L. Latif	Book Chapter of IERC IoT Book 2014 ISBN: 978-87-93102-94-1		River Publishers	Denmark	2014	143-197		Yes
17	Extending the EPCIS with Building Automation Systems: a New Information	N. Giang, S. Hoon Kim, D. Kim,	IEEE Transactions on Parallel and Distributed		IEEE Computer Society		2014		DOI: 10.1109/TPDS.2014.2306418	No

	System For the Internet of Things	M. Jung, W. Kastner	Systems							
18	Neighbor Table based Shortcut Tree Routing in ZigBee Wireless Networks	T. Kim, S. Hoon Kim, J. Yang, S. Yoo, D. Kim	IEEE Transactions on Parallel and Distributed Systems	Volume 25, Issue 3	IEEE XPLORE Digital Library		2014		DOI: 10.1109/TPDS.2014.9	No
19	Scalable integration framework for heterogeneous smart objects, applications and services	S. Ziegler, M. R. Palattella, L. Ladid, S. Krco, A. Skarmeta	Book Chapter of IoT Book 2014 ISBN: 978-87-93102-94-1			Denmark	2014			Yes

2.2 List of Dissemination Activities

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
No.	**Type of activities**	**Main leader**	**Title**	**Date/Period**	**Place**	**Type of audience**	**Size of audience**	**Countries addressed**
1	Newsletter	MI	IERC Newsletter Volume 2, Issue 2	09/2011	Ireland	EC, Research, Industry, Academics	1000s	World
2	IoT6 Presentation	MI, Ericsson	FIRE 2011	14/09/2011	Brussels	European Research Community	50	World
3	Project Website	MI, Ericsson, UL	IoT6 Web Portal http://www.iot6.eu	10/2011	Geneva	International Researchers, Industry, Academics	1000s	World
4	Social Media	All partners	LinkedIn, Facebook, Twitter	10/2011		International Researchers, Industry, Academics	1000s	World
5	Conference	UCL	WISE 2011	12-14/10/2011	Australia	Researchers, Industry	50	World
6	Conference	MI, Ericsson, IERC Cluster	Future Internet Assembly: FIA Poznan	26-28/10/2011	Poland	European Research Community	500	Europe
7	Conference	UMU	UCAml 2011	11/2011	Mexico	International	150-200	UMU

	Presentation		"Extending Terrestrial Logistics Solutions Using New-age Wireless Communications based on SunSPOTs"			Research Community		
8	IoT6 Presentation	Ericsson, UMU	IoT International Forum Presentation: IPv6: "Why it is important for the success of IoT."	23-24/11/2011	Berlin	International Researchers, Industry, Academics	50	World
9	Workshop	All Partners	IoT6 Sierre Workshop	01-03/02/2012	Switzerland	International Researchers, Industry, Academics	25	Europe
10	Conference Presentation	UMU	IEEE EMBS 5th International Conference on Health Informatics (HEALTHINF – 2012) in conjunction with the 5th Biomedical Engineering Systems and Technologies (BIOSTEC) "Heart monitoring system based on NFC for continuous analysis and pre-processing of wireless vital signs"	03/02/2012	Portugal	International Research Community	50	World
11	Conference Presentation	UMU	Presentation of IPv6 capabilities for IoT	14-15/03/2012	Spain	International Research Community	70	Europe

12	Organised and Participated	UMU	Workshop on Smart Object Security	23/03/2012	Paris	International Research Community	100s	Europe
13	Participation	UMU	IETF-83 - Core / LwIG Participation in the Scrim meetings	25-30/03/2012	Paris	International Research Community	100s	Europe
14	Workshop Participation	MI, UMU, Ericsson Serbia, UL	IoT Interoperability Workshop Participation in the workshop organised by Probe-IT within the IERC AC4 activity	26/03/2012	Paris	Consortium and researchers	100s	Europe
15	IoT6 Presentation	UL	Global IPv6 Summit	09-11/04/2012	USA	International Researchers, Industry, Academics	100	World
16	Presentation	VUT	Light+Building Exhibition	15-20/04/2012	Frankfurt	International Researchers, Industry, Academics	40	Europe
17	Presentation	VUT	Smart Cities Event	17/04/2012	Austria	International Researchers, Industry, Academics	50-75	Austria
18	Participation	UCL	INET 2012 + ISOC 20th Anniversary	22-24/04/2012	Geneva	Internet Community	50-60	World
19	Presentation	MI	ITU 5th JCA-IoT Meeting	09/05/2012	Geneva	Industry and Research	30	World

20	IoT6 Presentation	MI	FIA 2012	10-11/05/2012	Denmark	Industry and Research Community	30-40	Europe
21	Demonstration	MI, UL	IPv6 Day/Week	06/06/2012	World	World Media	100s	World
22	Presentations	MI, UL	Interop 2012	12-15/06/2012	Japan	International Researchers, Industry, Academics	100s	World
23	Co-organiser of the IoT week and several presentations	All Partners	IoT Week	18-22/06/2012	Venice	International Researchers, Industry, Academics	100s	World
24	Special Session IoT & IPv6 workshop	MI	IoT Week Special session on Smart buildings “IoT6 and smart IPv6 buildings presentation	20/06/2012	Venice	Researchers, Industry	50	World
25	Organised	MI, HESSO, KAIST	IoT6 demonstration at IoT week	19-21/06/2012	Venice	International Researchers, Industry, Academics	40	World
26	Organised and Participated	UL	ICT Spring	19-20/06/2012	Luxembourg	International Researchers, Industry, Academics	50	Europe
27	Co-organised	UMU	Future Network & Mobile Summit	04-06/07/2012	Berlin	International Researchers, Industry,	100s	Europe

						Academics		
28	Conference Presentation	KAIST	esIoT 2012 Enabling Transparent Communication with Global ID for the Internet of Things	04-06/07/2012	Italy	International Researchers, Industry, Academics	100s	Europe
29	Conference Presentation	HESSO	esIoT 2012 "Demand forecasting and smart devices as building blocks of smart micro grids"	04-06/07/2012	Italy	International Researchers, Industry, Academics	100s	Europe
30	Conference Presentation	VUT	esIoT 2012 "Integrating Building Automation Systems and IPv6 in the Internet of Things"	04-06/07/2012	Italy	International Researchers, Industry, Academics	100s	Europe
31	Keynote Speech	UL	esIoT 2012 "The power of IPv6 over the IoT"	04-06/07/2012	Italy	International Researchers, Industry, Academics	100s	Europe
32	Conference Presentation	UMU	esIoT 2012 "Interaction of patients with breathing problems through NFC in Ambient Assisted Living environments "	04-06/07/2012	Italy	International Researchers, Industry, Academics	100s	Europe
33	Conference Presentation	UMU	esIoT 2012 "Marketing 4.0: A new	04-06/07/2012	Italy	International Researchers, Industry,	100s	Europe

			value added to the Marketing through the Internet of Things "			Academics		
34	Conference Presentation	UMU	esIoT 2012 “Shifting primes: Optimising Elliptic Curve Cryptography for Smart Things”	04-06/07/2012	Italy	International Researchers, Industry, Academics	100s	Europe
35	Conference Presentation	UMU	esIoT 2012 “An analysis of M2M platforms: challenges and opportunities”	04-06/07/2012	Italy	International Researchers, Industry, Academics	100s	Europe
36	Press Release	UL	Washington Internet Daily Vol. 13, No 123 Industry Urges EC Not to Set New Rules for Internet of Things	18/07/2012	Washington	US Government bodies, policy makers, Researchers, Industry	1000s	USA
37	Presenters	MI, HESSO	Swissnex San Francisco	09/08/2012	USA	Industry and Researchers	100	USA
38	Co-organised	Ericsson + All Partners Invited	SenZation Summer School	03-07/09/2012	Serbia	Young Researchers	30	Europe
39	Participant and member of FIF	UL	ICT 2012	26-27/09/2012	Poland	Industry and Research Community	2000	Europe, Brazil, China, Japan, Korea, S. Africa

40	Flyer	MI, UL	IoT6 Flyer Available on the website to be downloaded	2012	World	EC, Researchers, Industry, Academia	1000s	World
41	Demo Session	VUT	IoT 2012 Demonstration of an IPv6 multi-protocol gateway for seamless integration of Building Automation Systems into Constrained RESTful Environments	24/10/2012	China	Industry and Research Community	100s	World
42	Keynote Speech	UCL	IoT 2012 IPv6 and the Future IoT: International IoT Initiatives	24/10/2012	China	Industry and Research Community, Academia	100s	China
43	IoT6 Presentation	MI	IoT 2012	24/10/2012	China	International Researchers, Industry, Academics	100s	China
44	Demo Session	KAIST	IoT 2012 Demonstration of an Smart Thing Information Services (STIS), which is a collaboration paper with MI	24/10/2012	China	International Researchers, Industry, Academia	100s	China
45	Workshop	MI, UL, UCL, UMU, Ericsson	Organised IoT6 Workshop on IoT and IPv6	24/10/2012	China	International Researchers, Industry, Academics	100s	China

46	Presentation of the IoT6 project	MI	IEEE CCIS 2012	30/10/2012	China	International Researchers, Industry, Academics	100	China
47	Conference Presentation	TUV	KNX Scientific Conference 2012	05-06/11/2012	Spain	International Researchers, Industry, Academics	50-100	Europe
48	Conference Presentation	TUV, HESSO	IEEEiThings 2012	20-23/11/2012	France	International Researchers, Industry, Academics	50-100	Europe
49	Presentation of IoT6 flyers and attended Conference	TUV	sps/ipc/drives Exhibition 2012	27-29/11/2012	Germany	International Researchers, Industry	50000	World
50	Tutorial	UMU	Mobiworld 2012 in Globecom 2012 Tutorial Mobility Management in the Internet of Things: "Enabling dynamic ecosystems"	3/12/2012	USA	International Researchers, Industry, Academia	100	World
51	Poster Presentation	TUV, HESSO	ACM SAC 2013	18-22/3/2013	Portugal	International Researchers, Industry, Academics	100	Europe
52	Keynote Speaker	Ericsson	IEEE AINA 2013 "Building a Networked Society Using IoT" given	25-28/3/2013	Spain	International Researchers, Industry,	100	Europe

			by Dr. S. Krco			Academics		
53	Keynote Speaker	UMU	IEEE AINA 2013 The Impact of Internet of Things in Big Data Approach and Future Internet"	25-28/3/2013	Spain	International Researchers, Industry, Academics	100	Europe
54	Conference Presentation	UMU	IEEE AINA 2013 "Smart Lighting solutions for Smart Cities"	25-28/3/2013	Spain	International Researchers, Industry, Academics	100	Europe
55	Conference Presentation	VUT/HESSO	IEEE AINA 2013 "Building automation and smart cities: An integration approach based on a service-oriented architecture"	25-28/3/2013	Spain	International Researchers, Industry, Academics	100-150	Europe
56	Conference Presentation	UMU	IEEE AINA 2013 **"**Mobile Discovery: A Global Service Discovery for the Internet of Things**"**	25-28/3/2013	Spain	International Researchers, Industry, Academics	100	Europe
57	Workshop	Ericsson	Workshop organised by IoT-A on architecture	4/2013	Germany	International Researchers, Industry, Academics	20	Germany
58	IPSO Challenge	UMU, VUT, HESSO	IPSO Challenge 2013 IoT6 participation and finalists among the winners	13/04/2013	USA	International Researchers, Industry, Academics	100	World

59	Invited Talk	TUV	International Week at Tomas Bata University Zlin Invited Talk: "Building Automation and the Internet of Things"	22-26/04/2013	Czech Republic	International Researchers, Industry, Academics, PhD Students	80	Europe
60	IETF	UL	IETF 6TSCH draft: Using IEEE802.15.4e TSCH in an LLN context: Overview, Problem Statement and Goals draft-watteyne-6tsch-tsch-lln-context-02	23/05/2013		International Researchers, Industry, Academics	1000s	World
61	Conference Presentations	UL	The IFIP/IEEE International Symposium on Integrated Network Management Presentations: •"A semantic firewall for Content Centric Networking" •"A Key Management Scheme for Content Centric Networking" •"ASMATRA: Ranking ASs Providing Transit Service to Malware Hosters	27-31/05/2013	Belgium	International Researchers, Industry, Academics	100	World
62	Co-organiser of a	Ericsson	IoT Week 2013	17-20/06/2013	Finland	International	50	Europe

	Session		Co-organiser of a session on IoT architecture together with IoT-A project			Researchers, Industry, Academics		
63	Conference Presentation	UL	MEDHOCNET 2013 "Energy-Efficient Rate-Adaptive Passive Traffic Sensing using Smartphones	24-26/06/2013	France	International Researchers, Industry, Academics	100-150	France
64	Keynote Speech:	TUV	EG-ICE 2013 Keynote Speech: “Building Automation Systems Integration”	01-03/7/2013	Austria	International Researchers, Industry, Academics	50	Europe
65	Conference Presentation	UMU	IEEE Conference esIoT2013 Evaluation Framework for IEEE 802.15.4 and IEEE 802.11 for Smart Cities	03-05/7/2013	Taiwan	International Researchers, Industry	100	Taiwan
66	Workshop	UMU, UL, HESSO	IEEE Conference esIoT2013 Organise workshop Industrial Track	03-05/7/2013	Taiwan	International Researchers, Industry, Academics	100	Taiwan
67	Conference Presentation	UMU	IEEE Conference esIoT2013 “A Network Mobility Solution Based on 6LoWPAN Hospital Wireless Sensor Network”	03-05/7/2013	Taiwan	International Researchers, Industry, Academics	100	Taiwan

68	OASIS Draft	VUT	oBIX Version 1.1 Committee Specification Draft 01 / Public Review Draft 01	11/7/2013		International Researchers, Industry, Academics	1000s	World
69	OASIS Draft	VUT	Encodings for oBIX: Common Encodings Version 1.0 Committee Specification Draft 01 / Public Review Draft 01	11/7/2013		International Researchers, Industry, Academics	1000s	World
70	OASIS Draft	VUT	Bindings for oBIX: REST Bindings Version 1.0 Committee Specification Draft 01 / Public Review Draft 01	11/7/2013		International Researchers, Industry, Academics	1000s	World
71	OASIS Draft	VUT	Bindings for oBIX: SOAP Bindings Version 1.0 Committee Specification Draft 01 / Public Review Draft 01	11/7/2013		International Researchers, Industry, Academics	1000s	World
72	6TSCH Internet-Draft	UL	Terminology in IPv6 over Time-slotted Channel Hopping	15/7/2013		International Researchers, Industry, Academics	1000s	World
73	Conference Presentation	UL	5th Workshop on the Usage of Netflow/IPFIX in Network Management “Efficient Multidimensional Aggregation for Large	30/7/2013	Berlin	International Researchers, Industry, Academics	100s	World

			Scale Monitoring”					
74	Conference Presentation	UL	IEEE MASCOTS'13 “Path Extension Analysis of Peer-to-Peer Communications in Small 6LoWPAN/RPL Sensor Networks”	14-16/8/2013	USA	International Researchers, Industry, Academics	100	USA
75	Conference Presentation	UMU/HESSO	The 2013 IEEE WIC ACM “Determining Human Dynamics through the Internet of Things”	17-20/8/2013	USA	International Researchers, Industry, Academics	100	USA
76	Lecture and Participation	Ericsson, MI	SenZations’13 Summer School	02-06/09/2013	Serbia	International Researchers, Industry, Academics	60	Europe, Algiers, Australia, US
77	Lecture and Participation	MI	IEEE Africon 2013	09-12/09/2013	Mauritius	International Researchers, Industry, Academics	300	Africa, Europe and World
78	Workshop	IEEE ComSoc IoT (UMU, UL, MI)	Cliot 2013 Co-Sponsored Workshop on Cloud for IoT	11/09/2013	Spain	International Researchers, Industry, Academics	50	Europe
79	Workshop and Keynote Address	HESSO	Workshop in Cloud and IoT (CLIoT) ESOCC 2013 Keynote Address: “Driving from the city to	11-13/09/2013	Spain	International Researchers, Industry, Academics	100	Europe

			the Cloud: A trip to analyse the solutions, challenges and opportunities of the Cloud computing for the Smart Cities and the Internet of Things”					
80	Conference Presentation	UL, KAIST	4th International Conference on Network of the Future, Paper Presentation “CCN Traffic Optimisation for IoT”	21-24/09/2013	South Korea	International Researchers, Industry, Academics	100	South Korea
81	Networking	MI	IoT World Forum	29-31/10/2013	Barcelona	International Researchers, Industry, Academics	2000	Europe
82	Panel	UCL	EC ICT Conference	06-08/11/2013	Vilnius	International Researchers, Industry, Academics	2000	Europe
83	Conference Presentation	VUT	39th Annual Conference of the IEEE Industrial Electronics Society (IECON-2013),	10-13/11/2013	Vienna	International Researchers, Industry, Academics	2000	Europe
84	IoT6 Presentation	MI, UL	ITU Telecom World 2013	18-21/11/2013	Thailand	International Researchers, Industry, Academics	2000	World

	Conference Presentation	UMU	UCAmI 2013 7th International Conference on Ubiquitous Computing & Ambient Intelligence Context-Aware Energy Eficiency in Smart Buildings	2-6/12/2013	Costa Rica	International Researchers, Industry, Academics	100s	World
85	Conference Presentation	UL, UMU, MI, UCL, HESSO	Globecomm IoT SaC Track Lightweight Mobile IPv6: A mobility protocol for enabling transparent IPv6 mobility in the Internet of Things	11-13/12/2013	USA	International Researchers, Industry, Academics	100s	World
86	Session Chair	UMU	Globecomm IoT SaC Track, Session Chair SA-IoT3: “Enabling a Secure and Trustable Internet of Things”	11-13/12/2013	USA	International Researchers, Industry, Academics	100s	World
87	Conference Presentation	KAIST	Globecomm IoT SaC Track, SCoAP: An Integration of CoAP Protocol With Web based application	11-13/12/2013	USA	International Researchers, Industry, Academics	100s	World
88	Session Chair	UL, UMU, MI, UCL, HESSO	Globecomm IoT SaC Track Session Chair SA-IoT2: “Extending the Internet of	11-13/12/2013	USA	International Researchers, Industry, Academics	100s	World

			Things through Social, Mobile Networks and Cloud”					
89	Conference Presentation and Session Chair	UCL	Globecomm IoT SaC Track Conference Presentation and Session Chair "Gateways for the Internet of Things: An Old Problem Revisited"	11-13/12/2013	USA	International Researchers, Industry, Academics	100s	World
90	6TSCH Internet-Draft	UL	Security Framework and Key Management Protocol Requirements for 6TSCH draft-ohba-6tsch-security-00	26/12/2013		International Researchers, Industry, Academics	1000s	World
91	IEFT Draft	UL	IPv6 mapping to non-IP protocols draft-rizzo-6lo-6legacy-00	11/02/2014		International Researchers, Industry, Academics,	1000s	World
92	6TiSCH Internet-Draft	UL	6TiSCH On-the-Fly Scheduling draft-dujovne-6tisch-on-the-fly-02	14/02/2014		International Researchers, Industry, Academics,	100s	World
93	Presentation on the IoT6 project	KAIST	GS1 Global Forum	17-21/02/2014	Brussels	International Researchers, Industry, Academics	100	Europe
94	Invited Talk	UCL	Joint IoT6-KAIST workshop	02/03/2014	Korea	International Researchers,	100	Korea

			The Use of Handle in IoT6			Industry, Academics		
95	WG Meeting	UL	IETF89 6TiSCH WG meeting	02-07/03/2014	London	International Researchers, Industry, Academics	50	World
96	Invited Lecture	KAIST	Presentation: “The Internet – Past and Future”	05/03/2014	Korea	International Researchers, Industry, Academics	200	Academic
97	Invited Talk	RMP	IEEE AINA 2014 - PITSaC Workshop: Invited Talk: "Everything is Digital - How the Web is Eating the World"	06-08/03/2014	Canada	International Researchers, Industry, Academics	100s	World
98	Invited Talk	RMP, MI	IEEE AINA 2014 - PITSaC Workshop: Invited Talk: "IPv6 as a global addressing scheme and integrator for the Internet of Things and the Cloud"	06-08/03/2014	Canada	International Researchers, Industry, Academics	100s	World
99	Invited Talk	HESSO	IEEE AINA 2014 - PITSaC Workshop: Invited Talk: "Big Data in Smart Cities: From Poisson to Human Dynamics"	06-08/03/2014	Canada	International Researchers, Industry, Academics	100s	World
100	Conference	Ericsson	IEEE AINA 2014 -	06-08/03/2014	Canada	International	100s	World

	Presentation		PITSaC Workshop:: "Augmented Reality based Smart City Services using Secure IoT Infrastructure"			Researchers, Industry, Academics		
101	Conference Presentation	UMU	IEEE AINA 2014 - PITSaC Workshop: Conference: ""A Distributed Location-Aware Access Control for Smart Buildings"	06-08/03/2014	Canada	International Researchers, Industry, Academics	100s	World
102	TPC Participation	UCL	IEEE World Forum on Internet of Things S.Varakliotis participated in the TPC.	06-08/03/2014	Korea	International Researchers, Industry, Academics	100s	World
103	Conference Presentation	UL, UMU, MI, UCL, HESSO, VUT, RMP	IEEE World Forum on Internet of Things (WF-IoT) Conference presentation: "A Scripting-Free Control Logic Editor for the Internet of Things"	06-08/03/2014	Korea	International Researchers, Industry, Academics	100s	World
104	Poster	VUT, HESSO	IEEE World Forum on Internet of Things (WF-IoT) Poster: "oBeliX: Scripting-free Control Logic Editor for the Internet of Things"	06-08/03/2014	Korea	International Researchers, Industry, Academics	100s	World
105	Conference	UNIS,	IEEE World Forum on	06-08/03/2014	Korea	International	100s	World

	Presentation	Ericsson	Internet of Things (WF-IoT) Presentation: "Designing IoT Architecture(s),a European perspective"			Researchers, Industry, Academics		
106	Conference Presentation	UCL, UMU	IEEE World Forum on Internet of Things (WF-IoT) "A Process-Based Internet of Things"	06-08/03/2014	Korea	International Researchers, Industry, Academics	100s	World
107	Conference Presentation	UCL, UMU	IEEE World Forum on Internet of Things (WF-IoT) "A Survey of Internet-of-Things: Future Vision, Architecture, Challenges and Services"	06-08/03/2014	Korea	International Researchers, Industry, Academics	100s	World
108	Workshop	MI and all partners	IoT6 Korean workshop Session organiser and meetings with Korean stakeholders	06-08/03/2014	Korea	International Researchers, Industry, Academics	50	Korea
109	Poster	Ericsson	4th International Conference on Information Society and Technology Poster: "CoAP communication with the mobile phone over IPv6"	09-13/03/2014	Serbia	International Researchers, Industry, Academics	100s	Europe
110	Session organiser	MI, UL,	V6 World Congress 2014:	17-19/03/2014	Paris	International	100s	World

	and IoT6 presentation	UMU, UCL	IP on Everything			Researchers, Industry, Academics		
111	Conference Presentation	UCL	V6 World Congress 2014 “Routing in Name and Address Space”	18/03/2014	Paris	International Researchers, Industry, Academics	100s	World
112	Demo Presentation and Posters	MI, Ericsson, TUV, HESSO, UL	FIA 2014 Demonstration of the IoT6 project - Posters	18-20/03/2014	Greece	International Researchers, Industry, Academics	100s	World
113	Presentation of the IoT6 project	KAIST	GS1 Global Standards Event	18-20/03/2014	USA	International Researchers, Industry, Academics	100s	World
114	Conference Presentation	KAIST	Ottawa Linux Symposium 2014 “Policy-extendable LMK filter Framework for Embedded System”	07-09/05/2014	Canada	Researchers, Industry, Academics	200	Canada
115	Conference Presentation	RMP, MI	PITSaC 2014, IEEE 28th AINA "IPv6 as a global addressing scheme and integrator for the Internet of Things and the Cloud”	13-16/05/2014	Canada	Researchers, Industry, Academics	200	Canada
116	SME Handbook	UL, HESSO, MI, Ericcson, VUT	IoT-IPv6 Integration Handbook for SMEs	16/05/2014	Geneva	International Researchers, Industry,	1000s	World

						Academics, SMEs		
117	Project Presentation	MI, Ericsson	Danube-IT conference	29-30/05/2014	Serbia	International Researchers, Industry, Academics	150	Europe
118	Keynote Speech	HESSO	Living Bits and Things Keynote Speech: "Paving the Exploitation Roadmap of the IoT through Industrial-driven Standards"	02-05/06/2014	Slovenia	International Researchers, Industry, Academics	200s	Europe
119	Conference Presentation	UL, MI, UCL, UMU	5th European Summit on the Future Internet "Identifiers and end system Properties in the Future Internet"	12-13/06/2014	Luxembourg	International Researchers, Industry, Academics	150	Europe
120	Session Organiser and IoT6 Conference Presentations	UL, MI, UCL, UMU	IoT Week 2014 Two sessions organiser and IoT6 presentations	16-20/06/2014	London	International Researchers, Industry, Academics	500	World
121	Conference Presentation	UL, MI, UCL, UMU, Ericsson	IoT Week 2014 Presentation about IoT6 Architecture within the IoT6 session	16-20/06/2014	London	International Researchers, Industry, Academics	500	World
122	Panel Speaker	UL, MI, UCL, UMU, Ericsson	IoT Week 2014 Panel speaker: "A Digital Object Approach to IoT"	18/06/2014	London	International Researchers, Industry, Academics	100s	World

123	Panel Speaker	HESSO	IoT World Event Panel speaker about "IPv6-ready technologies for IoT"	17-18/06/2014	USA	International Researchers, Industry, Academics	1000	World
124	Project Demonstration	VUT	IPSO Challenge 2014 + Sensor Expo 2014 Project demonstration: "Demonstration of the IoTSys - Control Logic Editor"	24-26/06/2014	USA	International Researchers, Industry, Academics	100s	World
125	Conference Presentation	KAIST	11th IEEE International Conference on Services Computing (SCC 2014) Lilliput: Ontology-based platform for IoT Social Networks: Towards socialised people, objects, and places”	27/06/2014 - 02/07/2014	USA	International Researchers, Industry, Academics	100s	World
126	Conference Presentation	VUT, KAIST	esIoT "Extending the EPCIS with Building Automation Systems: a New Information System For the Internet of Things	02-04/07/2014	UK	International Researchers, Industry, Academics	500s	World
127	Conference Presentation	HESSO, UL	esIoT “Challenges of the Internet of Things: IPv6 and Network	02-04/07/2014	UK	International Researchers, Industry, Academics	100s	World

			Management"					
128	Conference Presentation	HESSO, UL	esIoT "Extending Extensible Authentication Protocol over IEEE 802.15.4 Networks"	02-04/07/2014	UK	International Researchers, Industry, Academics	100s	World
129	Conference Presentation	HESSO, UL	esIoT "Big Data for Cyber Physical Systems: An Analysis of Challenges, Solutions and Opportunities"	02-04/07/2014	UK	International Researchers, Industry, Academics	100s	World
130	Conference Presentation	UMU	esIoT "Towards Privacy-preserving data sharing in Smart Environments"	02-04/07/2014	UK	International Researchers, Industry, Academics	100s	World
131	Standards Presentation	UCL	ETSI-EC Standards presentation: “Handle and IOT Security	03-04/07/2014	France	International Researchers, Industry, Academics,	100s	World
132	IoT6 session, IoT6 presentation, IoT6 booth with demo and handbook dissemination	UL, MI, Ericsson, UMU	ICT Spring 2014	03-04/07/2014	Luxembourg	Industry, SMEs	4000	World
133	IEEE P2413 Standard Meeting	UCL, UMU	Standard: "Standard for an Architectural Framework for the	10-11/07/2014	Germany	International Researchers, Industry,	100s	World

			Internet of Things (IoT)"			Academics,		
134	IERC Document Contribution	UCL	TEMU 2014 IoT6 Contribution to the IERC Document on Government, Privacy and Security	28-29/07/2014	Greece	International Researchers, Industry, Academics,	25	World
135	IoT6 session and IoT6 presentation	MI, UL, UCL	TEMU 2014	28-29/07/2014	Greece	International Researchers, Industry, Academics,	300	World
136	IoT6 session and IoT6 presentation	UCL	TEMU 2014 “A Digital Object Approach to IOT”	28-29/07/2014	Greece	International Researchers, Industry, Academics,	300	World
137	Keynote Speech	HESSO	OpenIoT Summer School Keynote: "IPv6-devices integration with OpenIoT"	04-08/08/2014	Ireland	International Researchers, Industry, Academics,	100	World
138	Session organiser and Presenter	Ericsson, MI	Senzations Summer School 2014 Session organiser and presentation “The role of IoT in IPv6”	31/08/2014 - 06/09/2014	Croatia	International Researchers, Industry, Academics,	50	World
139	Conference Presentation	VUT	ETFA 2014 Conference Presentation: Building Automation Systems Integration into the Internet of Things,	16-19/09/2014	Spain	International Researchers, Industry, Academics,	500	World

			The IoT6 approach, its realisation and validation					
140	In Proceedings	UL	Proc. of ICACCI conference "Towards a New Way of Reliable Routing: Multiple Paths over ARCs"	24-27/09/2014	India	International Researchers, Industry, Academics,	100s	World
141	Demo Paper	KAIST	The 4th International Conference on Internet of Things (MIT Media Lab) "The GS1 code based Web of Things Service Architecture with Healthcare Scenario"	04-08/10/2014	USA	International Researchers, Industry, Academics,	100s	USA
142	Conference Presentation	VUT	IoT 2014 "The relevance and impact of IPv6 multicasting for Wireless Sensor and Actuator Networks based on 6LoWPAN and Constrained RESTful Environments"	06-08/10/2014	USA	International Researchers, Industry, Academics,	500	World
143	Demo	VUT	Demo: "IoTSyS: an integration middleware for the Internet of Things"	06-08/10/2014	USA	International Researchers, Industry, Academics,	500	World
144	6TiSCH	UL	Using IEEE802.15.4e	17/10/2014		International	100s	World

	Internet-Draft		TSCH in an IoT context Overview, Problem Statement and Goals draft-ietf-6tisch-tsch-02			Researchers, Industry, Academics,		

Section B (Confidential or public: confidential information to be marked clearly)

Part B1: Applications for patents, trademarks, registered designs, etc.

4 patents have been filled by KAIST. No Trademark have been registered by the partners for the IoT6 project.

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)
KR Patent (Registration)	NO		10-1202867	Method, apparatus and system for ZigBee and EPC global network connection, recording medium for the same.	Daeyoung Kim, Kyubaek Kim, Suho Jeong, Jongwoo Sung,
KR Patent (Registration)	NO		10-1321583	Method and system for providing Global ID for the Internet of Things	Suho Jeong, Daeyoung Kim, Seonghoon Kim, Minkeun Ha, Taehong Kim
US Patent (Application)	NO		13/785378	The Method and System for Browsing Things of Internet of Things on IP using Web Platform	Ky Nam Giang, Daeyoung Kim, Minkeun Ha, and Kiwoong Kwon
KR Patent (Registration)	NO		10-1188507	The Device and Method for Relaying Heterogeneous Network and User Terminal using the same based on Technology of Relaying Network and Browsing Things of Internet of Things based on IP using Web Platform	Daeyoung Kim, Sungho Bae, Minkeun Ha, Seonghoon Kim

Patent #1: Daeyoung Kim, Kyubaek Kim, Suho Jeong, Jongwoo Sung,
Method, apparatus and system for ZigBee and EPC global network connection, recording medium for the same.
KR Patent, Registration Number 10-1202867
This invention integrates Zigbee and EPCglobal network by equipping a Zigbee base-station with EPC translation table as an intermediate medium. In the Zigbee base-station, each sensor node is assigned an EPC so that the node can be identified by EPCglobal network. In addition, LLRP protocol of EPCglobal network is extended, and virtual memory space is assigned in the Zigbee base-station to control the sensor node.

Patent #2: Suho Jeong, Daeyoung Kim, Seonghoon Kim, Minkeun Ha, Taehong Kim
Method and system for providing Global ID for the Internet of Things
KR Patent, Registration Number 10-1321583
This invention is about a method of providing global ID for IoT of heterogeneous networks. It includes a thing which is assigned global ID, domain name, and IP address; a mapping server Thing Profile Server (TPS) between global ID and its profile; another mapping server Thing ID Server (TIDS) between global ID, domain name, and IP address; a DNS server translating domain name to IP address; and Thing Application Layer Protocol (TALP) adapter translating heterogeneous protocols to TALP regradless of their heterogeneity.

Patent #3: Ky Nam Giang, Daeyoung Kim, Minkeun Ha, and Kiwoong Kwon
The Method and System for Browsing Things of Internet of Things on IP using Web Platform
US Patent, Application Number 13/785378
This invention is for a method and system for browsing things on IP using web platform. It includes 5 steps; a user terminal identifies the tag information of a smart thing to get the domain; the user terminal searches for ip address through DDNS (Dynamic DNS) server; the user terminal gets the default web page by connecting to the lightweight web server which is embedded to the thing; the user terminal connects to a static rich Internet contents server; the user terminal gets the rich UI web pages together with the sensor data by using CoAP protocol to connect to the smart things.

Patent #4: Daeyoung Kim, Sungho Bae, Minkeun Ha, Seonghoon Kim
The Device and Method for Relaying Heterogeneous Network and User Terminal using the same based on Technology of Relaying Network and Browsing Things of Internet of Things based on IP using Web Platform
KR Patent, Registration Number 10-1188507
This invention is for an efficient way of mediating heterogeneous networks and using their resources at maximum. It consists of components: an IP search part searching for IP address of domain of sensor nodes, a static contents suppliers providing common data for multiple sensor nodes, and a communication mediator compressing and decompressing the message between sensor nodes and user terminals.

Part B2: Exploitable foreground

Type of Exploitable Foreground	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
	Ex: New superconductive Nb-Ti alloy			*MRI equipment*	*1. Medical* *2. Industrial inspection*	*2008* *2010*	*A materials patent is planned for 2006*	*Beneficiary X (owner)* *Beneficiary Y, Beneficiary Z, Poss. licensing to equipment manuf. ABC*
6LowPAN Sensors and Gateways	**Design of gateways for legacy system and integration on IPv6 networks**	**YES**	**-**	**Sensors and Gateways**	**Smart cities**	**2015, 2016**	**Planned patent for 2015**	**Beneficiary UMU (owner)**
IoT6 protocol pile and core Services	**IoT6 protocol pile and Service Oriented Architecture**	**YES**		**Components integration and services deployment and integration**	**IoT**	**2015, 2016**	**NO**	**IoT Consortium members**

6LoWPAN sensor gateway

As a results of the project UMU has been able to validate the usage of 6LoWPAN technologies and based on this some motes has been designed to implement sensors like temp, humidity and actuations on a 6LoWPAN node based on Contiki. Additionally some new gateways for legacy integration have been defined supporting IP and no-IP sensors and providing connectivity via UMTS and WiFI

These nodes (motes and gateways) are being used on deployment for smart building management integrating HVAC and energy consumption for data gathering on a Scada-Web interface for monitoring and actions definition

These products are now part of the technology transfer solution provided to the spin-off www.odins.es that is in the process of finalizing their commercialization and deployment on smart cities scenarios.

A patent it is planned on 2015 to cover the architecture for sensors and gateways integration in smart buldings solutions

IoT6 Stack and SOA

The IoT6 stack and services developed in the frame of the WP2 and WP3 are enabling the deployment of an IoT6 service oriented architecture. It includes specifications and the code developed in the frame of the work packages WP2 and WP3.

As indicated in the Consortium Agreement: *"Are considered as a common foreground jointly owned by all the parties:*

- *The specifications and use of the IoT6 shared communication protocol enabling interaction in the IP environment among IoT6 compliant components.*
- *The IoT6 network and service layer stacks developed in the frame of WP2 and WP3.*

As far as possible a joint strategy will be adopted by all the parties to this agreement for the promotion and exploitation of this joint asset, including after the termination of the research project." It is made available to the other partners for further development and exploitation. Such component may support both research and exploitation activities by the partners.

No specific measures have been adopted for the IPR, apart from aligning the IoT6 architecture as closely as possible to recognized standards.
Further developments are now up to the partners.

The impact is difficult to quantify, but should enable the partners to develop large scale IoT deployment and/or integration effort on a reliable IPv6-based architecture. It should also enable the adopters to benefit from a fully IPv6 compliant architecture.

3 Report on societal implications

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	288445
Title of Project:	IoT6: Universal Integration of the Internet of Things through an IPv6-based Service Oriented Architecture enabling heterogeneous components interoperability
Name and Title of Coordinator:	Sébastien Ziegler, Mandat International

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	**No**
2. Please indicate whether your project was involved any of the following issues (tick box) :	**No**
RESEARCH ON HUMANS	
• Did the project involve children?	
• Did the project involve patients?	
• Did the project involve persons not able to give consent?	
• Did the project involve adult healthy volunteers?	
• Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	
• Did the project involve Human Foetal Tissue / Cells?	
• Did the project involve Human Embryonic Stem Cells (HESCs)?	

• Did the project on human Embryonic Stem Cells involve cells in culture?	
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
• Did the project involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	
• Were those animals transgenic small laboratory animals?	
• Were those animals transgenic farm animals?	
• Were those animals cloned farm animals?	
• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	
• Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator		4
Work package leaders	1	8
Experienced researchers (i.e. PhD holders)	2	18
PhD Students	1	15
Other	3	19

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**6**
Of which, indicate the number of men:	6

D	Gender Aspects		
5.	**Did you carry out specific Gender Equality Actions under the project?**	O X	Yes No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
X	Design and implement an equal opportunity policy	O	X	O	O	O
❑	Set targets to achieve a gender balance in the workforce	O	O	O	O	O
❑	Organise conferences and workshops on gender	O	O	O	O	O
❑	Actions to improve work-life balance	O	O	O	O	O
X	Other:	Encouraging partners to favour women researchers participation and giving leadership role to women researchers (RMP and UL)				

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

O Yes- please specify

X No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

X Yes- please specify : Organizing educational session in the frame of Summer Schools

O No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

X Yes- please specify Website

O No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[27]: 2.2		
○ Associated disciplineErreur ! Signet non défini.: 2.1	○	Associated disciplineErreur ! Signet non défini.:

G	Engaging with Civil society and policy makers		
11a	**Did your project engage with societal actors beyond the research community?** *(if 'No', go to Question 14)*	X ○	Yes No
11b	**If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?** ○ No ○ Yes- in determining what research should be performed X Yes - in implementing the research X Yes, in communicating /disseminating / using the results of the project		
11c	**In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?**	X ○	Yes No
12.	**Did you engage with government / public bodies or policy makers (including international organisations)**		
	○ No ○ Yes- in framing the research agenda X Yes - in implementing the research agenda X Yes, in communicating /disseminating / using the results of the project		
13a	**Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?** X Yes – as a **primary** objective (please indicate areas below- multiple answers possible) ○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible) ○ No		
13b	**If Yes, in which fields?**		

[27] Insert number from list below (Frascati Manual).

Agriculture		**Energy**	X	Human rights	
Audiovisual and Media		Enlargement		**Information Society**	X
Budget		Enterprise		Institutional affairs	
Competition		**Environment**	X	Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		**Regional Policy**	X
Development Economic and Monetary Affairs	X	Food Safety		**Research and Innovation**	X
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs	X	Humanitarian aid		Transport	

13c If Yes, at which level?

- X Local / regional levels
- X National level
- X European level
- ○ International level

H	**Use and dissemination**
14. How many Articles were published/accepted for publication in peer-reviewed journals?	**19**
To how many of these is open access[28] provided?	**8**
How many of these are published in open access journals?	**8**
How many of these are published in open repositories?	
To how many of these is open access not provided?	**11**
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[29]: ……………	
15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*	**4**

[28] Open Access is defined as free of charge access for anyone via Internet.
[29] For instance: classification for security project.

16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	0
	Registered design	0
	Other	0
17. How many spin-off companies were created / are planned as a direct result of the project?		1
Indicate the approximate number of additional jobs in these companies:		**4**

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

X	Increase in employment, or	X	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
❑	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:* *13*

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

X Yes ○ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes X No

22. Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

❑	Press Release	X	Coverage in specialist press
❑	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
X	DVD /Film /Multimedia	X	Event targeting general public (festival, conference, exhibition, science café)

23. In which languages are the information products for the general public produced?		
❑ Language of the coordinator	X	English
❑ Other language(s)		

Question F-10: Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]

4 Final report on the distribution of the European Union financial contribution

This report will be submitted to the Commission within 30 days after receipt of the final payment of the European Union financial contribution.