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TERMS AND ACRONYMS

AC	Activity Chain
AIOTI	Alliance for Internet of Things Innovation
ARM	Architecture Reference Model
CATR	China Academy of Telecommunication Research
CVOs	Complex Virtual Objects
FIA	Future Internet Assembly
GSN	Global Sensor Networks
ICO	Internet-Connected-Objects
IERC	European Research Cluster in the Internet of Things
IoT	Internet-of-Things
M2M	Machine-to-Machine
SC	Smart Cities
SSN	Semantic Sensor Networks
Vos	Virtual Objects
W3C	World Wide Web Consortium

1 INTRODUCTION

1.1 Scope

VITAL is focusing on the use of IoT technologies for the development, deployment and operation of integrated added-value smart cities applications. As an IoT-focused project, VITAL is participating in the IERC cluster, sharing information and insights with other EU projects working in the IoT domain, and providing contribution to various aspects of the cluster, based on a variety of different modalities.

In this deliverable we report on the project's contribution to the IERC cluster activities during the first twenty one (21) months of the project's lifetime i.e. since the start of the project in September 2013. We also provide an outlook for the future activities and contributions of VITAL in terms of its participation in the cluster and its collaboration with other projects of the cluster.

In addition to reporting the project's IERC contribution, the deliverable provides also a brief presentation of the project's contribution to standardizations bodies and activities. While several IERC activities and activity chains provide opportunities to influence standards, VITAL will also endeavour to use its research results in order to influence specific standardization bodies and efforts. These include follow-up to the standardization efforts of the W3C SSN (Semantic Sensor Networks) incubation group, as well as de facto standardization efforts addressed to the open source community.

Note that the present document corresponds to the second release of deliverable D7.3. One more release (i.e. the final one) of this deliverable will be produced as part of later stages of the project's work plan, which will report on subsequent activities and contributions to the IERC cluster.

1.2 Audience

This deliverable targets the following audience(s):

- VITAL team members, who may read this deliverable in order to understand how their research efforts are reported, provided and contributed to the efforts of the pan-European IERC cluster.
- IERC cluster coordinators (including the EC side coordinator), who may use the document (as informative input) in order to audit the project's contributions to the cluster.
- Other IERC projects, which could find in this document information about VITAL's contributions to the IERC.
- EU project researchers and engineers, who are interested in detailed reports about IERC events organized/supported by VITAL, as well as in understanding how the VITAL project contributes to the IERC efforts and other standardization initiatives.

1.3 Summary

This deliverable illustrates the contributions of the VITAL project to the IERC cluster during the first nine months of the project's lifetime. These include participation and contribution to IERC meetings and activity chains, active presence in events relevant to the IERC (e.g., IoT Week, FIA), bi-lateral collaboration with other (IERC) projects, as well as contribution to IERC documents and publications. Special emphasis is given in the reporting of VITAL's contribution to the outputs of activity chains (such as deliverables), as well as to the project's contributions in the organization of sessions/workshops as part of the IoT Week (during both the 2014 and the 2015 editions of the IoT Week). Along with a description of the project's IERC contributions, this deliverable provides VITAL's general plan for contributing to IERC till the end of the project.

In addition to IERC participation and contributions, the present document provides also an overview of the project's envisaged contribution to standardization. This includes activities towards de-facto standardization in the open source community. The present version of the deliverable constitutes its second release. One more release of the document are planned later in the project's lifetime in order to report on future/planned achievements and contributions. In the scope of the second release, the partners refer also to plans for their contribution in EC's newly founded AIOTI (Alliance for IoT Innovation) initiative, which is directly linked to the IERC cluster given that the cluster is one of AIOTI's working groups (WGs).

1.4 Structure

The deliverable is structured as follows:

- Section 2, following this introductory section illustrates the ways in which VITAL will contribute to the IERC cluster.
- Section 3 reports the VITAL contributions to the IERC cluster including participation in meetings and joint activities of the various activities chains. The presented contributions refer to the first twenty-one (21) months of the project's lifetime and cover the project's contributions to IERC meetings, the 2014 and 2015 IoT Week events, as well as to the AC1, AC2, AC3 and AC4 activity chains.
- Section 4 outlines VITAL planned contributions to standards, with reference to liaisons the AIOTI initiative.
- Section 5 is the final and concluding section of this deliverable.

In addition to the above-listed sections, the document includes Appendices, which provide additional information about the sessions organized by the project during the 2014 and 2015 editions of the IoT week.

2 ORGANIZATION OF VITAL PARTICIPATION IN AND CONTRIBUTION TO IERC AND STANDARDIZATION

2.1 IERC Participation

In the following paragraph we briefly outline the organization/structuring of VITAL's contributions to the various activities of the cluster.

2.1.1 Activity Chains Contributions

Activity chains within the IERC are thematic working groups, which focus on the development and promotion of the pan European approach in certain aspects of the internet-of-things (IoT). Currently there are more than eight such working groups in the IERC, each one focusing on a different IoT topic/aspect. VITAL is committed to follow the developments of all the activity chains and to contribute to them on the basis of its results. However, the project will primarily focus on three of the activity chains, in particular:

- **Activity Chain 1 (AC1)**, which has produced and validated an Architecture Reference Model (ARM) for designing IoT architecture. This result of AC1 is now taken up by the IoT Forum, which focuses on the development of different flavours/profiles of the ARM towards addressing different IoT application requirements. Furthermore, AC1 continues its activities towards the structuring and organization of several IoT platforms as part of a wider open platforms initiative. VITAL is contributing to both of the above aspects of AC1. In particular, VITAL takes into account the ARM principles and building blocks as part of the developments of the architecture of the VITAL platform. The alignment of the VITAL platform architecture to ARM is illustrated in deliverable D2.3 of the project. Note however that the IERC ARM model work has been concluded as part of AC1 and hence following the delivery of D2.3, the project's architectural contributions are over.
- **Activity Chain 2 (AC2)**, which deals with models, technologies and techniques for naming, addressing and discovery in IoT. VITAL is playing a leading role in this activity chain, since it will be in charge of its coordination. VITAL is contributing to AC2 on the basis of its intelligent discovery schemes for ICOs in smart cities that are currently studied in WP4 of the project and which include discovery techniques that address mobile sensors. During the reporting period covered by the second release of this deliverable (D7.3.2), the project has also led the production of the EU-China white paper on IoT identification.
- **Activity Chain 4 (AC4)**, which deals with the semantic interoperability of IoT systems. VITAL will take advantage of IoT semantic interoperability in order to enable the integration of different IoT systems in smart cities (i.e. silo integration). Hence, the experiences of the project from integrated smart cities implementations will provide significant new insights in AC4 in terms of the use of semantic interoperability techniques in the smart cities domain. During the period covered by the present deliverable, the project has contributed to the final release of the AC4 white paper on semantic interoperability. Furthermore, VITAL has been implementing the basic principles of the semantic interoperability manifesto which has been produced by AC4.

Furthermore, the project has provided information about the VITAL applications and deployments as part of relevant work on collecting such information which is carried out in the scope of the third activity chain (AC3) of the project. Moreover, VITAL is having a leading role in the establishment of a new activity chain on IoT analytics. It has currently planned relevant discussions that will be held during the IoT Week 2015 in Lisbon.

The following table provides an overview of VITAL's (planned) contributions to the above-listed activity chains. Note that the table is an updated version of a respective table included in deliverable D7.1.

IERC Activity Chain	Topic	Planned VITAL contributions
AC1	IoT Architectures and Open IoT platforms	<ul style="list-style-type: none"> • Alignment of VITAL Architecture to the ARM; Provision of Feedback and Comments. • Registering VITAL platform as one of the available IoT platforms at EU level; Provision of relevant support.
AC2	Naming, Addressing and Discovery	<ul style="list-style-type: none"> • Coordination of the Activity Chain. • Collaboration with experts from China (CATR) towards producing a joint EU-China white paper on IoT identification. • Contribution of Intelligent Discovery Schemes for ICOs in Smart Cities; Contribution of schemes dealing with mobility aspects.
AC3	IoT Applications and Pilots	<ul style="list-style-type: none"> • Contribution to the white paper produced by AC3 on the basis of the applications and deployments planned and/or conducted as part of the VITAL project.
AC4	Semantic Interoperability	<ul style="list-style-type: none"> • Coordination of the Activity Chain. • Exploitation of semantic interoperability techniques for integrated applications in the smart cities area. • Implementation of the main principles laid out in the semantic interoperability manifesto (as part of AC4). • Contribution of designs and technologies for the semantic interoperability of disaggregated smart cities silos (IoT-based). • Contribution to the finalization of the AC4 white paper on semantic interoperability.

Table 1: VITAL Planned and On-going Contributions in IERC Activity Chains

2.1.2 Participation in Events

VITAL will participate in all IERC meetings. We also plan to participate in meetings organized by the activity chains where the project participates. At the same time, VITAL will be actively participating and contributing to conferences and workshops organized by the IERC cluster, such as the IoT Week.

2.1.3 Contributions to Documents and Publications

IERC publishes several documents on a regular basis, including:

- The IERC newsletter, which includes news, updates and latest information from the various IERC projects.
- The IERC cluster book, an annual publications produced by the cluster. The cluster book has a technical and scientific orientation and includes state-of-the-art IoT topics.
- Strategic Research Agendas, outlining forward-looking research topics, which define the EU IoT vision and elaborate on roadmaps to achieve the vision.

VITAL will contribute to the above-listed documents and publications. These contributions will be reported in subsequent versions/releases of this deliverable.

2.1.4 Collaboration with other IERC projects

The project's participation in the IERC cluster will provide opportunities for strengthening the collaboration links between VITAL and other projects of the cluster. Indeed, frequent participation in joint meetings and activities provide ample opportunities for the projects to exchange experiences, best practices and results. VITAL has already established collaboration links with other IERC projects (such as FP7 OpenIoT, FP7 iCore, FP7 Gambas), sharing knowledge in terms of best practices, software design and software implementation. At the same time VITAL is keen on facilitating access to its own results for other projects as a means of boosting the exploitation and wider adoption of the VITAL technological achievements. The project has also established collaboration links with other EU projects, as detailed in the scope of D7.2 deliverable. In the scope of the present deliverable we focus on reporting collaborations with IERC projects, rather than with EU projects in general.

2.2 Contribution to Standards

In terms of standardization beyond the IERC, VITAL plans a number of contributions. We discuss these contributions in the following sections.

2.2.1 W3C Semantic Sensor Networks (SSN)

The VITAL coordinator has been a prominent contributor to the W3C SSN incubator group, which produced the W3C SSN ontology and provided guidelines for its wider adoption and use [Compton12]. The group has underlined the importance of the adoption and deployment of this ontology in practical applications. VITAL provides a tangible opportunity for such a practical deployment, which will serve as a basis for reporting back to W3C regarding the SSN ontology.

2.2.2 Open Source (De Facto) Standardization

VITAL intends to become a de facto open source standard for the development of integrated interoperable IoT applications in smart cities. As such it intends to contribute to open source (de facto) standardization. To this end, VITAL will exploit and build upon relevant open source projects of the partners, which are already used by the IoT open source community. These include the OpenIoT platform.

2.2.3 Alliance for Internet Of Things Innovation (AIOTI)

The recently established Alliance for Internet of Things Innovation (AIOTI) aims at becoming an important tool for supporting the policy and dialogue within the Internet of Things (IoT) ecosystem and with the European Commission. It builds on the work of the IoT Research Cluster (IERC) and expands activities towards innovation within and across industries. This also offers an opportunity to discuss legal obstacles to further IoT take up, and to forge consensus. AIOTI includes a working group (WG) on standardization, which VITAL will exploit as a channel for standardizing its developments in terms of interfaces and services for semantic interoperability.

3 REPORT ON IERC PARTICIPATION AND CONTRIBUTIONS

3.1 VITAL's Participation in IERC Meetings

Since the project's commencement, VITAL has been actively participating in all IERC meetings. Participation in these meetings is a mechanism for staying up-to-date regarding the overall strategy and main activities of the cluster. Furthermore, discussion and presentations associated with the various activity chains are also taking place as part of the meetings. Table 2 lists the IERC meetings, where VITAL members have been participating and contributing. It also provides an outline of VITAL's participation and main contributions to each one of the meetings.

Date, Location	Meeting's Goal and Overview	VITAL Project Participants	Scope of VITAL Presentations and Contributions
Zurich (Switzerland) September 15th, 2013	<ul style="list-style-type: none"> Planning of Activity Chains Output in 2013-2014 Presentation and planning of IoT's related activities as part of the Horizon 2020 programme 	<ul style="list-style-type: none"> John Soldatos (AIT) Jorge Pereira Carlos (ATOS) 	<ul style="list-style-type: none"> Initial presentation of the VITAL project goals and objectives. Announcement of the project's start.
Vilnius (Lithuania), November 7th, 2013	Discussion of priorities for IoT topics as part of the Horizon 2020 programme	<ul style="list-style-type: none"> John Soldatos (AIT) Gregor Schiele (NUIG) 	No specific presentation/discussion on the VITAL project progress
Brussels (Belgium), January 24th, 2014	<ul style="list-style-type: none"> Presentation of position papers from the fourth and fifth activity chains (AC4, AC5). Planning of the outputs of other activity chains (AC1, AC2, AC3). 	<ul style="list-style-type: none"> John Soldatos (AIT) Jorge Pereira Carlos (ATOS) Gregor Schiele (NUIG) 	The VITAL project manager was appointed co-coordinator of the second activity chain (AC2)
Athens (Greece), March 21st, 2014	<ul style="list-style-type: none"> Presentation of and updates on position papers from several activity chains (AC2) Initial planning of IERC's participation in the IoT week 	<ul style="list-style-type: none"> John Soldatos (AIT) Jorge Pereira Carlos (ATOS) 	Contribution to a session proposal for the IoT Week 2014 on the basis of results from the second activity chain of the IERC.
Brussels (Belgium), October 23th, 2014	Presentation of the status of several activity chains (i.e. AC2, AC4), including their white-papers.	<ul style="list-style-type: none"> John Soldatos (AIT) 	Presentation of the joint EU-China White Paper on IoT Identification;

			Presentation of the status of AC4 (and its relevant position paper).
Brussels (Belgium), March 24th, 2015	Planning of future IERC activities, including new activity chains and collaboration with AIOTI	John Soldatos (AIT)	Presentation of updates in AC2/AC4, including updates on the status of position papers; Initial discussions/proposal about a session on IoT Analytics
Lisbon (Portugal), June 17th, 2015	AIOTI WG3 on Standards meeting collaboration with AIOTI working group on standards by providing inputs to direct innovation model.	Martin Serrano (NUIG)	Presentation of innovation model and report on AC4 semantic interoperability; Initial discussions on IoT Best practices and Standards

Table 2: Overview of VITAL's Participation and Contribution to IERC Meetings

VITAL plans to continue its active participation in IERC meetings, where it intends to report its work and contributions to the various IERC activity chains. Through its active participation in IERC meetings the project will ensure that its contributions are topical and aligned to the overall strategic directions of the cluster. Furthermore, VITAL plans to lead the establishment and evolution of a new AC on IoT analytics, which is a very topical issue in the IoT community, while at the same time being very relevant to VITAL's work. VITAL will also exploit the opportunity of participating in IERC meetings for networking and knowledge exchange with other projects.

3.2 VITAL's Participation in IoT Week

3.2.1 IoT Week 2014, London (UK)

VITAL partners NUIG and AIT proposed a session for the IoT Week 2014 (<http://www.iot-week.eu>), which has been accepted by the organizers. The session focuses on the discussion of IoT naming and addressing issues, as part of the position papers and issues discussed in the scope of the second activity chain of the IERC. The main goal of the session is to solicit third-party feedback on the results (i.e. position paper) of the IERC AC2, including feedback from Chinese experts (participating in the EU China collaboration) and from standardization bodies working on identification issues. One of the main characteristics of the session was its ability to attract speakers from EU, USA and China. It attracted the interest of more than 40 participants. Details about the session, including agenda and a short concluding report are provided in Appendix 1.

3.2.2 IoT Week 2015, Lisbon (Portugal)

VITAL led the effort of organizing a session on “Large Scale IoT Analytics” in the scope of the IoT Week 2015. The session was intended to provide a forum for presenting IoT analytics work that is on-going in the scope of IERC cluster projects. VITAL is one of these projects, since it provides modules and tools for the definition and execution of data analytics functions over data streams stemming from multiple IoT platforms/systems within a smart city.

The session included several presentations, which covered three main areas: (A) IoT analytics architectures and technologies; (B) IoT analytics applications in domain such as public safety and healthcare; (C) The ever important policy issues (including privacy and security issues). Moreover, the session included a discussion on the potential development of a new activity chain on IoT analytics, including main research topics, prototype systems that could be developed, datasets that could be used for research and experimentation, potential interested parties and more. Note that more details about the agenda and structure of the session are provided as an Appendix to this deliverable.

3.3 VITAL’s Contribution to IERC AC1

VITAL has already started work on the alignment of its architecture to the ARM of the IERC. This work has been undertaken as part of the architecture specification task in WP2 and is reported in deliverable D2.3. On the basis of this work VITAL will provide feedback for improving and fine-tuning the ARM, as well as for creating different flavours of the ARM in smart cities. This feedback will be provided following the conclusion of the VITAL architecture work in WP2, and during the use of the VITAL architecture in other work packages (notably WP3, WP4, WP5 and WP6) of the project.

During the reporting period, VITAL has also participated in initial discussions regarding the setup of the open platforms initiative within the IERC, an initiative linked to IERC AC1. VITAL is participating on structuring and organizing the various IoT platforms of the IERC, while it intends to adopt guidelines set as part of the initiative in order to render its platform part of the portal/directory of open platforms that the initiative has produced.

3.4 VITAL’s Contribution to IERC AC2

Members of the VITAL consortium (from AIT and NUIG) jointly coordinate and lead AC2. Therefore, VITAL, of course, contributes actively to all activities of the activity chain. As described before, among other activities, we are organizing a session at IoT Week 2014. Furthermore, IERC AC2 members have collaborated with Chinese experts from CATR in the production of a joint position paper on IoT identification, which covered naming, addressing and discovery of IoT resources. The joint paper was released in October 2014 [Soldatos14]. The abstract of the joint paper is presented as follow:

This paper is a joint effort of IoT experts under the support of EU-China IoT Advisory Group, towards documenting the state-of-the-art on IoT Identification technologies in EU and China, as well as towards providing an outlook for future developments. As a first step the document defines the scope of IoT identification and introduces relevant concepts and mechanisms, including IoT ID Naming, Addressing and Discovery. Accordingly, the development and deployment status of prominent IoT identification technologies in EU and China is reviewed. Furthermore, a range challenges for the future development and evolution of IoT technologies are presented, along with the limitations of existing solutions. The paper ends-up discussing various directions and development guidelines aiming at alleviating existing limitations in areas such as the integration and semantic interoperability of heterogeneous identification technologies, the security of identification and discovery processes, the support of identification and discovery processes for mobile applications and more. Several of these guidelines are already pursued by organizations in China and EU, as part of research and development initiatives.

Table 3: Abstract of the Joint EU-China Paper on IoT Identification

VITAL has contributed to the contents of this paper, through outlining challenges and solutions associated with the identification and discovery of resources in heterogeneous environment, but also in terms of solutions that take into account the mobility of the sensors during discovery (i.e. such as the solutions developed in WP4 of the project).

3.5 VITAL's Contribution to IERC AC4

VITAL has already adopted several principles of the semantic web manifesto published by the fourth activity chain, including the use of a sensor/IoT ontology for semantic interoperability, the adoption of URIs for IoT identification at the application layer, as well as the use of the OpenIoT blueprint middleware infrastructure for baseline semantic interoperability. These principles are reflected in the VITAL architecture and will also be exploited in the design and development of VITAL results in other work packages of the project. As a first step, VITAL will provide to IERC AC4 feedback on the use of the semantic interoperability principles and infrastructures of the activity chains in the scope of practical smart cities applications contexts. Furthermore, VITAL will contribute its extended developments (in terms of the VITAL ontology and middleware platform for integrated semantically interoperable smart city applications) to the activity chain. Based on these contributions, VITAL has provided input in the latest versions of the IERC AC4 manifesto and position papers.

VITAL has been in charge of finalizing the final version of the IERC AC4 position paper on semantic interoperability. Furthermore, it has presented the position paper in various occasions including two IERC meetings in Brussels (in October 2014 and March 2015). The abstract of the joint paper is presented as follow:

This document is an outcome of the activity Chain 04 in the Internet of Things Cluster. In this document we review the recent trends and challenges on interoperability in IoT domain, discuss physical versus virtual sensors and while addressing technology interoperability challenges in parallel, discuss how, with the growing importance of data understanding and processing, semantic web

technologies, frameworks and information models can support interoperability in the design of services in the Future Internet. The objective of this position paper is to identify relevant issues and challenges that need to be taken into account in the coming and future projects and H2020 and to identify synergies across the participating FP7 projects. This can be used to define an overall framework to address the interoperability challenges.

3.6 VITAL's Contribution to other IERC ACs

Besides the aforementioned activities in AC1, 2, and 4, VITAL also contributes to all other activity chains, e.g. by providing input to position papers or questionnaires (e.g. for AC3). In particular, VITAL has contributed information about its applications and use cases in the scope of a relevant paper that has been produced by the third activity chain of the cluster.

3.7 VITAL's Contribution to establishing new ACs

VITAL is driving the establishment of a new activity chain on IoT analytics, which will allow IERC project to consolidate their IoT analytics work in terms of data science techniques for IoT, covering IoT data collection, filtering, event generation, IoT data mining, IoT data analysis and more. Special emphasis is expected to be paid in the integration of IoT analytics within the emerging cloud and BigData infrastructures. As already outlined, in the scope of the reporting period, VITAL has undertaken preparatory work (e.g., contacting potential contributors, organizing planning discussions) towards establishing the activity chain.

3.8 Contributions to the IERC Cluster Book (2015)

VITAL has undertaken the editing of a chapter of the IERC Cluster Book, notably the chapter on IoT Analytics. The work was directly linked to the preparatory work for the establishment of the relevant activity chain on IoT analytics.

3.9 Contribution to EU-China collaboration

As part of its participation in the IERC AC2 activities, VITAL is also engaging in bilateral discussions with Chinese experts on «IoT Identification and Discovery». The objective of these discussions is to develop a joint position paper on identification and discovery issues, which shall reflect the viewpoints of both sides. VITAL has already participated in two teleconferences where experts from both the EU and the Chinese side participated. Basic information about these two audio-conferences are provided in the following table:

Table 4: EU-China Teleconferences on Identification and Discovery Issues, where VITAL members have participated

Date, Time	Organizers	Agenda Topics
January 16th, 2014 11:00-12:30 CET	<ul style="list-style-type: none"> Philippe Cousin, EU International Partnerships Coordinator, (philippe.cousin@eglobalmark.com) Shirley, CATR, China Side Coordinator (zhangxueli@catr.cn) John Soldatos, IERC AC2 Coordinator 	<ul style="list-style-type: none"> Scope of the collaboration / expected outcomes & deliverables Exchange of Information (e.g., collaborative spaces) Technologies for globally unique identification (naming and addressing) <ul style="list-style-type: none"> Status in EU, Status in China, Indicative Reference projects Technologies for discovery <ul style="list-style-type: none"> Status in EU, Status in China, Indicative Reference projects Identification of main challenges in naming/addressing (e.g., heterogeneity of ID technologies, governance, virtual sensors/entities) <ul style="list-style-type: none"> Challenges from EU perspective, Challenges from Chinese perspective, Common points / Differences / Consolidation Setting of Agenda for Future Thematic (more focused discussion)
February 26th, 2014 10:00-12:00 CET	<ul style="list-style-type: none"> Philippe Cousin, EU International Partnerships Coordinator, (philippe.cousin@eglobalmark.com) Shirley, CATR, China Side Coordinator (zhangxueli@catr.cn) John Soldatos, IERC AC2 Coordinator 	<ul style="list-style-type: none"> Continue/finish the discussion on EU Position Paper Discussion on “China IoT ID white paper” - Questions and comments from EU experts Identification of main challenges in naming/addressing/discovery (e.g. heterogeneity of ID technologies, governance, virtual sensors/entities) Initial approach to the expected outcomes & deliverables i.e. a joint white paper topic on IoT ID between EU and China.

As already outlined, a joint paper on IoT identification has been produced based on the collaboration of experts from the IERC AC2 and CATR.

3.10 Bi-lateral Collaborations with other IERC projects

In addition to networking with other IERC projects during IERC meetings and collaborating with them as part of the activity chains of the cluster, VITAL has already established directly collaboration links with IERC projects with a view to exchanging experiences and reusing its results.

3.10.1 VITAL and OpenIoT Collaboration

During the first nine months of the project's lifetime, VITAL has established very close collaboration links with the OpenIoT project, with a view to reusing parts of the open source OpenIoT platform (available at: <https://github.com/OpenIoTOrg/openiot>), towards designing and building the VITAL platform. This bi-lateral collaboration has been substantiated through:

- Participation of OpenIoT consortium members (notably members of the implementation team such as Nikos Kefalakis from AIT and Danh Le Phuoc from NUIG) in technical discussions of the VITAL teams. To this end, the OpenIoT members have attended VITAL WebEx teleconferences, where the detailed VITAL architecture and technical specifications have been discussed. The aim of the participation of OpenIoT members to the VITAL discussions was to ensure the proper exploitation and reuse of selected OpenIoT modules (such as the X-GSN platform/library and the OpenIoT ontology) in the scope of the VITAL architecture. Note that in order to facilitate the technical discussion, several documents have been exchanged between the members of the two projects.
- Discussions between the VITAL project manager (Gregor Schiele) and the OpenIoT project management (Martin Serrano) on the technical capabilities of the OpenIoT platform, but also on issues associated with licensing and reuse.
- Provision of support from the OpenIoT project to VITAL members, notably VITAL members experimenting and/or validating selected functionalities of OpenIoT that are relevant to VITAL. As a concrete case of support, the VITAL team at INRIA, received support in its effort to integrate data streams from the FIT platform to the OpenIoT cloud. Note that this represents prerequisite prototyping work, which will be exploited towards the realization of the first proof-of-concept implementation of the VITAL platform.

As evident from the description of the above-listed activities, the interaction between VITAL and OpenIoT has been greatly facilitated from the partners that participate in both projects (i.e. NUIG and AIT), which have both strong interest and will to exploit and extend the award winning OpenIoT open source platform in the scope of the VITAL implementation.

3.10.2 VITAL and iCore Collaboration

VITAL maintains also very close links to the iCore project, based on partner ATOS, which is an active contributor to both projects. VITAL will leverage the work done in iCore with the focus pointed to the following topics:

- Discovering and accessing to virtual objects based on their semantic description.
- Discovering and accessing to Complex Virtual Objects (CVOs), which offer a means for rendering the application request, to fulfill the request from VITAL.
- VITAL access to CEP techniques built/developed in iCore.

3.10.3 VITAL and IoT Forum Collaboration

VITAL will establish close links to the IoT Forum, with a view to discussing potential contributions of the VITAL architecture to the IoT ARM. As a first step, VITAL will participate to the dedicated IoT ARM session on Semantic Interoperability & Security/Privacy/Trust aspects, which will be organized in the scope of the IoT Week (Wed, June 18th, 2014, London UK).

3.11 Participation in Future Internet Assembly (FIA)

VITAL co-organized a pre-FIA workshop during FIA Athens 2014, entitled: “IoT as a proponent of new Business Models and Social Engagement in Smart Cities (SC)” and co-organized by several FP7 IoT/Smart Cities projects (namely VITAL, RERUM, CityPulse, COSMOS). It was held on Monday, March 17th, 2014 (9:30-13:00). Leveraging the expertise of four FP7 projects the workshop covered the topics:

- IoT as enabler of new business opportunities in SCs.
- Role of SC stakeholders in the development of a successful business ecosystem.
- Role of communities and social media/networks in IoT applications.
- Incentives and barriers for citizens’ engagement in SCs.

VITAL participated in the workshop on the basis of a presentation titled: «*Social Networks as a means for Citizens Participation in smart cities*» (given by John Soldatos). The project participated also on one of the panel discussions dealing with the topic of: «The citizen’s role in a truly smart city».

Details of the pre-FIA workshop are available at: <https://www.fi-athens.eu> and <https://www.fi-athens.eu/program/workshops/iot-proponent-new-business-models-and-social-engagement-smart-cities>.

4 REPORT ON STANDARDS CONTRIBUTIONS

4.1 W3C SSN

At the time of writing this deliverable, VITAL has commenced work towards extending the W3C SSN ontology for use in the scope of integrated smart city applications. This is the first step to the practical deployment and use of the W3C SSN work in smart city applications.

The working group at the W3C on SSN extensions is still under discussions for defining the new model specifications and submit a working group to W3C, NUIG Insight is the main representative / participant in this activity.

4.2 Open Source

VITAL has (as part of WP6 of the project) commenced the specification of its open source infrastructure, the decided portal will be GitHub and this will serve as a basis for the open source contributions of the project. Currently all the software development and project integration is taking place in GitLab (an Open Source Software platform) that allows more flexibility for development, once the code is integrated the GitHub project will be populated and the first release of the code take place following the WP6 licensing activity.

4.3 Eclipse IoT

VITAL has started cooperation with the Eclipse IoT group and specifically the Eclipse Ponte project. VITAL's project manager (Martin Serrano) is actively discussing with the Eclipse Ponte project leader (Mateo Colina) with respect to semantic (meta) data models and interoperability between VITAL and Ponte.

The scope of the Ponte project is threefold:

- Define a simple REST API to expose the machines needs through REST, exposing multiple protocols (MQTT, CoAP) through the same API.
- Embrace multiple data formats, such as JSON, XML, Msgpack, Bysant and provide ways to automatically convert between them; eventually, common representation of sensors and actuators data will be defined (or adopted from Paho).
- Define and build a user-driven security solution to support the communication between all these devices.

The VITAL-PONTE collaboration can go in the form of define an internal API for adding new protocols easily, through plugins in VITAL with the main objective for:

- Define a JSON-based support for message formats, and add converters between them. The converters API should be exposed to Ponte through plugins.
- Study an OAuth 2 solution that can be embedded inside the machines, to allow the end user, and eventually the owner, to authorize or deny every access.

5 CONCLUSIONS

VITAL acknowledges the importance of its active participation in the IERC and its activities. In particular, the project views its active involvement in the IERC as a first class opportunity towards:

- Aligning several of its results to EU wide best practices and standards such as the IERC ARM model for IoT architectures. VITAL is already pursuing the alignment of its architecture with the ARM as illustrated in deliverable D2.3 of the project.
- Contributing to the development of a pan-European approach in IoT areas such as naming, addressing and semantic interoperability. To this end, VITAL is contributing to several working groups (i.e. activity chains) of the IERC.
- Driving the establishment of new working groups within the cluster (such as the IoT analytics activity chain), which are closely related to topics dealt within the project.
- Offering contributions that could facilitate the linking and collaboration between the IERC cluster and the emerging AIOTI initiative.
- Strengthening its collaboration with other IERC projects and engaging with them in the reuse of their results. This approach holds the promise to maximize the project's value for money at the end of VITAL's lifetime. Note that VITAL has already established very close collaboration links with other IERC projects such as FP7 OpenIoT and FP7 iCore.
- Providing part of or even the whole VITAL platform as an open platform, through relevant mechanisms established within the IERC (such as the open platforms initiative of the cluster). This could greatly facilitate the sustainability and wider take-up of the project's results.

With these considerations in mind, VITAL has actively participated in the IERC cluster activities with an emphasis on activity chains one (AC1), two (AC2) and four (AC4). It has also contributed to other activity chains (e.g., AC3) and taken a leading role in the establishment of a new AC on the topical subject of IoT analytics. Note that VITAL has the leading/coordinating role in AC2, where it also has a leading role in the collaboration of the activity chain with experts on IoT addressing from China (as part of the EU-China collaboration). Furthermore, VITAL has an active participation in meetings and events organized (or co-organized by the IERC), notably IERC meetings and the IoT Week (where it contributed to the organization of sessions during both the 2014 and the 2015 editions). In addition to its participation in IERC, VITAL will pursue to have an impact on the SSN incubator group of the W3C, the open source community and AIOTI initiative. The final version of this deliverable will provide a conclusive report on all the activities and contributions of the project in the IERC cluster, while at the same time providing an assessment of their overall impact in the EU IoT community and beyond.

APPENDIX 1 IOT WEEK 2014 - SESSION ON «IOT IDENTIFICATION AND DISCOVERY» - AGENDA & SHORT SESSION REPORT

Session Information

Date and Time of Session	Venue	Session Organizers
Wednesday June 18th, 2014 14:00-17:30	The Grange Tower Bridge Hotel 45 Prescott Street, London, E1 8GP	Gregor Schiele (gregor.schiele@insight-centre.org) John Soldatos (jsol@ait.gr)

Agenda

14:00 – 14:15	Welcome and Introductions (Dr. Gregor Schiele, Research Fellow / Adjunct Lecturer, INSIGHT @ NUI Galway)
14:15 – 14:50	"Identifier Services in IoT applications", (Sam Sun, Corporation for National Research Initiatives (CNRI), USA)
14:50 – 15:30	"Global identifiers and Interoperability", (David Weatherby, Business Consultant, GS1 UK)
15:30 – 16:00	Afternoon refreshment break/networking
16:00 – 16:35	"Understanding and Discussion on Internet of Things Identifiers in China" (Dr. Yuming GE, CART, China)
16:35 – 16:55	IERC Projects Solutions on IoT Identification and Discovery, (Prof. John Soldatos, Athens Information Technology)
16:55 – 17:15	"The use of the a Secure Identifier Resolution System in IoT", (Prof. Peter Kirstein, University College London)
17:15 – 17:30	Q&A and Discussion: «Outlook on IoT Identification and Discovery»»

List of Participants

No.	Name	Organization	Country	E-mail
1	Ge Yuming	CATR	China	geyuming@catr.cn
2	Rui Costa	Ubiwhere	Portugal	rcosta@ubiwhere.com
3	Thierry Demol	CITC-Eura RFID	France	tdemol@cict-eurarfid.com
4	Mark Wharton	ARKESSA	UK	Mark.wharton@arkessa.com
5	Si Zhexi	Red Ninja	UK	xi@redninja.com

6	Elliot Adderton	Red Ninja	UK	elliott@redninja.com
7	Zoltan Gal	University of Debrecen	Hungary	zgal@unideb.hu
8	Nikos Pronios	Technology Strategy Board	UK	nikos.pronios@tsb.gov.uk
9	Bryan Masull	Newnet	UK	Bryan.masull@newnet.co.uk
10	Kostas Kalaboukos	Singularlogic	Greece	kkalaboukas@singularlogic.eu
11	Stephane Pique	Motorola	UK	Stephane.pique@motorola.com
12	Arkady Zaslavsky	CSIRO	Australia	Arkady.Zaslavsky@csiro.au
13	Alvaro Garcia	IK4-Tekniker	Spain	alvaro.garcia@tekniker.es
14	Jens Ziegler	TU Dresden	Germany	Jens.ziegler@tu-dresden.de
15	Malika Boulkenafed	Dassault Systems	France	malika.boulkenafed@3ds.com
16	Paul Grace	IT Innovation, University of Southampton	UK	pjg@it.innovation.soton.ac.uk
17	Milos Tesanovic	FUJITSU Labs of Europe	UK	milos.tesanovic@uk.fujitsu.com
18	Carlos Pedrinaci	The Open University	UK	carlos.pedrinaci@open.ac.uk
19	Ali Intizou	National University of Ireland, Galway	Ireland	ali.intizou@insight-center.org
20	Claudio Pastrone	ISMB	Italy	pastrone@ismb.it
21	Francesco Sottile	ISMB	Italy	sottile@ismb.it
22	Ivana Podnar Zrko	University of Zagreb	Croatia	Ivana.podnar@fer.hr
23	Marco Carugi	ITU-T		marco.carugi@gmail.com
24	Yong-Woon KIM	ETRI	Korea	kim@etri.re.kr
25	David Weatherby	GS1	UK	David.Weatherby@gs1uk.org
26	Peter Kirstein	UCL	UK	kirstein@ucl.ac.uk
27	Sam Sun	CNRI	USA	ssun@cnri.reston.vas.us
28	Anu Deri	Flexeye	UK	Ad@flexeye.com

29	Diryang Sharma	Flexeye	UK	ds@flexeye.com
30	Jorge Berzosa	IK4-Tekniker	Spain	jorge.berzosa@tekniker.es
31	Gregor Schiele	National University of Ireland, Galway	Ireland	gregor.schiele@insight-centre.org
32	John Soldatos	Athens Information Technology	Greece	jsol@ait.gr

Main points raised during the session

- Presentation of different technologies and schemes for Identification.
- Acknowledgement that IoT applications will be supported by a variety of identification technologies and standards.
- Taxonomy of different identification schemes at various levels, including physical level, communication level, application level.
- Presentation of holistic solutions covering all aspects of the identification functionalities (such as the Handle System and the GS1/ONS standards).
- ID technologies in EU, China and USA have several differences but also common/overlapping schemes.

Positive feedback

- The session's presentations covered of a wide range of viewpoints/perspective on ID technologies.
- The rich content presented included information beyond EU/IERC projects (e.g., based on the speakers from CNRI, GS1).
- Many participants (≥ 30 in the session – 40+ at certain times) and active participation/interactions throughout all talks.

Negative feedback

- The scope of IERC AC2 was not clear for some participants, especially in terms of whether it tries to define new identification schemes or exploit existing ones. Relevant clarification is needed.
- Feedback from more standardization bodies should be solicited/taken into account.

Received suggestions/ proposals for improvement & Topics that were proposed to be addressed in the future

- Establishment and use of a common terminology / glossary for IoT identification and discovery issues. This could facilitate the presentation of ID and discovery issues. The terminology could be based on terms defined by standardization bodies.
- Specifications of the circumstances where interoperability across different Identification schemes are needed. Relevant best practices could help.
- Scalability and performance benchmarks on some of the presented technologies could be useful.

APPENDIX 2 IOT WEEK 2015 - SESSION ON «LARGE SCALE IOT ANALYTICS» - AGENDA & SHORT SESSION REPORT

Session Information

Date and Time of Session	Venue	Session Organizers
Tuesday June 16th, 2015 14:00-17:20	Centro de Congressos de Lisboa Praça Indústrias 1300-307 Lisboa	John Soldatos (jsol@ait.gr)

Tuesday, June 16th, 2015 –Programme

14:00 – 14:10	Welcome – Introduction – Goals of the Session (John Soldatos, Athens Information Technology)
14:10 – 14:30	“Dynamic Data Analytics for the Internet of Things: Challenges and Opportunities”, Payam Barnaghi, University of Surrey , UK
14:30 – 14:50	“IoT is a King, Big Data is a Queen and Cloud is a Palace”, Abdur Rahim, CREATE-NET, Italy
14:40 – 15:10	“Making Sense of real Data in Smart Cities applications: Mobility and Energy Efficiency”, Antonio Skarmeta, University of Murcia
15:10 – 15:30	"IoT Analytics for Public Safety", Flavio Cirillo, , NEC Labs Europe
15:30 – 15:50	Coffee Break
15:50 – 16:10	“IoT Analytics for Smart HealthCare”, Christoph Thuemmler, Technical University of Munich, Germany
16:10 – 16:30	“Towards a positive approach in dealing with privacy in IoT data analytics”, Maarten Botterman GNKS Consult, The Netherlands
16:30 – 16:50	Panel Discussion (Speakers) – Audience Q&A
16:50 – 17:20	Setting up an IoT Analytics Working Group (Activity Chain) under IERC <ul style="list-style-type: none"> • Scope & Objectives • Expressions of Interest • Next Steps

Main points raised during the session

The session covered three main areas of IoT analytics, including IoT analytics technologies, IoT analytics applications and policy issues. In particular:

- **IoT Analytics Technologies:** In terms of IoT Analytics technologies, technologies for collecting, aggregating and unifying semantically data streams were discussed, along with technologies for discovering IoT data streams in a large scale environment. Furthermore, the integration of cloud computing, BigData and IoT technologies was discussed. Along with the presentation of these technologies the challenges that are addressed through these technologies were introduced and discussed, including the multi-modal and heterogeneous of IoT data streams, the noisy and incomplete character of IoT data, their time and location dependencies, the need for (near-) real-time analysis, as well as privacy and security issues.
- **IoT Analytics Applications:** Several applications of IoT analytics technologies were presented including applications for healthcare, applications for smart safety, applications for urban mobility, as well as applications for detecting patterns in smart buildings. For each one of the applications, the presenters discussed the implementation challenges, along with the technologies deployed and used. In several cases the presentation of the application (e.g., of the smart mobility applications) provided an opportunity for an accompanying presentation of the platform(s) used to support them.
- **IoT Analytics Policy Issues:** The session included a dedicated presentation on policy issues. It provided insights on the alignment of IoT analytics technology developments with societal needs. The issues of accountability, transparency and choice were also stressed. Note that privacy and security issues (including data protection) peculiar to healthcare applications were also discussed as part of the IoT analytics for healthcare presentation of the session.

Positive feedback

- Coverage of several topics associated with IoT Analytics
- Good level of interaction from the audience, especially in terms of policy, security, privacy and data protection issues.
- Presentations of several practical applications that illustrated the value of IoT analytics.

Negative feedback

- Absence of some topics (e.g., IoT data visualization).
- Lack of emphasis on effective analytics algorithms focused exclusively on IoT analytics applications.

Topics associated with the establishment of new activity chain on IoT Analytics (within the IERC cluster)

The session included a panel discussion with the participation of all speakers. In addition to answering questions from the audience, this panel discussion provided an opportunity for identifying (research) topics that should be explored as part of the activity chain. A list of main topics follows: (A) IoT Data Collection and Fusion; (B) Cloud Integration; (C) IoT Data Storage; (D) Semantics for IoT Analytics; (E) Data Mining techniques for IoT analytics; (F) IoT Data Analytics Algorithms; (G) BigData & IoT Integration; (H) Performance Optimization and Evaluation for IoT analytics; (I) IoT Analytics Visualization; (J) IoT analytics applications.

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[Soldatos14] John Soldatos and Ge Yuming (eds.), «EU-China Joint White Paper on Internet-of-Things Identification», October 2014, available at: <http://www.theinternetofthings.eu/john-soldatos-joint-eu-china-white-paper-iot-identification>.