Enabling the business-based
Internet of Things and Services

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D12.3 Activities for contribution to standardisation work

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1. Executive Summary

Ebbits aims at developing a platform which fosters the semantic integration of the Internet of Things with mainstream enterprise systems and herewith bridge enterprise applications and information generated by tags, sensors and other devices. This document compiles a list of standards in the field of service science, system integration as well as sensors, devices and distributed networks relevant in the context of the ebbits project. Furthermore, the most important standardisation bodies are outlined as a starting point for discussion and planning of standardisation activities initiated from the ebbits consortium. In addition, a roadmap, including internal surveys and periodical review meetings, is proposed. Based on this framework it can be guaranteed, that the planned activities always match the actual needs of the project with regard to the dissemination of research results.

2. Introduction

This document summarizes the first activities in task T12.2. The main objective of the corresponding task is to coordinate the contribution of the results developed in the whole project to relevant European and internal standardisation bodies. This includes the identification of existing standards, relevant in the context of ebbits, as well as assembling information about partner's access to and affiliation with relevant standardisation bodies. In addition, the compiled list of relevant standards and standardisation activities is maintained and iteratively updated over the whole project lifecycle in correspondence to new research results. Moreover, work package 12 in general and this task in particular aims at coordinating the interaction with relevant standardisation bodies and at identifying potential candidates for defining new standards or extending existing ones. Furthermore, initiating and organizing the participation of partners in standardisation work are important objectives. Herewith, it can be guaranteed, that the project is building upon available and emerging standards and industry specifications to ensure interoperability and enable quick market take-up. Where these standards are insufficient or are difficult to apply, the consortium will seek to influence and contribute to their extension, or where feasible, propose amendments.

As a starting point for the discussion of the application of concrete standards in the various research fields of ebbits, the document will layout and categorize the most relevant standards in the context of ebbits. In an iterative process this list will continuously be extended during the project. Afterwards, the most important standardisation committees and initiatives are introduced. Apart from that, the first potential candidates for contributions based on ebbits research results are discussed. The document concludes by presenting the roadmap for further activities in this work package.

3. Relevant standards

This section outlines the main areas targeted by ebbits, together with the most important and relevant standards, respectively. The standards introduced and categorized here serve as a first draft and starting point for further discussion and planning on standardisation activities.

3.1 Service science

Ebbits aims at providing a service oriented architecture based on open protocols (HTTP, SOAP etc.) and LinkSmart middleware[1] facilitating to abstract from any specific service implementation or device communication interface by providing web services with semantic resolution and herewith leveraging the ideas of the Internet of Things (IoT) and the Internet of Services (IoS). Apart from the well established and widely adopted standards in the web service domain like SOAP, together with various extension like (WS-Addressing, WS-Reliable Messaging etc) or WSDL and standards from the semantic web, like OWL, SPARQL or RDF(S), the combination of both fields are of special interest for the ebbits platform. Moreover, standards for service description and service orchestration are in the scope of the project. The most important candidates in this field are introduced in the following sections.

3.1.1 OWL-S

The Semantic Markup for Web Services (OWL-S[2]) is based on OWL and aims at annotating web services with additional semantics in order to facilitate service discovery, invocation, composition and monitoring. The standard, driven by the W3C, provides a service ontology which can be utilized to explicitly specify the semantics of the service interface. Therefore, the OWL classes *Service Profile*, *Service Grounding* and *Service Model* are provided, each of them answering one of the following questions:

- What does the service do?
- How can it be accessed?
- How does it work?

Based on this knowledge, clients can automatically infer information needed to find and use the service. Whereas, OWL-S is a solid conceptual basis for semantic annotations of web services, in the context of ebbits, the biggest challenge is the automatic discovery, composition and deployment of semantic web service workflows in real-time environments. Therefore, ebbits also needs to investigate how the semantic integration based on annotations and reasoning affects performance and execution times in real-world scenarios.

3.1.2 WSMO

The Web Services Modeling Ontology (WSMO[3]) is an initiative to create an ontology for describing various aspects related to semantic web services. It primarily aims at solving the integration problem of heterogeneous web service architectures and is led by the Semantic Web Services working group[4]. Similar to OWL-S, the ontology provided is used to annotate web services in order to enable automatic discovery and application of web services. Therefore, WSMO offers four main elements:

1. Ontologies that provide the terminology used by other elements,
2. Goals that state the intentions that should be solved by web services,
3. Web services descriptions that define various aspects of a Web service, and
4. Mediators which resolve interoperability problems.

[1] Hydra EU Project, http://www.hydramiddleware.eu/news.php.

[2] OWL-S Standard, http://www.w3.org/Submission/OWL-S/.

[3] WSMO, http://www.w3.org/Submission/WSMO/.

[4] WSMO Working group, http://www.wsmo.org/.

Apart from the syntactical differences, there are also some conceptual differences with respect to OWL-S (see (1) for a detailed comparison). In the context of ebbits, it has to be evaluated whether one of the standards is suitable to realize the vision of semantic services in the ebbits platform.

3.1.3 RO-SOA

The Reference Ontology for Service Oriented Architectures[5], driven by OASIS, aims at consolidating other approaches to semantic web services by providing a corresponding reference model. The scope of it is to provide an ontology that formally describes the different elements comprising a SOA in order to be able to apply tools to automatically reason about service description.

3.1.4 USDL

The Unified Service Description Language[6] is proposing a holistic service description approach, covering technical as well as business-related aspects of services. It was mainly driven by the consortium of the German THESEUS/TEXO[7] project and is now further specified by the W3C Unified Service Description Language Incubator Group[8], led by SAP Research. The main goal of USDL is to align business services by unifying them using a common description format, building on top of existing formats as WSDL. The experience gained during the development of USDL can serve as a suitable basis to enhance matching services between ebbits information and enterprise systems data structures and services. Furthermore, the strong involvement of SAP Research in the standardisation efforts around USDL could be used to propose enhancements or extensions.

3.2 System integration

The ebbits project aims to semantically integrate the Internet of Things into mainstream enterprise systems and support interoperable real-world, on-line end-to-end business applications. It will provide semantic resolution to the Internet of Things, and hence present a new bridge among backend enterprise applications, people, services and the physical world, using information generated by tags, sensors, and other devices performing actions in the real-world. In order to reach this goal, architectures have to be designed and developed, which allow for seamless vertical and horizontal integration across multiple heterogeneous systems. In doing so, ebbits framework architecture will build upon open and well established standards for messaging and data representation. The most relevant standards in this field are listed and introduced below.

3.2.1 ISA 95

Starting in 1995, the ANSI/ISA-95[9] (2) standard has been developed in an international working group of the American National Standards Institute (ANSI) and the Instrumentation, Systems and Automation Society (ISA). The key objective is to describe standard interfaces between control systems on the manufacturing side and enterprise systems on the supplier side. It specifies models, operations and processes which foster the integration of different manufacturing execution systems (MES), responsible for production, maintenance and quality management, and arbitrary enterprise resource planning systems (ERP), covering sales, finance and logistics, across all industries. The set of models described reaches from models of the physical structure of enterprises and production procedures to models of information flows and object models. All in all, ISA-95 provides a shared conceptualization for describing data exchange as well as workflows and processes in plant systems, and therefore facilitates inter and intra-company system integration. The main

[5] RO-SOA, http://docs.oasis-open.org/semantic-ex/ro-soa/v1.0/see-rosoa-v1.0.html.

[6] USDL, http://www.internet-of-services.com/index.php?id=382&L=0.

[7] THESEUS/TEXO, http://www.theseus-programm.de.

[8] USDL Incubator Group, http://www.w3.org/2005/Incubator/usdl/.

[9] ISA 95 Standard, www.isa-95.com.

benefits of ANSI/ISA-95 promises are cost and risk reduction by applying integration best practices as well as improved inter and intra-company communication due to shared vocabularies.

3.2.2 OAGIS

In contrast to ISA-95, which solely focuses on MES to ERP integration, the OAGIS standard (3) is much broader. The Open Application Group Integration Specification is designed to cover every class of business to business transaction. Nevertheless, as a result of the broader scope, the coverage of pure P2B integration scenarios is less detailed. In order to facilitate integration between various business systems, OAGIS proposes a reference-architecture for exchanging messages. Every message is represented as a so called Business Object Documents (BODs). Every BOD contains general information, as e.g. a timestamp or a unique identifier, as well as a data area which describes actions and data types to be exchanged between heterogeneous systems. In addition to BODs, OAGIS provides a set of integration scenarios which describe the integration of various business applications based on BOD messages by example.

3.3 Sensors, devices and distributed networks

Research work in the area of communication technologies as well as distributed networks and device integration will deal with capturing real-world events of loosely coupled objects, such as sensors, behavioral/people events, or business events and with performing safe and secure actions on the physical world. Therefore, ebbits will explore available communication technologies in changing industrial environments, including KNX, LONworks, EIB, etc. as well as wireless technologies such as WiFi, IEEE 802.15.4, ZigBee, RFID, Bluetooth or EnOcean and others. Moreover, connectivity in the ebbits infrastructure has to be designed to be network agnostic in order to support any application domain and use case, regardless of time, bandwidth and protocol constraints. Some of the most relevant standards for the integration of physical world devices are listed below.

3.3.1 ZigBee

The ZigBee[10] protocol is an open standard for very low-power-consumption, two-way, wireless networking, allowing a wide range and number of devices to be managed in one single controlled network. Devices can be divided into several classes ranging from sensors and control devices in manufacturing to consumer electronics. The standard has explicitly been designed for application domains that require long battery life, easy installation and removing (either automatic or semi-automatic) of nodes as well as low system costs. Moreover, it provides security layers on top of the IEEE 802.15.4 standard as well as device discovery and pairing capabilities. In addition, ZigBee standardized a set of application profiles, e.g. smart energy, home automation and remote control. Every profile is a collection of device descriptions which builds the foundation for one specific application domain. By means of those profiles, vendors can build upon a common understanding of messages, message formats and actions that need to be provided in a specific domain.

3.3.2 Dash7

Dash7[11], which is promoted by the Dash7 Alliance formed in 2009, is a wireless sensor networking specification based on the ISO/IEC 18000-7 standard for active radio frequency identification. While originally created for military use, it now promises extreme low power consumption and ranges from 10 meters up to 10 km's also for public use. Furthermore, it supports the tracking of moveable sensors and offers security capabilities. In contrast to ZigBee, which uses the 2.4 GHz band, it operates on the 433 MHz world-wide available ISM band. Furthermore, it allows for direct tag-to-tag communication and not only penetrates walls but also links through water.

[10] ZigBee, http://www.zigbee.org/.

[11] Dash7, http://www.dash7.org/.

4. Relevant committees and initiatives

The following section will introduce the most relevant standardisation bodies identified in the context of ebbits and not already covered in the previous sections. Just as the list of standards in the previous section, it can be seen as a starting point for discussion. According to the needs of the project, the research results and the feedback of all partners, the list will be continuously extended and complemented. The most relevant committees and initiatives identified so far are listed below.

4.1 EFFRA

The European Factories of the Future Research Association[12] is a non-profit organization found to support the European commission in the "Factories of the Future" public-private partnership (PPP). EFFRAs objectives are to identify the most important research activities in strong cooperation with industry and academic partners as well as to communicate research results back to the private sector. EFFRA also engages in contact with the public sector through representatives of the European Commission, the European Parliament and the EU Member States. Thus, it can be seen as an information hub between the public and private sector in order to ensure the industrial relevance of ongoing and future projects as well as to transfer research results back to the private sector. With Comau, Fraunhofer and SAP, three partners of the ebbits consortium are involved in projects funded under the umbrella of the "Factories of the Future" and therefore have a link to the EFFRA which can be used to also communicate and disseminate results of ebbits. The contact can also be used to propose and discuss new standards with other industry and academic partners.

4.2 EPCglobal

EPCglobal[13] is a joint venture between GS1 and GS1 US set up to achieve world-wide adoption and standardisation of Electronic Product Code (EPC) and RFID technology. The EPC is a unique number used to identify a specific item during the whole product lifecycle, ranging from manufacturing to the supply chain and maintenance. The EPCglobal organization consists of manufacturers, technology solution providers, and retailers from various industries ranging from aerospace, apparel, chemical, consumer electronics, consumer goods, healthcare & life sciences and transportation to logistics. Standards driven by EPCglobal are e.g. EPCIS[14] (EPC Information Services Standard) as well as ONS (Object Name Service). Whereas EPCIS covers data sharing within and across companies based on EPC, the ONS, similar to DNS, offers product information discovery from the EPC.

4.3 W3C

The World Wide Web Consortium focuses on the specification of World Wide Web-related standards. This includes standards for XML, SOAP, WSDL, OWL, HTML and many more. Apart from those, which will be relevant in the context of ebbits in any case, especially the incubator groups introduced below could be of interest. Both of them cover aspects which are relevant to ebbits. Moreover, SAP Research is already involved in both groups.

4.3.1 Object Memory Modeling Incubator Group

The OMM[15] incubator group works on defining a standardized object memory format capable of modeling events or other information about physical artifacts on so called "smart labels" directly attached to the artifacts. In addition, the data stored is semantically annotated in order to foster data integration and automatic reasoning about the provided knowledge. Moreover, data is collected over the full lifecycle of products. This vision of a "digital product memory" is mainly driven by the research results of the alliance of

[12] EFFRA, http://www.effra.eu.

[13] EPCglobal, http://www.gs1.org/epcglobal.

[14] EPCIS, http://www.gs1.org/sites/default/files/docs/epcis/epcis_1_0_1-standard-20070921.pdf.

[15] OMM Incubator Group, http://www.w3.org/2005/Incubator/omm/.

the projects SemProM[16], ADiWa[17] and Aletheia[18], all funded by the German Ministry of Education and Research (BMBF). Moreover, the European project SmartProducts[19] contributes to the group. The ebbits consortium is represented by SAP Research, which is heavily involved in the definition to the OMM format.

4.3.2 Unified Service Description Language Incubator Group

As introduced in section 3.1.4, the USDL incubator group[20] tries to establish the Unified Service Description Language as a W3C standard, positioning USDL as a domain-independent service description language optimized for modeling business aspects, like pricing, legal terms and security. The group is mainly driven by SAP Research which offers potential interactions with standardisation or extension proposals driven by ebbits needs and research results.

4.4 OASIS

Founded in 1993, the Organization for the Advancement of Structured Information Standards[21] is an international consortium that aims at developing and adopting open standards in information technology. The portfolio of standards covers various fields ranging from web services (various WS-* standards) and SOA (RO-SOA) to business processes (WS-BPEL) and content technologies (ODF and DocBook).

4.5 Casagras

Casagras[22] is a European Framework 7 project consisting of international partners representing Europe, the USA, China, Japan and Korea who will look at global standards, regulatory and other issues concerning RFID and its role in realizing an "Internet of Things." The Casagras team involves standardisation organizations from all parts of the world, including ETSI. Casagras has also suggested creating European Centres for the IoT and establishing automatic identification and data capture to help business grasp the opportunities they offer. One initiative is the RFID Global Forum which ebbits intends to approach rapidly for discussions of liaison. Moreover, the Casagras project proposed an inclusive model for realizing the IoT, not only bound to RFID but embracing a range of other identification and object-connected technologies (4).

[16] SemProm project, http://www.semprom.de.

[17] ADiWa project, http://www.adiwa.net.

[18] Aletheia project, http://www.aletheia-projekt.de/.

[19] SmartProducts project, http://www.smartproducts-project.eu/.

[20] USDL Incubator Group, http://www.w3.org/2005/Incubator/usdl/.

[21] OASIS, http://www.oasis-open.org.

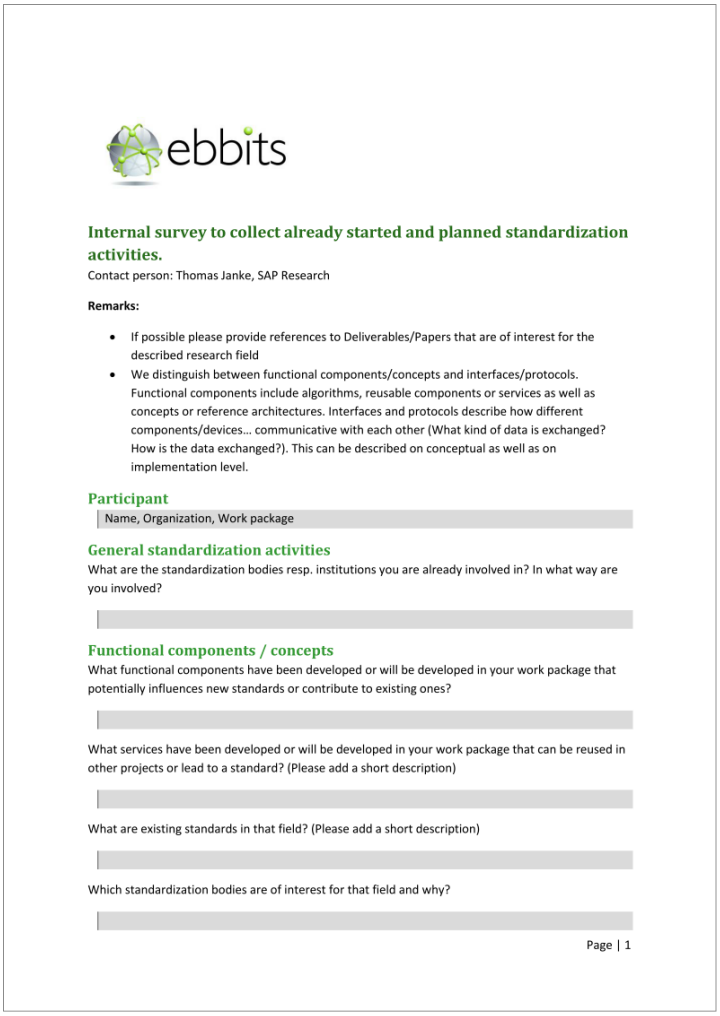
[22] Casagras, http://www.rfidglobal.eu/.

5. Activities and roadmap

As mentioned above, the compilation of standards and standardisation bodies in this document is used as a basis for further planning and discussion of the next steps towards contributing the results of the ebbits project to standardisation. Due to the nature of a research project, the list is by far complete but will be continuously adopted and extended with respect to research results and input from the various work packages and partners.

5.1 Internal Survey

In order to gather feedback as well as proposals for other relevant standards and institutions in a formalized way, a questionnaire will be prepared and sent to all partners. An excerpt of the survey is illustrated in Figure 1.



ebbits

Internal survey to collect already started and planned standardization activities.

Contact person: Thomas Janke, SAP Research

Remarks:

- If possible please provide references to Deliverables/Papers that are of interest for the described research field
- We distinguish between functional components/concepts and interfaces/protocols. Functional components include algorithms, reusable components or services as well as concepts or reference architectures. Interfaces and protocols describe how different components/devices… communicative with each other (What kind of data is exchanged? How is the data exchanged?). This can be described on conceptual as well as on implementation level.

Participant

Name, Organization, Work package

General standardization activities

What are the standardization bodies resp. institutions you are already involved in? In what way are you involved?

Functional components / concepts

What functional components have been developed or will be developed in your work package that potentially influences new standards or contribute to existing ones?

What services have been developed or will be developed in your work package that can be reused in other projects or lead to a standard? (Please add a short description)

What are existing standards in that field? (Please add a short description)

Which standardization bodies are of interest for that field and why?

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Figure 1: Extract from survey to collect data on standardisation activities

The survey will, amongst others, include the following questions:

- What are the standardisation bodies and institutions, respectively, you are already involved in?
- What functional components have been developed or will be developed in your work package that potentially influences new standards or contribute to existing ones?

- What interface or protocols have been developed or will be developed in your work package that potentially influences new standards or contribute to existing ones?
- Have you already initiated any steps towards standardizing concepts or components developed in ebbits?

The results of the survey will be used to consolidate the current document and to create a concrete roadmap for starting interaction with the respective standardisation bodies as well as to plan further steps.

Moreover, a wiki page will be created and updated in order to document current activities and refers to the latest standardisation document. The URL to the wiki will be communicated to the consortium via the respective mailing lists.

5.2 Continuous adoption and refinement

In order to guarantee that the standardisation activities are always in line with the progress of the ebbits project, the current document will be presented and discussed every 6 month as part of the half-yearly review meeting. Moreover, the survey will be carried out every 12 month. This will be done in synchronization with the yearly development cycles defined in nearly all work packages. Following this approach, relevant committees can be approached at the beginning of each iteration phase in order to align the planning in each work package. After completing each iteration phase, in turn, feedback about the results can be transferred back. The roadmap for the surveys and the synchronization meetings is depicted in Figure 2. It outlines the activities with respect to project years and project months.

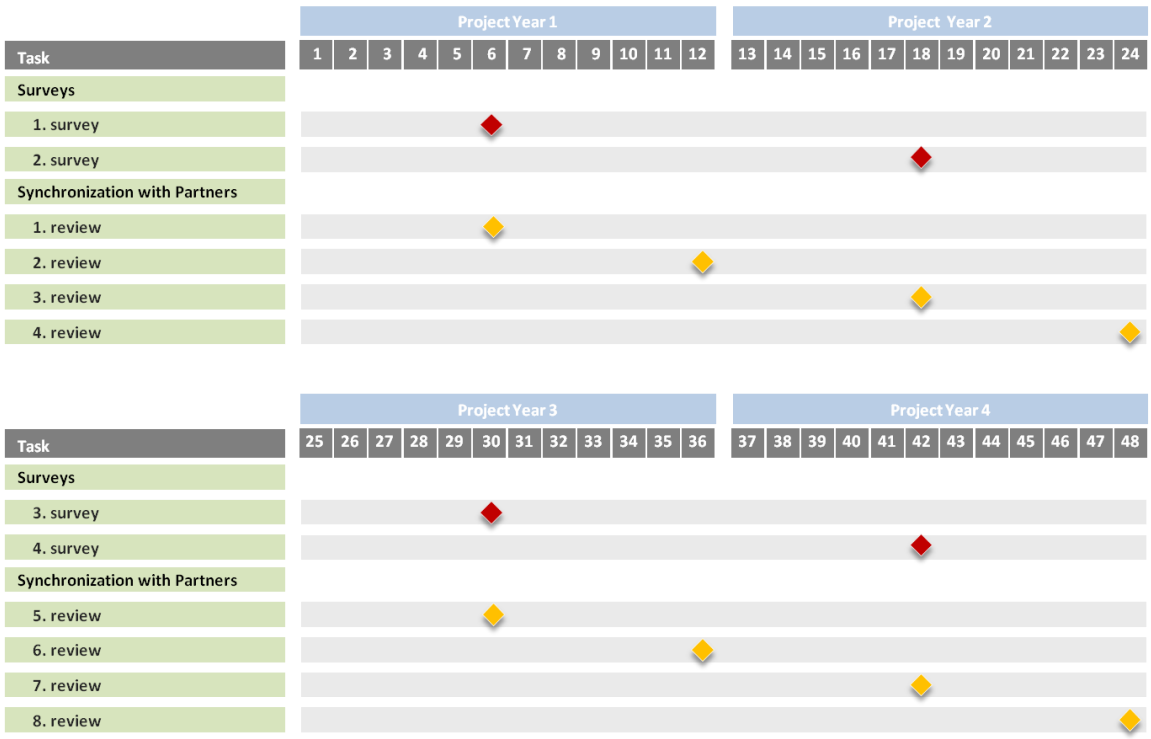

Figure 2: Roadmap for continuous adaption and refinement

6. Conclusion

This document introduced standards and standardisation bodies that are most relevant in the context of the research objectives in the ebbits project. Furthermore, a roadmap for further activities has been proposed that will ensure that the planned activities are at any time well aligned with the research results from ebbits. The roadmap also makes sure that the process is flexible enough to cope with changing requirements and scope of activities by means of half-yearly synchronization meetings.

7. Bibliography

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8. List of Figures