D19.1v0.1. WSMO in DIP

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1. Introduction

The SDK project cluster has the mission of strengthening the European research and industry in the areas of Semantic Web and Semantic Web Services, ensuring the integration of European research efforts and the cooperation with the US-based DAML initiative towards international standardization. There are three major European research projects in the area of Semantic Web and Semantic Web Services integrated in the SDK cluster, namely: SEKT, DIP, and Knowledge Web. Their integration ensures a close cooperation between the three projects and enables the joint dissemination of the projects' results both to academia and to industry.

This document presents the relation between the Semantic Web Services working group of the SDK cluster and DIP, emphasizing on DIP contribution to the working group and how the project benefits from the close cooperation with SDK working group.The next sections describe the Semantic Web Services working group of the SDK cluster and its integrating subgroups. Section 2 describes the role of DIP in the working group, WSMO integration in DIP and how the results of the working group are fed back to the project. In the end, section 3 presents conclusions and future work.

1.1 WSMO

The Web Services Modelling Ontology (WSMO) working group is the Semantic Web Services working group of the SDK cluster. WSMO aligns the research and development efforts in the field of Semantic Web Services between SEKT, DIP and Knowledge Web. The mission of the working group is to, through cooperation between the three projects and the combination of their participants expertise, provide mature results in the area of Semantic Web Services languages, architectures and platforms.

The WSMO approach aims to solve the integration problem based on the following main features: simplicity (a solution to the integration problem as simple as possible), completeness (solve every aspect of the integration problem), and executability (providing a set of execution semantics and a reference implementation). The pillars of the work in WSMO are given by the Web Services Modelling Framework (WSMF [Fensel & Bussler 2002]), which gives the conceptual grounding that will be further developed by the working group.

WSMO emphasizes the modelling of real use cases from different application areas, including tourism, banking, marketplaces, supply chains, etc. These use cases will be based on the requirements of industrial partners and research groups joining the working group.

The activities of WSMO include the definition of an ontology for describing the various aspects of a Web Service, the modelling of B2C and B2B use cases using the developed ontology, a conceptual and formal comparison to the DAML proposal (OWL-S), the semantic description of the choreography and orchestration of Web Services, and a comprehensive tutorial on the modelling ontology and its related research and results. The definition of the ontology follows a layered approach, addressing the different levels of complexity of different application scenarios. For this reason, three different layers are defined, namely: WSMO, WSMO-Standard, and WSMO-Full, ranging from the simplest ontology that is still meaningful for the integration problem to a full ontology covering all the business aspects of Semantic Web Services.

The working group includes two subgroups: the WSML working group, which aims at developing the Web Service Modelling Language (WSML) that formalizes the Web Service Modelling Ontology, and the WSMX working group, which aims at developing a Web Services Execution Environment. The WSML and WSMX working groups are described in more detail in the following sections.

1.2 WSML

The Web Service Modelling Language (WSML) working group is a sub-group of the WSMO working group. Where WSMO aims at developing a sufficient conceptual model for the description of Semantic Web Services and showing its application, WSML aims at providing the formal basis for this conceptual model and to provide a concrete modelling language based on this conceptual model.

Members of the WSML working group include key participants with expertise in Semantic Web-related research areas.

The SDK WSML working group aims to, through alignment between key European research projects in the Semantic Web Service area, further the development of Semantic Web Services and work toward further standardization in the area of Semantic Web Service languages and to work toward a common architecture and platform for Semantic Web Services. Specifically, the working group aims at developing a language called Web Service Modelling Language (WSML) that formalizes the Web Service Modelling Ontology (WSMO). In this context, the mission of WSML is two-fold: (1) developing a proper formalization language for semantic web services and (2) providing a rule-based language for the semantic web.

The current activities in WSML include work on the syntax for the Web Service Modelling Language, Web Service discovery using the goal-capability matching, evaluating formal languages, developing an ontology API based on the WSMO conceptual model for ontologies and work on a Semantic Web rule language, which uses the DLP (Description Logic Programming) [Grosof et al., 2003] fragment of OWL Lite as a basis. WSML will furthermore provide three formal semantics for Web Service description. A full First-Order Logic, a Description Logic and a Horn Logic-based semantics.

1.3 WSMX

The Web Services Execution Environment (WSMX) is an execution environment for dynamic discovery, selection, mediation and invocation of web services. WSMX is based on the Web Services Modelling Ontology (WSMO) which describes all aspects related to this discovery, mediation, selection and invocation.

The main WSMX functionality resembles the one of a workflow engine. In addition, extra functionality is included to it, functionality that concerns semantic web (ontologies management and reasoning) and web services (web service invocation, matching, selection and mediation).

WSMX can be regarded also as a web service as it can be invoked to provide its own functionality and also can invoke other web services / WSMX systems in order to compose and use their outcomes. Furthermore, it can be regarded as a platform that can support various B2B and industrial applications for business or integration purposes.

WSMX is a reference implementation for WSMO. The goal is to provide both a test bed for WSMO and to demonstrate the viability of using WSMO as a means to achieve dynamic inter-operation of web services. The development process for WSMX includes defining its conceptual model, defining the execution semantics for the environment, describing an architecture and software design, and building a working implementation.

2. WSMO in DIP

In this section, we present the objectives and structure of the DIP project and define the relation to WSMO, describing the results and problems flow between the SDK cluster working group and DIP.

2.1 DIP (Data, Information and Process Integration with Semantic Web Services)

DIP is a FP6 project that aims to further develop Semantic Web and Web Services and especially to enable their combination. Web Services are the proper means to access semantically enriched data and semantic enrichment of Web Services is essential for their scalability and maturity in the world of complex enterprise applications. This new area is called Semantic Web Services. Semantic Web Service technology will allow structural and semantic definitions of documents providing completely new possibilities in knowledge management, Enterprise Application Integration, and eCommerce. Semantic Web Services will provide a new infrastructure for eWork and eCommerce, just as the telephone did a century ago, based on its ability to provide semantic processing of data, information, and processes. DIP will develop this technology and will focus on applications in eWork and eCommerce including sub topics such as Knowledge Management, Enterprise Application Integration, eBanking, Virtual Internet Service Provision and eGoverment.

DIP's mission is to make Semantic Web Services a reality, providing an infrastructure (i.e. an architecture and tools) that will revolutionize data and process integration in eWork, and eCommerce as the web did it for human information access.

The core objectives of DIP are the following:

1. Make Semantic Web technology a reality. An important objective of DIP is to further develop the vision of the Semantic Web based on machine processable semantics as a new communication and cooperation infrastructure. Machine-processable semantics enable the mechanization of information access and processing.
2. Combine Semantic Web technology with Web Services for semantics-based services. Web Services based on the Semantic Web may provide the killer application for Semantic Web technology, and the combination of both may provide an infrastructure that will revolutionize not only information processing but the general way we access computational resources. It will provide a completely new infrastructure for eWork and eCommerce.
3. Apply Semantic Web Services as an infrastructure in real world scenarios within an organization and between organizations and its

customers/partners. We aim to ensure that we will develop practical technology, and DIP will illustrate in practice its impact on new methods for eWork, eGoverment, and eCommerce. The main types of applications are:

- Intelligent Information Management: This involves improving human information access to unstructured and semi-structured information.
- Enterprise Application Integration: This is the integration of data, processes, and applications within an organization.
- Dynamic & Smart eCommerce: B2B Applications provide Semantic Web Services as a new infrastructure for intra organization cooperation enabling virtual and smart organizations in commercial and non-commercial environments. Here we talk about the integration of data, processes, and applications between different organizations introducing higher requirements on openness, heterogeneity, and change.

The major results of DIP will be:

Standard proposal through SWSI. Through the already existing Semantic Web Services Initiatives (SWSI) a major standards proposal in the area of Semantic Web Services is produced and submitted to one of the major standards organizations in the space like W3C or OASIS. DIP will generate major input to the work of SWSI through continuous participation and through this mechanism the results of DIP will influence SWSI in major ways.
Open source Semantic Web Services Architecture. One of the key deliverables of DIP is an open source Semantic Web Service Architecture that is made public on a world-wide basis. The goal of the open source approach is to make the architecture easily available for other organizations (research as well as industrial). Through this approach a fast uptake of the work of DIP will be achieved.
Exploitable tools. Since tools are implemented that realize part of the overall architecture they become exploitable for the partners of DIP on a large scale. This approach ensures that real impact can take place and in combination with the open source architecture these tools will be in great demand from many organizations.

DIP as a consortium consists of 19 partners divided into core partners that are leading universities and industrial companies, associated research partners that have expertise in specific technology areas, associated tool developing partners that are very experienced in tool construction, associated case study partners that provide real world domain expertise and associated horizontal support partners that have a variety of skills applicable to all areas of work.

DIP will interact bidirectional with WSMO, benefiting from the work done in the SDK working group and providing inputs back to WSMO for further developments. In the following section, there are presented the concrete relations that emerge between DIP and WSMO.

2.2 The potential of WSMO in DIP

2.2.1 WSMO in DIP work-packages

Considering DIP main objectives and approaches, WSMO is going to have a significant impact in contributing to DIP goals' achievement. DIP project is structured on 15 work packages in which WSMO is contributing as follows:

Workpackage 1 - Ontology reasoning and querying

As WSMO will evolve and once the inference engine developed in WP1 is in a more advanced state, the inference engine will be capable to process WSMO descriptions. This will be done by a close cooperation with WSMO team.

Workpackage 2 - Ontology management

WSMO will contribute to the following deliverables that belong to workpackage 2:

- D2.1 and D2.2: Strong alignment with WSMO D18 "Language Neutral API".
- D2.3 will: Add WSMO-specific browsing.
- D2.4 will provide a survey on known ontology versioning tasks and problems and its relation to WSMO, a scenario about ontology versioning in the context of Semantic Web Services and requirements for an ontology versioning tool.
- D2.5 will address the requirements of the WSML scenario of D24 and will investigate the possibility of incorporating ontology versioning capabilities into the WSMO ontology.
- D2.6 will provide a prototype that will allow the WSMO ontological modelling of the webservices space to be browsed and versioned. The prototype will provide the basis to enable the following possible future stages of development:

    - Interacting with WSML-enabled systems by reading ontologies formalized in WSML
    - Mapping services (expressed in various languages such as WSDL) to ontological models, thus allowing the assignment of semantics to web services that are expressed in non-ontological standards
    - Integration with a WSMX execution environment, with the next-stage-prototype software serving ontological information.

- D2.7 will integrate the results from D2.5, D2.1 and D1.5 into a new (or extended version of an existing) ontology language. Thus the alignment done in these deliverables will be reflected in D2.7 as well.
- FZI will provide a proposal for extending the ontology language with rules. This part should also be aligned with WSML as far as this is possible.

Workpackage 3 - Service Ontologies and Service Description

WP3 is concerned web with service ontologies and web service description. Therefore WSMO will be intensively used in modelling ontologies (in WSMO format) in the following deliverables: D3.3 (business data ontology), D3.4 (business process and protocol ontology) and D3.5 (goal ontology and repository).

Furthermore, it is expected that WSMX is going to be used as a base for D3.2 (framework for semantic service description) and also will contribute on integration aspects in D 3.6 (service ontology and web service description integration).

Workpackage 4 - Service Usage

Regarding WSMO, it is expected that will be aligned with this in the Service Usage Workpackage both directly and via the work of WP3. In WP4 are defined the requirements for, specifying and building prototypes for a set of modules or processes needed in service usage. As such it will be drawn upon the outcome of the WSMO work as appropriate, but also ensure compatibility with the service ontology work of WP3 (which is itself drawing on WSMO).

Workpackage 5 - Service Mediation

Considering that workpackage 5 is concerned with mediation, further development of the mediation parts in WSMO could provide a valuable input. Currently there are ongoing discussions about the impact of WSMO in the current work on the specification deliverables.

Workpackage 6 - Interoperability and Architecture

As described in D13.4v0.1 WSMX Architecture, there are two types of components in the WSMX architecture: components dedicated to compilation of integration definition types and components dedicated to execution of WSMX messages/events. For compilation of the integration definition types two components are dedicated while for execution of the WSMX messages/events eight of them are allocated.

WSMX Management and Ontology Repository components are shared among compilation and execution functions of the WSMX platform. Components dedicated to compilation of integration definition types are: User Interface and Compilation Engine. Components dedicated to execution of the WSMX messages/events are: Events Management, Event Transformer, Discovery, Mediation and Selection engines and Invoker.

Based on WSMO and WSMX, in the next figure 1 and figure 2 is presented the proposal for DIP architecture. Figure 1 presents the basic architecture proposal. The dash-dot boxes represent the prospective components to be added to the existing architecture. Figure 2 presents the architecture with the possible specifications to be used.

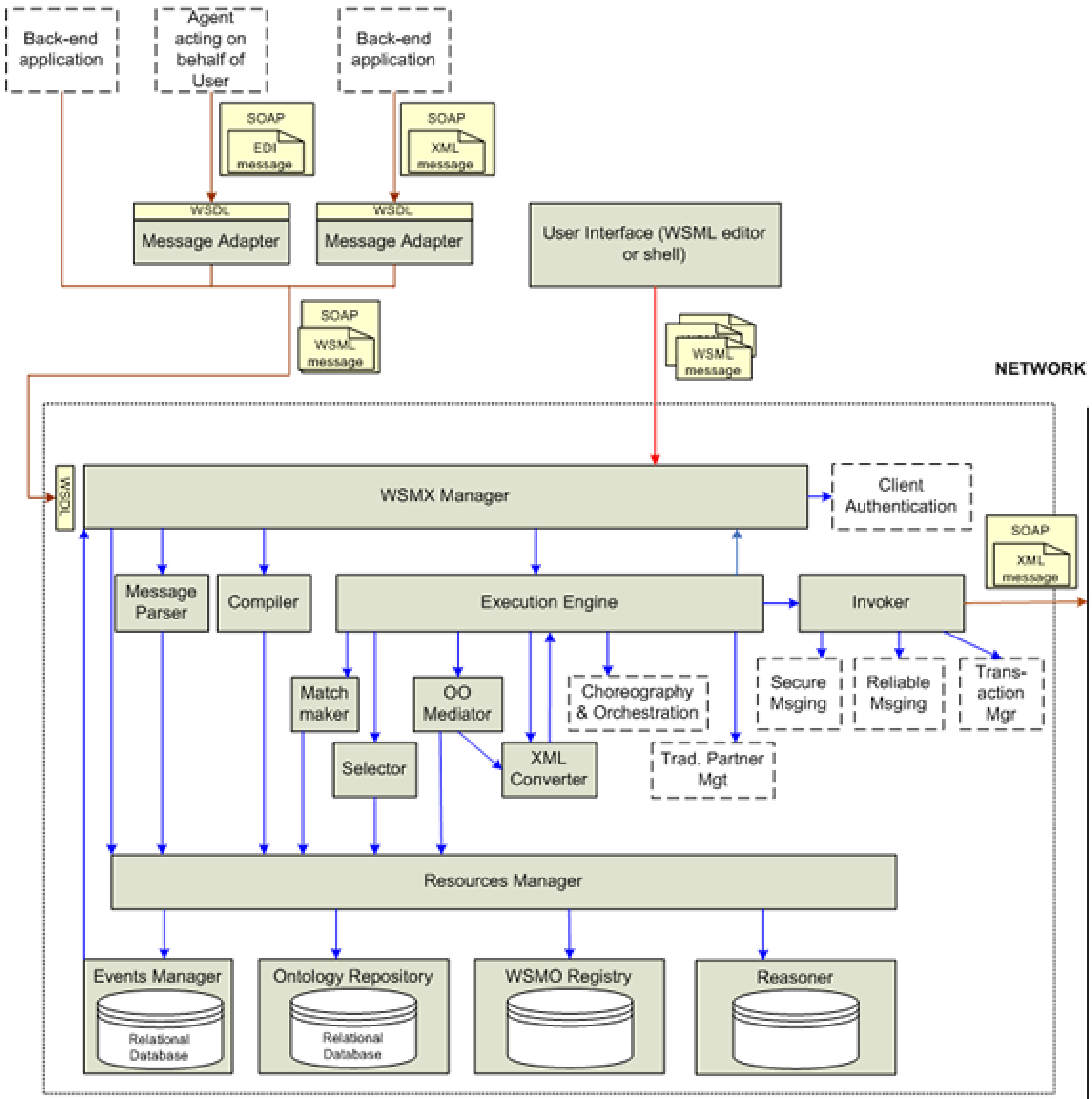

Figure 1. DIP-WSMX architecture proposal

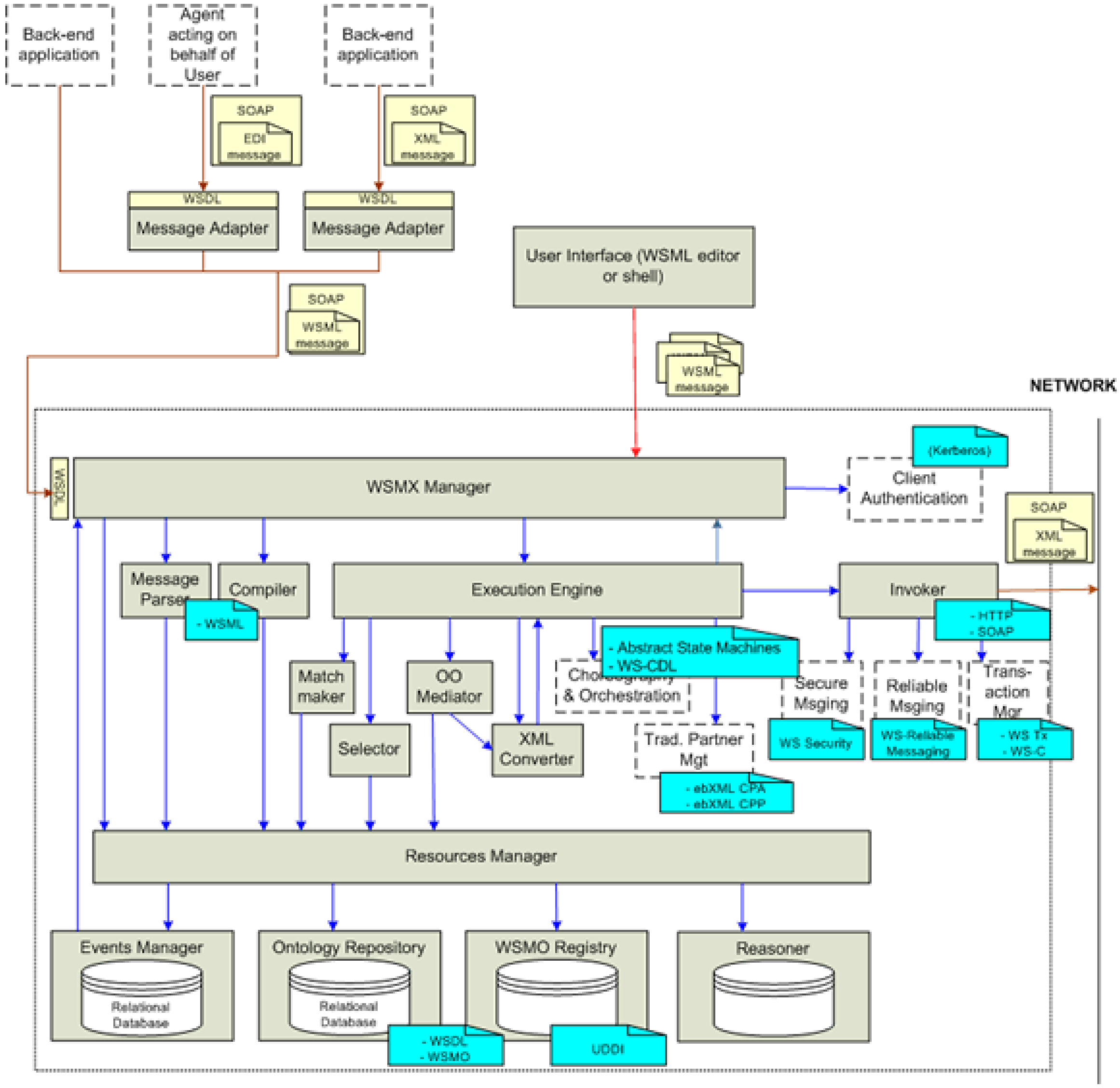

Figure 2. DIP-WSMX architecture proposal with specifications that are possible to be used

Workpackage 7 - Technology watch and Standardisation

WSMO is considered as one of the current standardization efforts/initiatives in area of SWS and therefore represents an input for this work-package.

Workpackage 9 - Case Study eGovernment

Open University, one of the partners in WP9, is committed to the Standard version of WSMO. There will be two implementations of the Mock-up for our use case, one of which will use OU's IRSII. IRSIII is forthcoming and will be WSMO compatible.

Workpackage 10 - Case Study eBanking

WP10 is a Case Study and don't provide technology but uses DIP and others own technology, and so WSMO will be used in this case study. WSMO is targeted for usage. The mock-up in summer will use some of the WSMO frame structures.

Workpackage 12 - Market Observation

WP12 is concerned with market observation. Since this work package is not producing any technology, choosing WSMO does not impact the work performed in a direct way. The work evolving in this WP might discover that market needs are matched or not matched by WSMO (but this is not yet apparent).

Workpackage 14 - Training

WP 14 has concerning WSMO the following position:

- It will use the WSMO tutorial slides as part of the background workshop. OU is part of the WSMO tutorial team giving a tutorial in Bulgaria, September, AIMSA 2004 and of the proposal submitted to ISWC2004 in November, Japan.
- WSMO will also be a component of a number of DIP tools. In fact the OU's main tool IRS will become WSMO compliant over this summer and will be also used for DIP training purposes.

Next there are presented several architectural and C2B, B2B applications that are based on WSMO and WSMX and are intended to provide the platform solutions for the DIP case studies.

2.2.2 C2B / B2B generic application example using WSMX

The figure 3 below represents link between WSMX architecture and DIP project by proposing a generic B2B architecture example based on which can be designed further any C2B and B2B application that needs to use semantics and web services functionalities. In the present example of figure 2, there are chosen randomly three different ERP systems (BAAN, EPICOR and SAP) that need to integrate together in order to fulfil a specific goal. They are interconnected by the help of a WSMX module and they are also invoking independent web services to provide them with a partial required functionality.

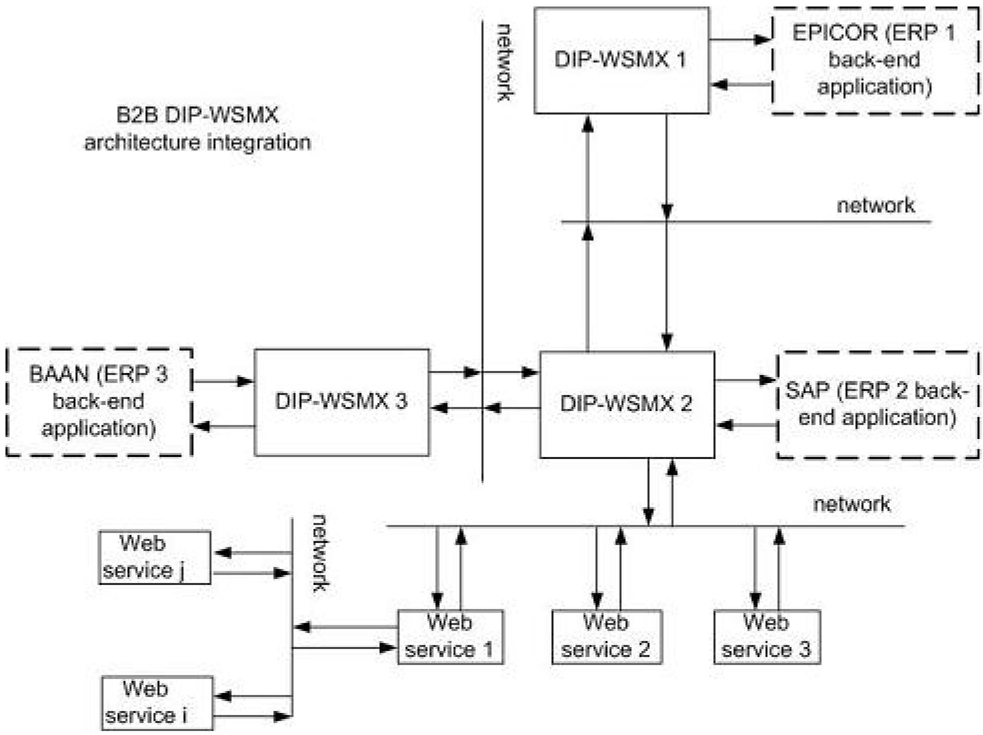

Figure 3. DIP-WSMX B2B theoretic application proposal

2.2.3 Use Cases

In the figure 4 below is illustrated a DIP-WSMX C2B and B2B eBanking application, that is an architectural proposal for one of DIP project case study. Here the actors are Final Customer, Financial Institution, Appraisal Institution, the Moneylender, Public property registry and Defaulter registry. This application follows the logic of the theoretical example described in Figure 3.

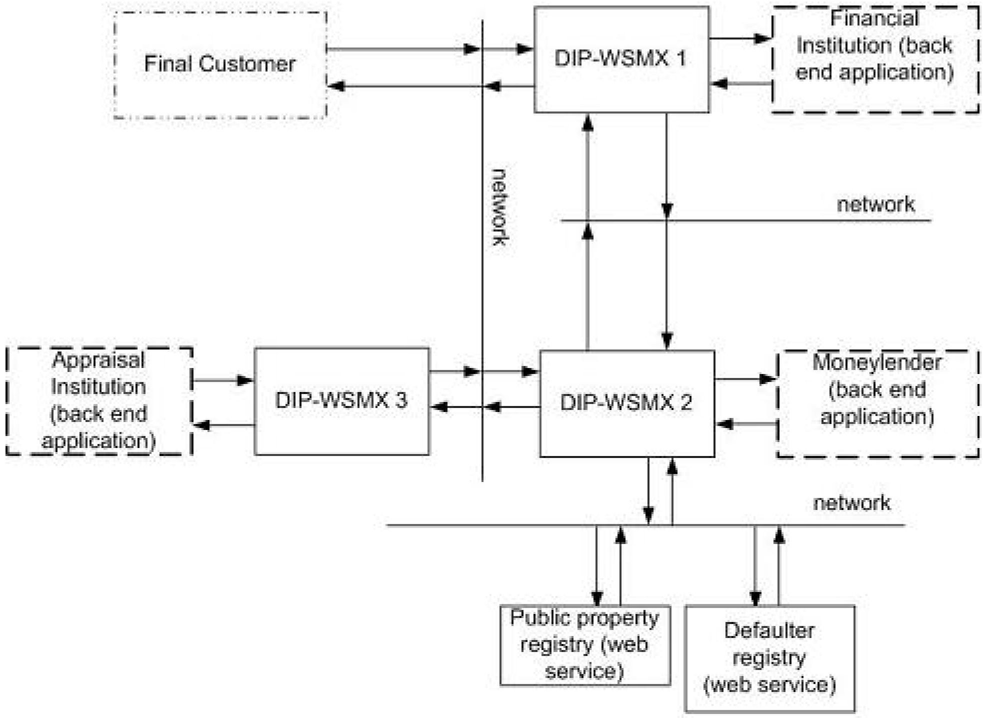

Figure 4. DIP-WSMX C2B + B2B eBanking application

In the figure 5 below is illustrated a second DIP case study (Virtual Internet Service Provider) application. Here the actors are the customer, supplier, ISP (Internet Service Provider and VISP by VISP platform:

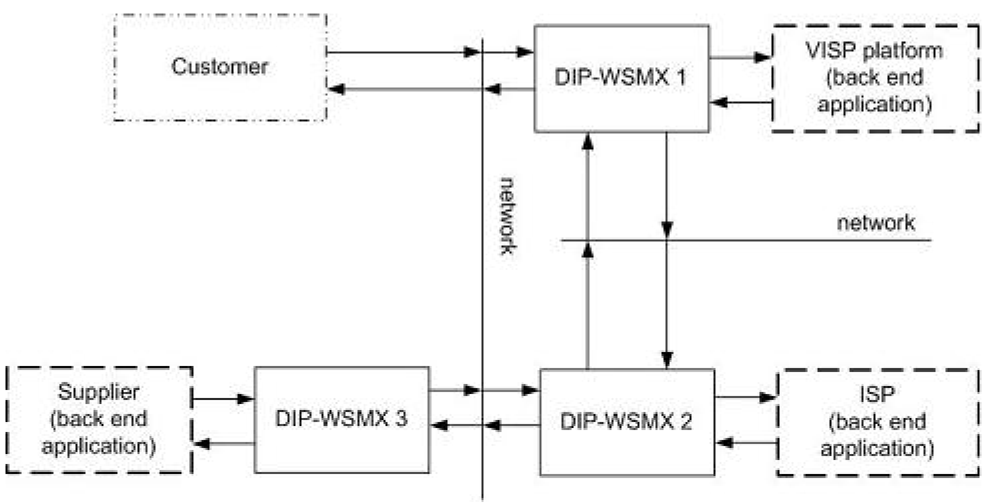

Figure 5. DIP-WSMX C2B + B2B VISP application

In the figure 6 below is illustrated the third DIP eGovernment application. In this case the actors are the Service provider, eGovernment, Essex Social Services, the social worker and the occupational therapist:

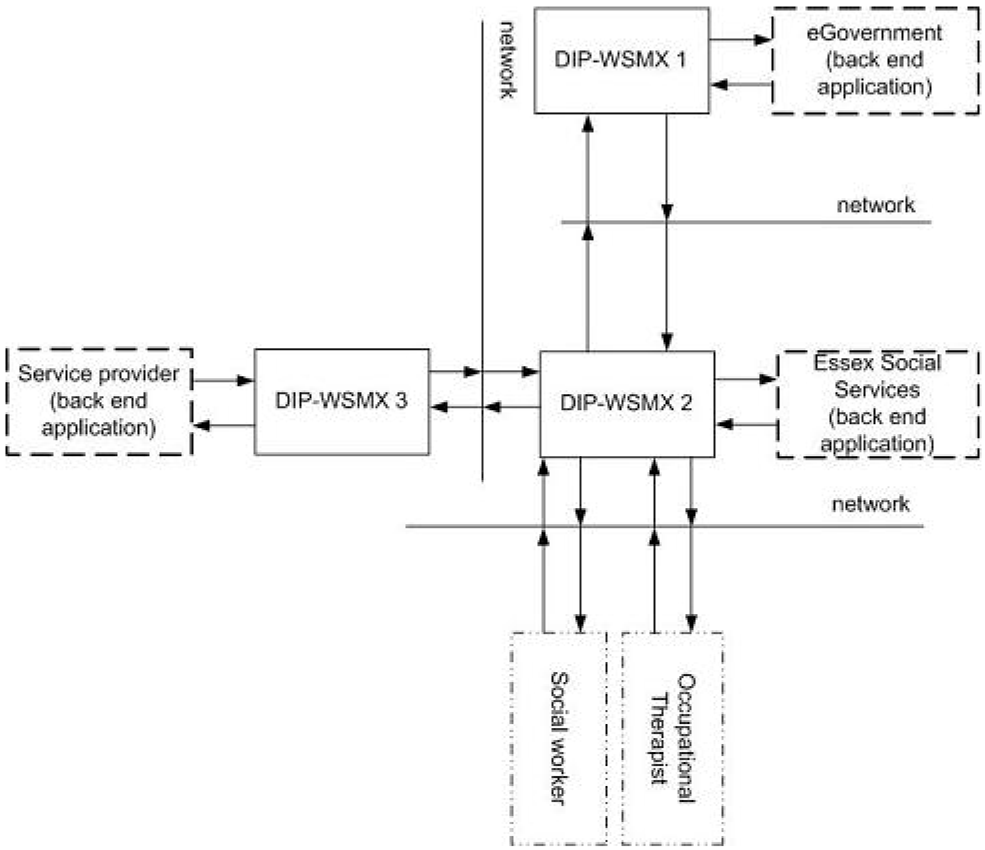

Figure 6. DIP-WSMX C2B + B2B eGovernment application

3. Conclusions and further work

The role of WSMO in DIP will influence consistently the project development providing important inputs to the research area and cooperating with the industry area to support the adoption of WSMO in an industrial setting. The industrial impact of the joint WSMO and DIP efforts is intended to be a major one. DIP and WSMO are working closely providing to each other useful bi-directional inputs for the benefit of both research groups. DERI is involved in both efforts and provides the logistics and expertise to fulfil the both common goals.

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