Publishing Intentional Services using extended semantic annotation

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Abstract—With the increasing growth in popularity of Web services, it is still difficult for business users to fully benefit from the SOA if it remains at the software level. The introduction of intentional services has been proposed to bridge the gap between low level, technical software-service descriptions and high level, strategic expressions of business needs for services. This proposal leverages on the SOA to an intentional level, and introduces the iSOA architecture. As current Web services technology based on UDDI and WSDL does not make use of this “intention” and therefore fails to address the problem of matching between capabilities of services and business user needs, we are interested in this work in extending existing approaches for the description of intentional services. Our proposed approach is an extension of the W3C recommendation on semantic annotation for Web services (SAWSDL). The semantic annotations added to the descriptor are based on intentional service ontology. This ontology is built upon the intentional service model and the goal model; it contains all necessary concepts for defining the goal and the intentional service. We introduce the intentional service descriptor to be published in an extended registry, and illustrate our work with an example.

Keywords—intentional service; goal model; intentional service ontology; intentional service description; semantic annotation

I. INTRODUCTION

Within a decade, Web services and SOA have become a viable technical solution for the development of information systems. They provide flexibility in maintenance and evolution of systems, and ensure a high degree of interoperability between heterogeneous systems [22]. However, it is difficult for business users to fully benefit from the SOA if it remains at the software level, the technological tools currently available such as WSDL (Web Service Description Language) and UDDI (Universal Description Discovery and Integration) are semantically poor and conceptually far from the concerns of the business users [22]. There is in fact a "conceptual mismatch" between low level software services located on the operational level, and the user’s high level needs expressed in business terms. To bridge this gap, a proposition has been made to move towards a description of services in business terms [14]. Business needs are expressed as maps of intentions and strategies to achieve them; a map takes the form of a graph with intentions as nodes and strategies as edges. Derivation mechanisms are proposed so that to organize the identification and specification of intentional services [26, 27].

The work presented in this paper is built on this earlier research work around the Intentional Services Model (ISM). With ISM, the service description brings out the business intention that the service allows to fulfill with pre and post conditions instead of defining the signatures of operations that can be invoked. In the following, we begin by presenting briefly the iSOA underlying model.

A. Intentional Service Model

The concept of intentional service is defined as “a business oriented service described in an intentional perspective, i.e. focusing on the goal it allows to achieve rather on the functionality it performs” [14, 15]. There are three different aspects in the description of an intentional service, Figure 1:

(i) the service interface describes the visible parts of an intentional service, namely the goal achieved by the service, the initial and final situations;

(ii) the intentional service behavior describes the state of the classes handled by the services, namely the pre- and post-conditions according to initial and final situations of a service;

(iii) and finally, the service composition which details with the different kinds of services, namely the atomic service (directly operationalized by the software service), and the aggregate service (the composite and the variant service).

![Intentional Service Model](image)

This model exposes the intention of the service which plays an important role when a business agent wants to retrieve an intentional service matching his needs which reflects his intention.
The intention of the service is defined by the goal. A goal expresses what is wanted i.e. a state that is expected to be reached or maintained [26, 27]. To highlight the intentional nature of services, a service is thus named with the goal it permits to achieve; i.e. the service intended to Make Room Booking is named S\text{Make Room Booking}.

Compared to a classical Web Service, an intentional service reflects fragments of business logics associated with a well identified business goal. While a classical web service would provide basic functions such as converting the temperature from Fahrenheit to Celsius or running a web search using the Google search engine, an intentional service provides high level business functionality which is abstracted in the associated goal. This functionality correspond to a well identified action (e.g. make a booking) concerning a high level business object (e.g. hotel room), and that would make a known modification in the state of this object (e.g. room.status="Booked").

Another important aspect in the intentional service approach is high level service composition. Using specific operators such as sequential composition, variant composition, and parallel composition [14, 27], intention based services can be aggregated so that to provide new business oriented services. For example, using the sequential operator, the atomic intentional services S\text{Make Room Booking} and S\text{Accept Payment} are element of the aggregate intentional service S\text{Make Confirmed Booking}. This new aggregate sequential service expresses the fact that for making a confirmed booking of a hotel room, a booking should be made first and then payment should be accepted.

The ISM model is a proposal inline with research directions in Service Oriented Computing. Service oriented applications should abstract away the logic at the application or business level, so that to enable the composition of distributed business processes and transactions [23]. And for improving service discovery, it is necessary to explicate the semantics the service when provided. This is the ground problem addressed in this paper.

B. Problem addressed

As iSOA is now a platform for publishing and finding intentional services, the ISM model could be used to power the registry of intentional services. At this point, iSOA raises the question about the structure of this registry and the corresponding operations of publish, find and bind. The lack of semantics in WSDL [4] prevents however the direct introduction of the intentional approach.

Hence, the question that is tackled here concerns the issue of populating the intentional service registry with the adequate service descriptions. Evidently, every service must be available in the registry. That is, every intentional service (atomic or aggregate) will be kept in the registry. For an aggregate intentional service, what kind of information about composition links and relationships should be kept? In other words, what is the structure of the intentional descriptor to be published in the registry?

C. Proposed solution

To deal with the issues of publishing enriched service descriptors, our approach shares similar concerns with semantic web services that enrich SOA-like service descriptions with semantic properties to ease their understanding and retrieval. While the need for semantic service description languages is widely recognized, the current solutions do not really relate to business users’ needs for services [23, 24] and therefore, do not really ease finding services that meet their goals. We believe that the ISM shares with these approaches the view of semantically rich descriptions, but overcomes the aforementioned drawback by leveraging the entire notion of a service to the intentional level, thus matching the business user’s needs for services.

A number of authors have contributed to the semantic web perspective [16, 17, 21, 28 and 30]. Several languages have been defined such as OWL-S [20], WSML [6], DAML+OIL [13], SAWSDL [33] and WSMO [8]. These approaches rely on business domain ontologies to provide semantic descriptions in terms of concepts. A business concept is used to annotate service description parts (e.g. operation, interface, etc.). But these description languages are either “closed” (OWL-S, WSMO), i.e., the set of concepts they defined is limited and is difficult to extend or do not specify the nature of the semantic information referenced by a concept (for instance, each element WSDL in SAWSDL could be referenced by multiple concepts in a domain ontology). However, the annotation of an element by a concept of a business domain is a large-scale annotation, since there would be no specification of the nature of the semantic information.

In this work, we propose to describe intentional services using the de-facto standard WSDL. It requires no other changes to existing WSDL or XML Schema [9] documents, or the way in which they had been used previously, namely the existing tools for parsing WSDL documents or for service invoking. To meet this target, our approach proposes to overcome the lack of semantic in WSDL by using an annotation approach to implement the intentional descriptions of services. To meet this target, we propose an extension of SAWSDL that use three ontologies. The first one, called Technical Ontology, describes intentional service concepts (e.g. verb, product, atomic service, pre-condition...) and relations between these concepts. This ontology is based on the intentional service model and a theoretical goal model for reasoning and formalizing these goals. The second ontology, called Verb Ontology, concerns syntactic and semantic concepts related to verbs. This ontology is domain independent. The third ontology, called Product Ontology, concerns ontologies that define the semantics of the service business domain (e.g. tourism, health, trade...).

The structure of this paper is the following: in section 2, we introduce the goal model used for formalizing service's intention; in section 3, we describe the intentional service ontology; in section 4, we reveals how we introduced the intentional descriptor by adding semantic annotations; in section 5, the intentional service descriptor is illustrated in an example. The paper ends with a discussion in which some related works will be invoked (section 6), and with concluding remarks in section 7.
II. GOAL MODEL

We consider that user business' requirements are driven by goals, and are expressed using a language easily understandable by non-expert domain users, which is different from service models definition languages that require technical knowledge. To catch these needs, we propose an ontology based solution.

The implementation of the ontology requires the prior definition of a goal model. This model will allow knowledge extraction from business requirements so that to describe semantically the intentional services. In a later step, this model will facilitate the exploitation of domain ontologies for expressing queries and to find similarities between elements in the user query and the attributes of the intentional services published in the directory.

In a similar fashion, the goal rent a car in London by credit card is composed of a “verb” Rent, “product” car, a “location” in London, and a “mean” by credit cart. It is noted:

(Rent) verb (car) product (in London) location (by credit card) mean

III. TECHNICAL INTENTIONAL SERVICE ONTOLOGY (iSOnto)

From a philosophical point of view, ontology is the study of the categories of things that exist or may exist in a particular domain. In other words, domain ontology explains the type of things in that domain. It is a fundamental part of the acquired and available knowledge in a domain, and all other knowledge should rely on it or refer to it.

The intentional service ontology is an attempt to reach a common ground between high level business needs and low level software services, and to provide foundations for interoperability and implementation tool. In addition, the ontology will also help in future work to build a unified query facility. Business users search services satisfying their needs, expressed according to the ontology concepts. Then, matching facility is used to translate the initial query into a specific query compliant to the intentional service descriptor.

This section shows the ontology's concepts and their relationship defined in the ontology of intentional service descriptors. iSOnto has been built upon the goal model and the fact that the intentional service is designed as a collection of atomic and aggregate services. The following explains in turn, concepts defined in iSOnto, relationships, and additional added concepts as they appear in Figure 4.

First, all attributes in the goal model and in the ISM model are presented by respective concepts in the ontology. We added the relation “satisfied by” between theses two models to show that a user’s needs expressed as a goal are satisfied by an intentional service. This defines a perfect match between the goal concept form the goal model with the goal concept in the ontology, and defines a perfect match between the service concept from the ISM model with the service concept in the iSOnto ontology.

Second, we added a small modification to the aggregate part of the service in iSOnto concerning the components of the aggregate service (composite or variant). In Figure 3 below, we show the new concept called “service component”, its “is a” relation to the concept “iService”, and the relation “composed of” with the concept “aggregate”.

For instance, the goal Make Room Booking is composed of a “verb” Make and a “result” as Room Booking. It is noted:

(Make) verb (Room Booking) result
Third, the relation “related to” between the concept of “verb” and the concept of “target” helps in the enrichment of the service semantic and in the reformulation of the user’s query [1], where ontology is used to facilitate matching between user needs and available intentional services. Finally, the service part is composed of the initial situation, final situation and pre- and post- conditions. These four concepts are respectively matched in our ontology with the initial situation, final situation, precondition and post condition concepts.

To summarize, each concept of iSOnto is matched in the set of concepts issued of the goal model and the intentional service model. The ontology represents a semantic common ground useful to reduce the conceptual mismatch between service provider and user’s needs expressed in business terms and will help in defining the descriptor for intentional services. This is the subject of the next section.

IV. INTENTIONAL SERVICE DESCRIPTOR

This section presents how the ontology can be used to build an intentional descriptor, and introduces our proposal to use an annotation approach to implement it using SAWSDL.

Figure 5 summarizes YASSA approach [2, 3] to extend service description to domain description with the usage of a technical ontology. In our case, this technical ontology is iSOnto. The service description is structured in two layers:

- Basic service description based on standards such as OWLS or WSDL.
- Technical and domain descriptions represented in our case by any intentional service descriptor encoded in an XML format.

The basic service description refers to the technical and to the domain descriptor through annotations embedded in the technical layer and referring domain value mentioned in the domain description. Annotations are expressed according to the ontology concepts in order to build search algorithms according to iSOnto instead of the service descriptor. This means that an intentional service registry is built upon the semantic in the intentional service [12].

- Extended intentional descriptor
  - Annotation based on domain ontologies: verb and Product
  - Annotation based on technical ontology iSOnto

In our work, we rely on the use of SAWSDL, because there is no explicit mention of precondition and effects that one can find in WSMO and OWL-S. In addition SAWSDL is not dedicated to describe Web service behavior, which is essential for service invocation and composition.
Nevertheless, SAWSDL is an approach independent of the underlying used semantic representation language, thanks to the separation of semantic annotation mechanism from the representation of the semantic descriptions. This gives flexibility to the developers' community to select their favorite semantic representation language, to reuse semantic domain models and annotate descriptions using multiple ontologies.

The main idea here is to extend SAWSDL for enhancing expressiveness of service description. In SAWSDL, for a given WSDL element one can use many references to concepts in domain ontology but there is no specification of the semantic information nature: is it a verb, a target, a destination, a soft goal, a hard goal, an atomic service or aggregate? Etc. That is why we propose, in our description, a new attribute called `iServiceConcept` to give references to the intentional service concepts corresponding in the same order, to the domain concepts listed in the original SAWSDL "modelReference" attribute [2, 3].

In this way, we can define for each WSDL element two attributes. The first attribute, called `iServiceConcept`, references the corresponding concepts in intentional service terms. The second attribute, called `modelReference`, contains a set of URI corresponding to the first list and which defines the concepts of the service in the ontologies of domain.

In Figure 6, we use two types of domain ontologies [1]. The first type of ontologies is the verb ontology as it is described and classified in [31]. The second type of ontologies, called `Product ontology`, contains the semantics of the product concepts.

In the map formalism, a `map` is a labelled directed graph with `intentions` as nodes and `strategies` as edges. An edge enters a node if its strategy can be used to achieve the intention of the node. Since there can be multiple edges entering a node, the map can represent many strategies that can be used for achieving an intention. A map in its entirety can be associated to an intention that expresses the global purpose of the business modelled as an intention/strategy graph.

The electricity supply example deals with the business of selling electricity to end-users. At the highest level of abstraction, the ESM map has four intentions (Figure 7): (a)Start, (b)Serve Customer Request, (c)Sell Electricity, and (d)Stop. To serve the customer request, two strategies are available: either a `Captive strategy` if the electricity operator is in a monopole position, or a `Competitive strategy` otherwise. To sell electricity, two strategies are available: `Advance Payment Strategy`, and `Credit Allocation Strategy`.

In a Map, a section (which is a triplet `<source intention, intention in the refined map. Similarly, the `Serve Customer Request` section (which is shown in Figure 8) includes several intentions and provides several strategies to achieve each of them. In the refined map, there are two intentions `Measure Electricity Consumption` and `Get Financial Counterpart` and several strategies to achieve them as shown in Figure 8.

In our example, the strategy `Credit Allocation strategy` is a complex strategy and the section `bc2` is refined as a map which is shown in Figure 8. The source intention of the refined section, namely `Serve Customer Request` corresponds to the `Start` intention in the refined map. Similarly, the `Stop` intention of the refined map corresponds to the target intention of the refined section, `Sell Electricity` in our example. The refined map includes several intentions and provides several strategies to achieve each of them. In the refined map, there are two intentions `Measure Electricity Consumption` and `Get Financial Counterpart` and several strategies to achieve them as shown in Figure 8.
Having represented business intentionality in a hierarchy of maps, we proceed to determine services and their composition according to the iSOA approach. The rules for deriving intentional services from a map are presented in details in [14, 26, and 27]. These rules will be briefly described here.

The first step consists in associating every non-refined section of the map to an atomic service. This correspondence leads in the case of the ESM example, to services shown in Table I in correspondence with each of the 5 sections of the ESM map. Section <Serve Customer Request, Sell Electricity, Credit Allocation strategy> is not mentioned because this section is refined into a map (Figure 8), and will be later associated with an intentional service of aggregate type.

For the sake of conciseness, we use an abbreviated notation to refer to a section. We refer to each intention by a letter and to each strategy between a pair of intentions by a digit starting from 1 (see Figure 7). Therefore, ab2 is the reference of section <Start, Serve Customer Request, Competitive strategy> between the source intention "Start" labelled "a", the target intention "Serve Customer Request" labelled "b", and the "Competitive strategy" numbered 2. It can be seen that the name of each service reflects the business intention that can be achieved as well as the strategy to achieve it.

Table I. LIST OF ATOMIC SERVICES OF THE ESM MAP

<table>
<thead>
<tr>
<th>Sections</th>
<th>Atomic Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>ab1</td>
<td>S Serve Customer Request with Captive Strategy</td>
</tr>
<tr>
<td>ab2</td>
<td>S Serve Customer Request with Competitive Strategy</td>
</tr>
<tr>
<td>bc1</td>
<td>S Sell Electricity with advance payment strategy</td>
</tr>
<tr>
<td>cd1</td>
<td>S Stop on Customer Demand</td>
</tr>
<tr>
<td>bd1</td>
<td>S Stop on Company Decision</td>
</tr>
</tbody>
</table>

The 2nd step consists in calculating all paths in the map. This is done using guidelines that generates different types of paths (paths, multi-paths, multi-threads and bundle relationships). Theses paths allow us to determine aggregate services as well as their nature, composite or variant. For more details, refer to how to derive intentional services from the map in [14, 26, and 27].

Below, we present all intentional services from the ESM map. However, we only introduce the services of the refined map shown in Figure 8.

A. Deriving atomic intentional services in the Map

By associating each section of the refined MAP (Figure 8) ith an atomic service, we obtain the atomic services as mentioned in Table II. This map contains no further refinements, so all sections appear as atomic intentional services.

Table II. LIST OF ATOMIC SERVICES IN REFINED SECTION

<table>
<thead>
<tr>
<th>Sections</th>
<th>Atomic Services</th>
<th>N°</th>
</tr>
</thead>
<tbody>
<tr>
<td>ab1</td>
<td>S Measure electricity by meter reading</td>
<td>S1</td>
</tr>
<tr>
<td>ab2</td>
<td>S Measure electricity by remote meter reading</td>
<td>S2</td>
</tr>
<tr>
<td>ab3</td>
<td>S Measure electricity by semi-remote meter reading</td>
<td>S3</td>
</tr>
<tr>
<td>ab4</td>
<td>S Measure electricity by remote meter substation inspection</td>
<td>S4</td>
</tr>
<tr>
<td>bc1</td>
<td>S Get financial counterpart based on contract</td>
<td>S5</td>
</tr>
<tr>
<td>bc2</td>
<td>S Get financial counterpart based on consumption</td>
<td>S6</td>
</tr>
<tr>
<td>cd1</td>
<td>S Recover financial counterpart</td>
<td>S7</td>
</tr>
</tbody>
</table>

B. Deriving aggregate intentional services in the Map

Table III presents three aggregate services. Services S8 and S9 are directly derived from refined map (Figure 8). S Measure electricity is a variant service which corresponds to the path from intention Start to intention Measure Electricity Consumption, it offers four alternative strategies for attaining the target intention. S Get financial counterpart is an exclusive variant service which corresponds to the path from intention Measure Electricity Consumption to intention Get Financial Counterpart, it offers two exclusive alternative strategies for attaining the target intention. Finally, S10 is the aggregate service which corresponds to the whole map (Figure 8). It is in fact the service associated with the refined section. It is a sequence of 3 services: The first is the variant service S Measure electricity, the second is the exclusive variant service S Get financial counterpart, and the third is the atomic service S7 (Table II).

Table III. LIST OF AGGREGATE SERVICES

<table>
<thead>
<tr>
<th>Aggregates types</th>
<th>Identified Services</th>
<th>N°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variant services</td>
<td>S Measure electricity = \lor (S Measure electricity by meter reading, S Measure electricity by remote meter reading, S Measure electricity by semi-remote meter reading, S Measure electricity by remote meter substation inspection)</td>
<td>S8</td>
</tr>
<tr>
<td></td>
<td>S Get financial counterpart = \otimes (S Get financial counterpart based on contract, S Get financial counterpart based on consumption)</td>
<td>S9</td>
</tr>
<tr>
<td>Composite services</td>
<td>S Sell electricity with credit allocation = \cdot (S Measure electricity, S Get financial counterpart, S Recover financial counterpart)</td>
<td>S10</td>
</tr>
</tbody>
</table>
C. Formalization of services’ goals

After having identified intentional services and their classification into aggregate and atomic, we proceed now to determine the goal associated with these intentional services. As presented in the previous sections, the goal is composed of Verb, Target, and a set of Parameters. For instance, the intentional service goal of “Sell electricity with credit allocation” is formalized as:

\[(\text{Sell}) \text{ verb (electricity) product (with credit allocation)) manner}\]

Table IV includes the formalization of services’ goals of the refined map (table II and III).

<table>
<thead>
<tr>
<th>Service</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>(Measure) verb (electricity) product (by meter reading) manner</td>
</tr>
<tr>
<td>S2</td>
<td>(Measure) verb (electricity) product (by remote meter reading) manner</td>
</tr>
<tr>
<td>S3</td>
<td>(Measure) verb (electricity) product (by semi-remote meter reading) manner</td>
</tr>
<tr>
<td>S4</td>
<td>(Get) verb (financial counterpart) result (based on contract) manner</td>
</tr>
<tr>
<td>S5</td>
<td>(Get) verb (financial counterpart) result (based on consumption) manner</td>
</tr>
<tr>
<td>S6</td>
<td>(Get) verb (financial counterpart) result (based on consumption) manner</td>
</tr>
<tr>
<td>S7</td>
<td>(Measure) verb (electricity) product</td>
</tr>
<tr>
<td>S8</td>
<td>(Get) verb (financial counterpart) result</td>
</tr>
<tr>
<td>S9</td>
<td>(Sell) verb (electricity) product (with credit allocation) manner</td>
</tr>
<tr>
<td>S10</td>
<td>(Sell) verb (electricity) product (with credit allocation) manner</td>
</tr>
</tbody>
</table>

D. Presentation of services in iSOnto

Before moving to the implemented descriptor, we present for a subset of services appearing in table II and III (namely services S1, S9 and S10), the corresponding elements in the ontology of intentional services iSOnto.

Figure 9 introduces the presentation of the atomic service SMeasure electricity by remote meter reading (S1) in iSOnto. As can be seen in this figure, we have made a graphical distinction between nodes and leafs when instantiating the iSOnto ontology.

Figure 10 introduces the presentation of the variant service SGet financial counterpart (S9). This aggregate service specifies two alternatives for getting financial counterpart: either by contract or by consumption.

Figure 11 introduces the presentation of the composite service SSell Electricity with credit allocation (S10) in iSOnto. This aggregate intentional service is composed of a sequence of three intentional services: two variant services (SMeasure electricity consumption, SGet financial counterpart) and one atomic (SRecover financial counterpart).

Table V contains the former three services: atomic, composite and variant using iSOnto concepts, in the same way they are going to be presented in the descriptor.

<table>
<thead>
<tr>
<th>Service</th>
<th>ESM SERVICES’ DESCRIPTIONS RELATED TO ISONTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>(Measure) verb (electricity) product (by meter reading) manner</td>
</tr>
<tr>
<td>S2</td>
<td>(Measure) verb (electricity) product (by remote meter reading) manner</td>
</tr>
<tr>
<td>S3</td>
<td>(Measure) verb (electricity) product (by semi-remote meter reading) manner</td>
</tr>
<tr>
<td>S4</td>
<td>(Get) verb (financial counterpart) result (based on contract) manner</td>
</tr>
<tr>
<td>S5</td>
<td>(Get) verb (financial counterpart) result (based on consumption) manner</td>
</tr>
<tr>
<td>S6</td>
<td>(Get) verb (financial counterpart) result (based on consumption) manner</td>
</tr>
<tr>
<td>S7</td>
<td>(Measure) verb (electricity) product</td>
</tr>
<tr>
<td>S8</td>
<td>(Get) verb (financial counterpart) result</td>
</tr>
<tr>
<td>S9</td>
<td>(Sell) verb (electricity) product (with credit allocation) manner</td>
</tr>
<tr>
<td>S10</td>
<td>(Sell) verb (electricity) product (with credit allocation) manner</td>
</tr>
</tbody>
</table>
E. Descriptors for the intentional services

Finally, we introduce only the part of the WSDL descriptor modified to present the annotation added to the services in Table 5. Hence, the atomic service $S_{\text{Measure electricity by meter reading}}$ (S1) is presented in Table VI.

### TABLE VI. DESCRIPTION OF ATOMIC SERVICE $S_{\text{Measure electricity by meter reading}}$

```
<service name="MeasureElectricityByMeterReading"
    iServcieConcept="http://.../iServiceOntology#Verb#Product#Manner
    #Atomic"
    modelReference="http://.../VerbOntology#measure#/OntologyElectricity
    #electricity#/OntologyElectricity#MeterReading">
```

The variant service descriptor $S_{\text{Get financial counterpart}}$ (S9) is presented in Table VII.

### TABLE VII. DESCRIPTION OF VARIANT SERVICE $S_{\text{Get financial counterpart}}$

```
<service name="GetFinancialcounterpart"
    iServiceConcept="http://.../iServiceOntology#Verb#Result#Variant
    #ServiceComponent#ServiceComponent"
    modelReference="http://.../VerbOntology#Get
    #OntologyElectricity#FinancialCounterpart
    #OntologyElectricity#GetFinancialCounterpartBasedOnContract
    #OntologyElectricity#GetFinancialCounterpartBasedOnConsumption">
```

The composite service descriptor $S_{\text{Sell Electricity with credit allocation}}$ (S10) is presented in Table VIII.

### TABLE VIII. DESCRIPTION OF VARIANT SERVICE $S_{\text{Sell Electricity with credit allocation}}$

```
<service name="SellElectricityWithCreditStrategy"
    iServiceConcept="http://.../iServiceOntology#Verb#Product#Manner
    #Composite#ServiceComponent#ServiceComponent#ServiceComponent"
    modelReference="http://.../VerbOntology#Sell
    #OntologyElectricity#Electricity
    #OntologyElectricity#CreditAllocation
    #OntologyElectricity#MeasureElectricity
    #OntologyElectricity#GetFinancialCounterpart
    #OntologyElectricity#CoverFinancialCounterpart">
```

F. Summing up

The ESM example demonstrates how to publish atomic and aggregate intentional services by extending the W3C recommendation on semantic annotation for Web services (SAWSDL). The semantic annotations added to the descriptor are based on a technical ontology which references semantic concepts in intentional services. In addition, we have shown how our approach allows providers to specify the correspondence between intentional service concepts (verb, target, initial situation...) and business concepts.

Finally, by externalizing the semantic of business domain models and the technical concepts, providers can annotate their services with their choice of ontology language.

VI. PRESENTATION OF THE TOOL ARCHITECTURE

The approach presented in this paper concerns the implementation facet of a general framework for publishing, querying and searching intentional services. This framework, called PASIS (Publishing and Searching for Intentional Services), is intended for both providers and end-users, and is organized according to three levels of abstractions (Figure 12):

![Figure 12. PASIS proposed framework and architecture](image)

Business level: on user side, we express user’s needs as a goal using natural language and using the ontologies; on provider side, we publish services extracted from the MAP using a publishing tool and relying on the ontologies.

Informational level: we respond according to the user query, we select the appropriate search technique. To manipulate the user's request, we are bringing it to the same level as the intentional services stored in the registry using the ontologies. Then we apply the chosen technique to find the matching between user’s needs expressed as goals and services’ intentions stored in the registry.

Implementation level: correspond to the extended registry with ontologies and descriptors implemented in several forms.

Our work fits into the family of research approaches for goal-driven services. Most of these approaches [5, 29, 32], focus on specifying goals in the context of searching Web services that meet these goals, using different models to specify goals without focusing on the problem of their capture. SATIS [18], proposes ways to assist end users in the explanation of their needs (goals). The GODO approach [11] proposes models and tools to capture the users’ goals with the help of ontology and natural language.

VII. CONCLUSION

The intentional service model is a powerful approach for leveraging the SOA framework to the intentional level, thus, matching the business manager’s view for services. In order to build an extended registry for intentional services, we have introduced in this paper the intention service ontology as a basis for adding goal oriented semantic annotations to web services. This ontology relies on the intention service model and a linguistic based goal model developed in previous work.
These semantic annotations are used to define the descriptor for atomic and aggregate intentional services. The obtained descriptor is clearly more expressive than the W3C recommendation and submissions to W3C on semantics of Web services. This proposal is part of an ongoing work for implementing the iSOA framework through the development of a general architecture for publishing, querying and searching a repository of intentional services. Future work will concern the specification of a natural language query facility together with mechanisms for searching the intentional service repository. The intentional service ontology sketched in this paper is a fundamental component in this work as the query facility and the search engine rely on it to analyze the user's requests and match with corresponding intentional services.

REFERENCES


