Towards the Definition of an Ontology for Service Contract Specification

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Abstract. Service contracts are legal binding exchanges of promises between service providers and consumers expressed through a set of contractual terms that regulate the service provisioning. Currently, service contracts are mainly expressed through long and articulated texts in natural language; they often contain ambiguities, conflicts and omissions, and they cannot be automatically processed by a machine. In order to address these inherent complexities in many service contracts, there is the need for contract authoring tools, to support definition and verification of contracts, and contract matchmaking tools to assist consumers in service selection. These tools in turn require a formal representation of contracts that allows the usage of formal methods to reason about the contractual terms. In this paper, we discuss our preliminary activities towards the definition of the Service CONTract Ontology (SCONTO), a formal definition of service contracts that enables the development of innovative contract authoring and contract matchmaking tools.

1. Introduction

In the literature, the mutual understanding between providers and consumers is typically established by specifying policies [1], service level agreements [2] and licenses [3]. Though there are some differences among them, the common denominator is the identification for a belief of a transaction between the service provider and the service consumer and thereby, commonly considered under the umbrella term service contract or simply by contract. A contract is a legally binding exchange of promises or agreement between a service provider and its consumers that the law will enforce. A contract is expressed through a set of contractual terms that regulate the service provisioning. Such terms are of different nature including quality of service terms (e.g., response time and availability), legal terms (e.g., compliancy to legal statements and regulations), and business terms (e.g., payment and tax) [4].

As there is no single formal ontology or unique way of describing service contracts, service providers and consumers can represent contractual terms as they wish. This causes strong ambiguity and redundancies in terms descriptions, preventing the correct interpretation of contracts in multi-provider service-oriented environments. In this paper, we motivate and discuss the development of the Service CONTract Ontology (SCONTO), a formal definition of contractual terms of services. The paper is organized as follows. Section 2 motivates the work. Section 3 provides an overview of SCONTO. Section 4
presents future work.

2. Motivation and Background

Currently, service contracts are mainly expressed as long and articulated texts in natural language; they often contain ambiguities, conflicts and omissions and they cannot be automatically processed by a machine. In order to address these inherent complexities in many service contracts, there is the need for different tools such as contract authoring tools, to support definition and verification of contracts, or tools for contract matchmaking to assist customers in service selection. These tools in turn require a formal representation of contracts that allows the usage of formal methods to reason with and about the service contractual terms. In particular, the formal representation is required to identify and make evident the mutual relationships among various terms in a contract that cannot be considered in isolation.

Contract authoring tools must assist the contract editor guiding towards the specification of contractual terms, avoiding tacit, redundant and conflicting terms. Current available contract authoring tools are based on the usage of templates that only partially covers the assistance that the editor needs. Moreover, these tools do not support the composition of contracts needed when the editor wants to define a contract for a composite service or a service bundle (i.e., a service that aggregates smaller and fine-grained services each characterized by its own contract).

Contract matchmaking tools must assist the customer in service selection defining lists of services ranked according to the degree of match between preferences explicitly defined by the customer and the contractual terms offered by service providers. Current available contract matchmaking tools are based on the assumptions that a service customer is always aware of the contractual terms established in a contract and that he/she is always able to specify reasonable preferences on them. Actually, a service customer often specifies preferences only on a limited set of common and well-known terms (e.g., price) omitting the consideration of preferences on other potentially relevant contractual terms. This is traditionally determined by the lack of the customer knowledge about the full-set of terms characterizing a service contract. In the field of economics, a situation in which one party in a transaction has more information compared to another is called information asymmetry and generates adverse selection and moral hazard problems.

The definition of catalogues of contractual terms is address by several works in the literature. The contribution from [5] focuses only on quality of service that are a particular type of contractual terms. The contribution from [6] cover only the service consumers perspective. This is a limitation since the terms to be included in a contract should cover both the costumer’s and the provider’s perspectives. The contribution from [7] represents the most com-
plete catalogue of contractual terms. However, it contains only the 75% of the terms included in the other two mentioned catalogues.

3. The Service Contract Ontology

In this paper, we sketch the main concepts that guide towards the definition of SCONTO. The ontology must support the specification of contracts composed of sections filled by contractual terms potentially characterized by inter-dependencies. Moreover, in order to provide the required knowledge for defining service contracts, the concepts of sections and contractual terms must be specialized in terms of subclasses.

Figure 1 shows the main concepts of SCONTO. The class Contract defines the contract that regulates the service provisioning. The class Section defines the different parts in which the contract is structured and it is composed of contractual terms. Sections and contractual terms are linked by membership relations. Basically, a contractual term can be specified only in some sections and a section can include only some contractual terms. The class ContractualTerm defines the terms of the contract and it is specialized by a potential high number of subclasses, each one representing a property of the service on which a contractual term can be defined. Dependence is introduced to support the specification of dependency relations between terms. The class is characterized by two properties stating that each individual has 0 or 1 regent and has 0 or 1 rule. SCONTO must support the specification of the following types of dependencies:

- **Type 1**: a contractual term $t_i$ has a type 1 dependency to contractual term $t_j$ (with $i \neq j$) denoted as $t_i \rightarrow t_j$ if and only if it is possible to specify $t_i$ in a contract $C$ only after the specification of $t_j$ in $C$.

- **Type 2**: a contractual term $t_i$ has a type 2 dependency to contractual term $t_j$ (with $i \neq j$) denoted as $t_j, exp \rightarrow t_i$ if and only if it is possible to specify $t_i$ in a contract $C$ only after the specification of $t_j$ in $C$ with a value defined
In addition to the possibility to define dependencies between terms, SCONTO must also support the specification of the multiplicity and the cardinality of instances of a Contractual Term class, defined as follows:

- **Multiplicity**: number of distinct values assumed by the same contractual term $t_i$ in the same contract $C$. It represents the possibility for a contractual term to assume different values to describe the same aspect of the contract.

- **Cardinality**: number of distinct instances of the same contractual term $t_i$ in the same contract $C$. It represents the possibility to have multiple instances of $t_i$ in $C$ allowing the specification of $t_j$ and $t_z$ (with $j \neq z$ and $z \neq i$) with whom $t_i$ has a Type 1 or Type 2 dependency.

4. **Future Work**

Future work deals with the complete formalization of SCONTO and the design and development of a contract authoring tool that uses the knowledge in SCONTO for (i) the semi-automatic extraction of contractual terms from service contracts, available as textual documents in natural language and (ii) the validation of dependencies among specified contractual terms in the service contract.

**References**


